TOXECON™ RETROFIT FOR MERCURY AND MULTI-POLLUTANT CONTROL ON THREE 90-MW COAL-FIRED BOILERS

Final Report: Project Performance and Economics

Reporting Period: April 1, 2004–September 30, 2009

Principal Authors: Steven Derenne (We Energies) and Robin Stewart (ADA-ES)

Project Team: We Energies
ADA Environmental Solutions, Cummins & Barnard, and the Electric Power Research Institute

DOE Cooperative Agreement No. DE-FC26-04NT41766

Report No. 41766R23

December 2009

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Abstract

This U.S. Department of Energy (DOE) Clean Coal Power Initiative (CCPI) project was based on a cooperative agreement between We Energies and the DOE Office of Fossil Energy's National Energy Technology Laboratory (NETL) to design, install, evaluate, and demonstrate the EPRI-patented TOXECON™ air pollution control process. Project partners included Cummins & Barnard, ADA-ES, and the Electric Power Research Institute (EPRI). The primary goal of this project was to reduce mercury emissions from three 90-MW units that burn Powder River Basin coal at the We Energies Presque Isle Power Plant in Marquette, Michigan. Additional goals were to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter emissions; allow reuse and sale of fly ash; advance commercialization of the technology; demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use at power plants; and demonstrate recovery of mercury from the sorbent.

Mercury was controlled by injection of activated carbon upstream of the TOXECON™ baghouse, which achieved more than 90% removal on average over a 44-month period. During a two-week test involving trona injection, SO_2 emissions were reduced by 70%, although no coincident removal of NO_x was achieved. The TOXECON™ baghouse also provided enhanced particulate control, particularly during startup of the boilers. On this project, mercury CEMs were developed and tested in collaboration with Thermo Fisher Scientific, resulting in a reliable CEM that could be used in the power plant environment and that could measure mercury as low as 0.1 $\mu g/m^3$.Sorbents were injected downstream of the primary particulate collection device, allowing for continued sale and beneficial use of captured fly ash. Two methods for recovering mercury using thermal desorption on the TOXECON™ PAC/ash mixture were successfully tested during this program. Two methods for using the TOXECON™ PAC/ash mixture in structural concrete were also successfully developed and tested.

This project demonstrated a significant reduction in the rate of emissions from Presque Isle Units 7, 8, and 9, and substantial progress toward establishing the design criteria for one of the most promising mercury control retrofit technologies currently available. The Levelized Cost for 90% mercury removal at this site was calculated at $77,031 per pound of mercury removed with a capital cost of $63,189 per pound of mercury removed. Mercury removal at the Presque Isle Power Plant averages approximately 97 pounds per year.

Points of Contact

Steve Derenne
Principal Engineer
We Energies
333 West Everett Street
Milwaukee, WI 53201
414-221-4443
steven.derenne@we-energies.com

Robin Stewart
Manager, Contract R&D
ADA-ES, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120
303-734-1727
robins@adaes.com

Michael H. McMillian
U.S. Department of Energy
National Energy Technology Laboratory
3610 Collins Ferry Road
Morgantown, WV 26507
304-285-4669
mmcmil@netl.doe.gov

Ramsay Chang
Electric Power Research Institute
3420 Hillview Avenue
Palo Alto, CA 94304
650-855-2535
rchang@epri.com

Table of Contents

List of Tables ix
List of Figures xvi
List of Abbreviations xxix
Glossary of Terms xxxi
Executive Summary xxxiii
1.0 INTRODUCTION 1-1
1.1 Purpose of the Project Performance and Economics Report 1-1
1.2 Overview of the Project 1-1
1.2.1 Background and History of the Technology 1-1
1.2.2 Project Organization 1-6
1.2.3 Project Description 1-7
1.2.4 Project Location 1-8
1.2.5 Project Schedule 1-10
1.3 Objectives of the Project 1-11
1.4 Significance of the Project 1-12
1.5 DOE's Role in the Project 1-13
2.0 TECHNOLOGY DESCRIPTION 2-1
2.1 Description of the Demonstrated Technology 2-1
2.2 Description of the Demonstration Facilities 2-2
2.3 Proprietary Information 2-3
2.4 Simplified Process Flow Diagram 2-3
2.5 Stream Data 2-4
3.0 UPDATE OF THE PUBLIC DESIGN REPORT 3-1
3.1 Design and Equipment Changes 3-1
3.1.1 Baghouse Modifications 3-1
3.1.2 Ash Handling System Modifications 3-1
3.1.3 Ductwork Modifications 3-2
3.1.4 Access Platform Additions 3-2
3.2 Demonstration Plant Capital Cost Update 3-2

3.3 Demonstration Plant Operating Costs Update 3-2
4.0 DEMONSTRATION PROGRAM 4-1
4.1 Task 1: Design Review Meeting 4-1
4.2 Task 2: Project Management Plan 4-1
4.3 Task 3: Provide NEPA Documentation, Environmental Approvals Documentation, and Regulatory Approval Documentation 4-2
4.4 Task 4: Balance-of-Plant (BOP) Engineering 4-2
4.5 Task 5: Process Equipment Design and Major Equipment Procurement 4-5
4.6 Task 6: Prepare Construction Plan 4-7
4.7 Task 7: Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment 4-8
4.7.1 Status of Mercury Emission Monitors in 2003 4-8
4.7.2 ADA-ES Mercury Semi-Continuous Emission Monitors 4-8
4.7.3 Thermo Electron Mercury System Description 4-11
4.7.4 Thermo Electron Mercury CEMS – Prototype Stage 4-13
4.7.5 Thermo Electron Mercury CEMS – Alpha Stage 4-19
4.7.6 Thermo Electron Mercury CEMS – Mercury Converter/Speciation 4-24
4.7.7 Thermo Electron Mercury CEMS – Beta Stage 4-27
4.7.8 Thermo Electron Mercury CEMS – Commercial Production 4-40
4.8 Task 8: Mobilize Contractors 4-48
4.9 Task 9: Foundation Erection 4-49
4.10 Task 10: Erect Structural Steel, Baghouse and Ductwork 4-51
4.11 Task 11: Balance-of-Plant Mechanical and Civil/Structural Installations 4-53
4.12 Task 12: Balance-of-Plant Electrical Installations 4-53
4.13 Task 13: Equipment Pre-Operational Testing 4-54
4.14 Task 14: Startup and Operator Training 4-54
4.15 Task 15: Operate, Test, Data Analysis, and Optimize TOXECON™ for Mercury Control 4-57
4.15.1 Overview 4-57
4.15.2 Instrumentation and DAQ 4-58
4.15.3 Operating Procedures 4-60
4.15.4 Test Plan 4-62

4.15.5 Analysis of Feed Stock, Products, and Reagents 4-63
4.15.6 Startup Issues – Hopper Fires and Ash Overheating 4-65
4.15.7 Mercury Removal Performance 4-99
4.15.8 Optimization of TOXECON™ System for Hg Control 4-150
4.15.9 Mercury Continuous Emissions Monitoring Systems 4-160
4.15.10 Baghouse Performance 4-326
4.15.11 Equipment and Operational Issues 4-360
4.16 Task 16: Operate, Test, Data Analysis, and Optimize TOXECON™ for SO_2 and NO_x Control 4-388
4.16.1 Summary 4-388
4.16.2 Background 4-389
4.16.3 Test and Equipment Description 4-390
4.16.4 Trona Injection Results 4-395
4.16.5 Economic Assessment of Full-Scale Trona Injection 4-407
4.16.6 Conclusions 4-423
4.17 Task 17: Carbon-Ash Management System 4-425
4.17.1 Mercury Recovery Processes 4-425
4.17.2 Concrete 4-444
4.18 Task 18: Revise Design Specifications, Prepare O&M Manuals 4-491
4.19 Task 19: Reporting, Management, Subcontracts, Technology Transfer 4-491
4.19.1 Reporting 4-492
4.19.2 Management 4-493
4.19.3 Technology Transfer 4-494
5.0 ENVIRONMENTAL PERFORMANCE 5-1
5.1 Impact of the Environment 5-1
5.2 Waste Streams and their disposal 5-1
5.3 Potential Environmental Concerns 5-3
6.0 ECONOMICS 6-1
6.1 Economic Parameters 6-1
6.2 Estimated Process Capital Costs 6-2
6.3 Projected O&M Costs 6-5

6.4 Summary of Performance and Economics 6-6
7.0 MARKET ANALYSIS 7-1
7.1 Market Drivers 7-1
7.2 Applicability of the TOXECON™ Technology 7-1
7.3 Market Potential 7-2
8.0 CONCLUSIONS AND RECOMMENDATIONS 8-1
9.0 BIBLIOGRAPHY 9-1
Appendix A. Gaston COHPAC® Testing A-1
Appendix B. Test Plan for PIPP B-1
Appendix C. Coal and Ash Analysis – Baseline C-1
Appendix D. Coal Analysis – Long-Term D-1
Appendix E. Ash Analysis – Long-Term E-1
Appendix F. PAC Size Distribution F-1
Appendix G. GE Baseline Stack Testing 2006 ..... G-1
Appendix H. Monthly Baghouse Operation Graphs H-1
Appendix I. Monthly Mercury Removal Graphs I-1
Appendix J. Alternative PAC Testing 2009 ..... J-1
Appendix K. Inlet CEMS Daily Average Mercury Concentrations K-1
Appendix L. Inlet CEMS Calibration Record L-1
Appendix M. Inlet CEMS Monthly Maintenance Records M-1
Appendix N. Outlet CEMS Daily Average Mercury Concentrations N-1
Appendix O. Outlet CEMS Calibration Record O-1
Appendix P. Outlet CEMS Monthly Maintenance Records P-1
Appendix Q. 40 CFR Part 75 ..... Q-1
Appendix R. CEMS Installation and Certification Plan – We Energies R-1
Appendix S. IRM Report S-1
Appendix T. Platt – Particulate and Halogens 2007 ..... T-1
Appendix U. Platt – Mercury RATA 2007 ..... U-1
Appendix V. Platt – Particulate Halogens Metals 2008 ..... V-1
Appendix W. Platt – Mercury RATA 2008 ..... W-1
Appendix X. Platt – SO_3 Testing 2009 ..... X-1

Appendix Y. GFTS Final Report Y-1
Appendix Z. EERC Particulate Penetration Task 1 Findings Z-1
Appendix AA. EERC Particulate Penetration Task 2 Findings AA-1
Appendix BB. SO_2 NO_x Reduction at PIPP – Topical Report Final BB-1
Appendix CC. SO_2 NO_x Economics CC-1

List of Tables

Table 1-1. Results Summary from Gaston Low Load Tests, November 2003. 1-5

Table 1-2. Compositional Analysis of Subbituminous Coal Used at PIPP. 1-10

Table 1-3. Flue Gas Composition Downstream of HESPs in Flues 7, 8, and 9 at PIPP..... 1-10

Table 2-1. Stream Data at PIPP. 2-4

Table 3-1. Summary of Operating and Maintenance Costs. 3-3

Table 3-2. Summary of Startup Costs. 3-3

Table 4-1. Prototype Thermo Mercury Calibrator Performance Tests. 4-16

Table 4-2. Ontario Hydro RATA Verification of Thermo CEMS, November 2004. 4-27

Table 4-3. CAMR 40 CFR Part §75.20(c)(1) Mercury CEMS Certification Tests. 4-30

Table 4-4. CAMR 40 CFR Part §75.21 Mercury CEMS On-Going QA/QC Tests..... 4-31

Table 4-5. Results from U.S. EPA Mercury CEMS Field Tests, February 2005. 4-32

Table 4-6. Seven-Day Calibration Error Test; October 21–27, 2005. 4-38

Table 4-7. Three-Point Linearity Check; October 27, 2005. 4-38

Table 4-8. Cycle Time Test; November 11, 2005. 4-39

Table 4-9. Comparison to STM Traps, RATA Testing; August 3, 2005..... 4-39

Table 4-10. Seven-Day Calibration Error Test at Big Brown; October 21–27, 2005. 4-43

Table 4-11. Comparison to STM Traps, RATA Testing at Big Brown, October 2005..... 4-44

Table 4-12. Comparison to STM Traps, RATA Testing at Big Brown, November 2005. 4-44

Table 4-13. Average Coal, Flue Gas, and Fly Ash Mercury Results at Big Brown in lb/Tbtu. 4-45

Table 4-14. PAC Injection System Calibration 4-56

Table 4-15. Baghouse Cleaning Setpoints. 4-61

Table 4-16. Compositional Analysis of Subbituminous Coal Used at PIPP. 4-64

Table 4-17. Ash Leaching Results. 4-65

Table 4-18. Temperature Comparisons on PAC and PAC/Ash Mixtures. 4-71

Table 4-19. Column Reactor Tests. 4-73

Table 4-20. Simulated Flue Gas Composition. 4-73

Table 4-21. Comparison of Presque Isle and Gaston. 4-76

Table 4-22. Summary of Temperature Data for Hopper Thermocouples. 4-83

Table 4-23. Comparison of Thermo CEM and Ontario Hydro Data. 4-101

Table 4-24. Flue Gas Temperature Comparison. 4-103

Table 4-25. Particulate Removal across the Baghouse. 4-103

Table 4-26. Hydrogen Halide and Halogen Measurements. 4-104

Table 4-27. Coal and Ash Sampling Schedule – Baseline. 4-106

Table 4-28. Coal and Ash Analysis Schedule – Baseline. 4-107

Table 4-29. Coal and Ash Results – Baseline. 4-107

Table 4-30. Operation Log during Parametric Tests. 4-109

Table 4-31. Comparison of Parametric Tests using DARCO® Hg. 4-117

Table 4-32. Baghouse Temperature during DARCO® Hg Parametric Tests. 4-118

Table 4-33. Sorbent Injection Rates and Concentrations at Varying Boiler Loads. 4-142

Table 4-34. Schedule for Testing Baghouse Pressure Drop. 4-151

Table 4-35. Cost Savings for Baghouse Pressure Drop Reduction. 4-153

Table 4-36. PIPP Units 7–9 Inlet Analyzer Initial Set Point Configuration. 4-162

Table 4-37. PIPP Unit 8 Inlet Calibration Check Responses; January 14–20, 2006. 4-163

Table 4-38. PIPP Unit 8 Inlet Ontario Hydro Test Results; February 14, 2006. 4-167

Table 4-39. PIPP Unit 8 Inlet Calibration Check and Recalibration; April 5–10, 2006. 4-169

Table 4-40. PIPP Units 7 and 8 Inlet Dilution Ratio Adjustments; August 12–13, 2006. 4-179

Table 4-41. PIPP Units 7–9 Inlet Calibrator Output Error; August 15, 2006. 4-179

Table 4-42. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 4Q06. 4-187

Table 4-43. PIPP Unit 8 Inlet Total Mercury Check Responses; September 29–October 3, 2006. 4-190

Table 4-44. PIPP Unit 8 Inlet Elemental Mercury Check Responses; September 29–October 3, 2006. 4-190

Table 4-45. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 1Q07. 4-193

Table 4-46. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 2Q07. 4-198

Table 4-47. PIPP Unit 9 Inlet Total Mercury Calibration Responses; May 2–7, 2007. 4-199

Table 4-48. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 3Q07..... 4-202

Table 4-49. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 3Q07..... 4-203

Table 4-50. PIPP Unit 9 Inlet Total Mercury System Cycle Time, 3Q07..... 4-204

Table 4-51. PIPP Unit 9 Inlet Total Mercury System Seven Day Drift, 3Q07..... 4-204

Table 4-52. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 4Q07..... 4-209

Table 4-53. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 1Q08..... 4-214

Table 4-54. PIPP Units 7–9 Inlet Mercury CEMS Availability, 1Q08. 4-214

Table 4-55. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 2Q08..... 4-218

Table 4-56. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 2Q08..... 4-219

Table 4-57. PIPP Units 7–9 Inlet Mercury CEMS Availability; 2Q08. 4-219

Table 4-58. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 3Q08..... 4-224

Table 4-59. PIPP Units 7–9 Inlet Mercury CEMS Availability, 3Q08. 4-224

Table 4-60. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 4Q08..... 4-228

Table 4-61. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 4Q08..... 4-229

Table 4-62. PIPP Units 7–9 Inlet Mercury CEMS Availability, 4Q08. 4-229

Table 4-63. PIPP Units 7–9 Inlet Method 30B Sorbent Trap Test Results, November 2008..... 4-230

Table 4-64. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 1Q09..... 4-234

Table 4-65. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 1Q09..... 4-235

Table 4-66. PIPP Units 7–9 Inlet Mercury CEMS Availability, 1Q09. 4-235

Table 4-67. PIPP Unit 8 Inlet Total Mercury Calibration Responses; January 1–5, 2009..... 4-237

Table 4-68. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 2Q09..... 4-240

Table 4-69. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 2Q09..... 4-241

Table 4-70. PIPP Units 7–9 Inlet Mercury CEMS Availability, 2Q09. 4-241

Table 4-71. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 3Q09..... 4-244

Table 4-72. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 3Q09..... 4-245

Table 4-73. PIPP Units 7–9 Inlet Mercury CEMS Availability, 3Q09. 4-246

Table 4-74. PIPP Unit 8 Inlet Total Mercury Calibration Responses; August 21–26, 2009..... 4-246

Table 4-75. PIPP Outlet Mercury CEMS Initial Set Point Configuration. 4-248

Table 4-76. PIPP Outlet Calibration Check Responses; January 14–20, 2006. 4-250

Table 4-77. PIPP Outlet Ontario Hydro Test Results; February 14, 2006. 4-253

Table 4-78. PIPP Outlet Calibration Check and Recalibration; May 23–30, 2006. 4-256

Table 4-79. PIPP Outlet Mercury Calibration Responses; November 29–December 12, 2006. 4-265

Table 4-80. PIPP Outlet Total Mercury CEMS-STM Comparison; March 29, 2007. 4-270

Table 4-81. PIPP Outlet Mercury RATA (M30A, M30B, Ontario Hydro), June 2007. .. 4-277

Table 4-82. PIPP Outlet Total Mercury System Linearity Check, 3Q07. 4-279

Table 4-83. PIPP Outlet Total Mercury Seven-Day Calibration Drift, 3Q07. 4-279

Table 4-84. PIPP Outlet Total Mercury System Cycle Time, 3Q07. 4-280

Table 4-85. PIPP Outlet Mercury CEMS Availability, 1Q08. 4-285

Table 4-86. PIPP Outlet Mercury CEMS Availability, 2Q08. 4-289

Table 4-87. PIPP Outlet Total Mercury System Linearity Check, 2Q08. 4-289

Table 4-88. PIPP Outlet Mercury CEMS Availability, 3Q08. 4-292

Table 4-89. PIPP Outlet Total Mercury System Linearity Check, 3Q08. 4-292

Table 4-90. PIPP Outlet Weekly System Integrity Checks (Converter 760 °C), 3Q08.... 4-294

Table 4-91. PIPP Outlet Weekly System Integrity Checks (Converter 800 °C), 3Q08.... 4-295

Table 4-92. PIPP Outlet Mercury CEMS Availability, 4Q08. 4-297

Table 4-93. PIPP Outlet Total Mercury System Linearity Check, 4Q08. 4-298

Table 4-94. PIPP Outlet Mercury RATA (M30B), June 2008. 4-298

Table 4-95. PIPP Outlet Weekly System Integrity Checks, 4Q08. 4-299

Table 4-96. PIPP Outlet Mercury CEMS Availability, 1Q09. 4-301

Table 4-97. PIPP Outlet Total Mercury System Linearity Check, 1Q09. 4-302

Table 4-98. PIPP Outlet Mercury CEMS Availability, 2Q09. 4-305

Table 4-99. PIPP Outlet Total Mercury System Linearity Check, 2Q09. 4-306

Table 4-100. PIPP Outlet Weekly System Integrity Checks, 2Q09. 4-307

Table 4-101. PIPP Outlet Mercury CEMS Availability, 2Q09. 4-309

Table 4-102. PIPP Outlet Total Mercury System Linearity Check, 3Q09. 4-309

Table 4-103. CAMR 40 CFR Part §75.20 Mercury CEMS Certification Tests. 4-312

Table 4-104. CAMR 40 CFR Part §75.21 Mercury CEMS On-going QA/QC Tests. 4-313

Table 4-105. PIPP Inlet Mercury Span and Calibration Level Concentrations. 4-314

Table 4-106. PIPP Outlet Mercury Span and Calibration Level Concentrations. 4-315

Table 4-107. ADA-ES Daily Calibration Error Test Maintenance Limits. 4-316

Table 4-108. Method 5/17, Particulate Matter. 4-329

Table 4-109. LOI % of each TOXECON Fly Ash Component. 4-330

Table 4-110. Halogens and Hydrogen Halides. 4-331

Table 4-111. November 2008 Method 26A, Halogens and Hydrogen Halides. 4-332

Table 4-112. 2008 Bromine Mass Balance. 4-333

Table 4-113. 2008 Chlorine Mass Balance. 4-334

Table 4-114. Sulfuric Acid Test Results. 4-335

Table 4-115. Method 29, Metals. 4-335

Table 4-116. Summary of Mercury Measurements over Three Test Periods. 4-336

Table 4-117. 2006 Comparison of Thermo CEMS and Ontario Hydro Data. 4-337

Table 4-118. 2007 Mercury RATA Results Summary. 4-338

Table 4-119. 2008 Results from Mercury Testing and RATA. 4-339

Table 4-120. Mercury Content by Location. 4-339

Table 4-121. Mercury on PM comparisons. 4-340

Table 4-122. Test Bag Description. 4-343

Table 4-123. Comparison of Drag and Bag Weights; 2/2007, 5/2008[a], 12/2008, and 8/2009. 4-354

Table 4-124. Summary of Cage Inspections. 4-366

Table 4-125. Schedule of Activities for SO_2/NO_x Control Testing. 4-390

Table 4-126. Trona Injection Results. 4-399

Table 4-127. System Design Criteria for SO_2 Control System at Presque Isle (6000 lb/hr injection, > 70% SO_2 control). 4-408

Table 4-128. Summary of Equipment, Balance-of-Plant, and Engineering Costs. 4-413

Table 4-129. First-Year Total Fixed O & M Costs. 4-415

Table 4-130. First-Year Variable O & M Costs for Power..... 4-416

Table 4-131. First-Year Variable O & M Costs for Sorbent Delivered by Rail and by Rail/Truck Combination..... 4-417

Table 4-132. First-Year Variable O & M Costs for Landfill Waste Disposal..... 4-418

Table 4-133. First-Year Total Variable O & M Costs..... 4-418

Table 4-134. Economic Factors and Parameters..... 4-419

Table 4-135. Levelized Capital Costs..... 4-420

Table 4-136. Levelized Total Fixed O & M Costs..... 4-420

Table 4-137. Levelized Total Variable O & M Costs..... 4-421

Table 4-138. Levelized Total Costs (Capital and Fixed & Variable O&M Costs)..... 4-422

Table 4-139. Removal Cost per Ton of SO_2..... 4-423

Table 4-140. PAC/Ash Composition..... 4-426

Table 4-141. Fertilizer Product Cost Calculation..... 4-430

Table 4-142. Weight Change of Carbon Before and After Heating..... 4-438

Table 4-143. Conductive Concrete Formulation Ranges..... 4-449

Table 4-144. Thirty Percent LOI W/C Ratio versus Resistance Data..... 4-455

Table 4-145. Moist Concrete versus Dry Concrete..... 4-458

Table 4-146. High-Frequency 1.0% LOI..... 4-464

Table 4-147. High-Frequency 23.0% LOI..... 4-465

Table 4-148. High-Frequency 30.0% LOI..... 4-466

Table 4-149. Solar Panel and Battery Specifications used for Analysis..... 4-469

Table 4-150. Conductive Concrete Cost Comparison..... 4-470

Table 4-151. Admixture Formulation Ranges..... 4-473

Table 4-152. Structural Concrete Formulation Ranges..... 4-474

Table 4-153. Hardened Air Void Results from PIPP Field Test..... 4-489

Table 4-154. Concrete Leaching Results..... 4-491

Table 6-1. Economic Analysis Parameters..... 6-2

Table 6-2. Major Equipment List..... 6-3

Table 6-3. Major Equipment Costs – 2009 Dollars..... 6-4

Table 6-4. Total Capital Requirement. 6-5
Table 6-5. Operating and Maintenance Costs. 6-6
Table 6-6. PM Environmental Performance. 6-7
Table 6-7. Summary of Performance and Cost Data. 6-7
Table 6-8. Cost of Mercury Removal – $/Pound. 6-10

List of Figures

Figure 1-1. Mercury Removal with ACI Upstream of COHPAC® at Gaston, 2001. 1-2

Figure 1-2. Mercury Removal in TOXECON™ Tests on Bituminous and PRB Coals. 1-6

Figure 1-3. Organizational Chart. 1-7

Figure 1-4. TOXECON™ Configuration. 1-8

Figure 2-1. Picture of the TOXECON™ Installation after Startup. 2-3

Figure 2-2. Process Flow Diagram. 2-4

Figure 4-1. EPM Environmental Inertial Filter Extraction Probe..... 4-13

Figure 4-2. Typical Thermo Prototype Mercury Analyzer and Calibrator. 4-13

Figure 4-3. Typical Thermo Prototype Mercury Extraction Probe..... 4-14

Figure 4-4. Mercury Measurement at Gaston Baghouse Outlet, February 2004. 4-15

Figure 4-5. Mercury Measurement at Holcomb SDA Inlet, June 2004. 4-17

Figure 4-6. Mercury Measurement at Holcomb Baghouse Outlet, June 2004. 4-18

Figure 4-7. Mercury Measurement at Holcomb SDA Outlet, June 2004. 4-19

Figure 4-8. Thermo Prototype Mercury Extraction Probe (Redesigned EPM Probe). 4-20

Figure 4-9. Mercury Measurement at Holcomb at SDA Inlet, July 2004..... 4-21

Figure 4-10. Mercury Measurement at Holcomb Baghouse Outlet, July 2004. 4-21

Figure 4-11. Mercury Measurement at Holcomb Stack, July 2004. 4-22

Figure 4-12. Prototype Thermo Electron Mercury CEMS at AEP Conesville. 4-23

Figure 4-13. Comparison of Thermo Calibrator to PSA Cavkit at Conesville, August 2004. 4-24

Figure 4-14. Function of the Thermo Mercury Converter at Conesville SCR Inlet, August 2004. 4-25

Figure 4-15. Speciated Mercury Measurements at Brayton Point Unit 3, November 2004..... 4-26

Figure 4-16. Prototype Thermo Mercury CEMS Instruments at Cherokee Station. 4-28

Figure 4-17. Comparison of the Prototype Thermo Extraction Probe and the EMC SCEM Probe..... 4-28

Figure 4-18. Schematic of Thermo Electron iSeries Mercury Freedom System™. 4-33

Figure 4-19. Thermo Electron Prototype C-Series Mercury CEMS installed at PIPP Unit 8 Inlet, June 2005. 4-35

Figure 4-20. Thermo Electron Prototype C-Series Mercury Probe Installed at PIPP Unit 8 Inlet, June 2005. 4-36

Figure 4-21. PIPP Unit 8 Inlet Mercury Concentrations, Daily Averages; July 7–12, 2005. 4-37

Figure 4-22. PIPP Unit 8 Inlet Thermo Mercury CEMS versus STM, August 2005. 4-40

Figure 4-23. Thermo Prototype iSeries Mercury CEMS at Big Brown Unit 1 Stack, October 2005. 4-41

Figure 4-24. Thermo Prototype iSeries Mercury Probe at Big Brown Unit 1 Stack, October 2005. 4-42

Figure 4-25. Installation of new iSeries Mercury CEMS at the PIPP Baghouse Outlet, December 2005. 4-46

Figure 4-26. Baghouse Outlet Duct Mercury CEMS Shelter and Installed Probe, December 2005. 4-47

Figure 4-27. Thermo iSeries Mercury CEMS Installed in the Shelter at the Outlet Location, December 2005. 4-47

Figure 4-28. Schematic of Mercury CEMS Integration into DAS and DCS. 4-48

Figure 4-29. View of Baghouse Foundation Installation. 4-50

Figure 4-30. View of the Fan and Motor Pedestal Foundations Installation. 4-51

Figure 4-31. Baghouse Temperature and Pressure Conditions during Overheating Event. 4-69

Figure 4-32. Column Reactor. 4-72

Figure 4-33. Column Test: PAC with Air at Ambient Temperature. 4-74

Figure 4-34. Column Test: PAC with Air at Flue Gas Temperature (340 ºF). 4-74

Figure 4-35. Column Test: PAC with Simulated Flue Gas (340 ºF). 4-75

Figure 4-36. Installation of Thermocouples in the Hopper for PAC Test. 4-78

Figure 4-37. Installed Thermocouples in PAC Bed. 4-78

Figure 4-38. PAC Hopper Test: Inside Wall Temperatures. 4-79

Figure 4-39. First PAC Hopper Test: PAC Bed Temperatures. 4-79

Figure 4-40. Second PAC Hopper Test: PAC Bed Temperatures. 4-80

Figure 4-41. Water Marks in Baghouse Hoppers. 4-81

Figure 4-42. Compartment 6 Hopper Wall Temperatures. 4-84

Figure 4-43. Compartments 1–3 Hopper Wall Temperatures. 4-85

Figure 4-44. Compartment 4 Hopper Wall Temperatures. 4-85

Figure 4-45. Compartments 5–7 Hopper Wall Temperatures. 4-86

Figure 4-46. Compartments 8–10 Hopper Wall Temperatures. 4-86

Figure 4-47. Laboratory Setup for Autoignition Tests. 4-88

Figure 4-48. Autoignition Test on DARCO® Hg PAC (75% LOI) Showing Overheating but No Ignition. 4-89

Figure 4-49. Autoignition Test on DARCO® Hg PAC (75% LOI) Showing Autoignition. 4-90

Figure 4-50. Autoignition Test on DARCO® Hg PAC and ESP Ash at 37% LOI. 4-90

Figure 4-51. Ash Pattern in an 8-Inch Bed of PAC after Autoignition. 4-91

Figure 4-52. Ash Pattern and Glowing Embers in an 8-Inch Bed of PAC. 4-92

Figure 4-53. Autoignition Correlation using DARCO® Hg PAC. 4-93

Figure 4-54. Autoignition Correlation of Surface Area to Volume Ratio versus Temperature. 4-94

Figure 4-55. Correlation of Oven Critical Temperature versus Bed Size according to Frank-Kamenetskii Model Equations. 4-95

Figure 4-56. Carbon Monoxide Produced during Autoignition of PAC. 4-96

Figure 4-57. Thermo CEM and Ontario Hydro Measurements. 4-101

Figure 4-58. Baghouse Temperature Profile. 4-102

Figure 4-59. Baseline Mercury and Baghouse Data; February 13–17, 2006. 4-105

Figure 4-60. DARCO® Hg Parametric (Round 1) Mercury and Baghouse Data; February 16–28, 2006. 4-111

Figure 4-61. Relationship between Inlet Temperature and Mercury Removal at 1.0 lb/MMacf with DARCO® Hg. 4-112

Figure 4-62. DARCO® Hg, Mercury, and Baghouse Data for May 25–July 3, 2006. 4-114

Figure 4-63. Mercury and Baghouse Data for August 17–September 12, 2006. 4-116

Figure 4-64. Average Mercury Removal using DARCO® Hg Sorbent. 4-118

Figure 4-65. Effect of Temperature on Mercury Removal Using DARCO® Hg. 4-119

Figure 4-66. Mercury and Baghouse Data during Changeover from DARCO® Hg to DARCO® Hg-LH. 4-120

Figure 4-67. Mercury and Baghouse Data during DARCO® Hg-LH Parametric Testing; October 20–November 10, 2006. 4-122

Figure 4-68. Parametric Test Results – 330 °F. 4-123

Figure 4-69. Parametric Test Results – All Temperatures. 4-124

Figure 4-70. Baghouse Performance Graphs, July 2009. 4-126

Figure 4-71. Mercury Removal Graph; December 2006. 4-127

Figure 4-72. Average Mercury Removal – 2006. 4-128

Figure 4-73. Average Mercury Removal – 2007. 4-129

Figure 4-74. Average Mercury Removal – 2008. 4-130

Figure 4-75. Average Mercury Removal – 2009. 4-131

Figure 4-76. Temporary Silo Installation. 4-133

Figure 4-77. Mercury Removal using High-LOI Ash. 4-134

Figure 4-78. High LOI Ash and PAC Co-Injection Parametric Test Results. 4-135

Figure 4-79. Effect of Milling on High LOI Ash. 4-135

Figure 4-80. Alternative Carbon Test Results. 4-136

Figure 4-81. Portable Injection Equipment – 2009 Tests. 4-139

Figure 4-82. Baseline Mercury and Plant Data. 4-140

Figure 4-83. PAC #2 Mercury Removal versus Temperature Correlations. 4-143

Figure 4-84. PAC #1 Mercury Removal versus Temperature Correlations. 4-144

Figure 4-85. PAC #3 Mercury Removal versus Temperature Correlations. 4-144

Figure 4-86. PAC #6 Mercury Removal versus Temperature Correlations. 4-145

Figure 4-87. PAC #5 Mercury Removal versus Temperature Correlations. 4-146

Figure 4-88. PAC #4 Mercury Removal versus Temperature Correlations. 4-147

Figure 4-89. Sorbent Performance Curves, Normalized to 330 ºF. 4-148

Figure 4-90. Sorbent Performance Curves, Normalized to 340 ºF. 4-148

Figure 4-91. DARCO® Hg-LH Performance Curves, Normalized to 330 ºF. 4-149

Figure 4-92. DARCO® Hg-LH Performance Curves, Normalized to 340 ºF. 4-149

Figure 4-93. Effect of A/C Ratio on Mercury Removal. 4-151

Figure 4-94. Effect of Baghouse Pressure Drop on Mercury Removal for 1.0 lb/MMacf DARCO® Hg LH. 4-152

Figure 4-95. Effect of Baghouse Pressure Drop on Bag Cleaning. 4-153

Figure 4-96. Effect of Temperature on Removal using DARCO® Hg. 4-154

Figure 4-97. Effect of Temperature on Mercury Removal using DARCO® Hg LH. 4-155

Figure 4-98. ESP Layout..... 4-157

Figure 4-99. Stack Opacity during ESP Detuning Tests..... 4-158

Figure 4-100. LOI during ESP Detuning Tests. 4-159

Figure 4-101. Average Mercury Removal – 2007. 4-160

Figure 4-102. PIPP Units 7–9 Inlet Total Mercury, December 2005–January 2006..... 4-162

Figure 4-103. PIPP Unit 8 Inlet Probe Converter Heater Failure, January 2006..... 4-164

Figure 4-104. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q06. 4-165

Figure 4-105. PIPP Unit 8 Inlet Total Mercury CEMS-Ontario Hydro; February 14, 2006. 4-166

Figure 4-106. PIPP Units 7–9Inlet Total Mercury Concentrations, 2Q06. 4-168

Figure 4-107. PIPP Unit 8 Inlet Mercury Probe Dilution Pressure, April 2006. 4-170

Figure 4-108. PIPP Unit 8 Inlet Mercury Probe Eductor/Dilution Pressure, May 2006. 4-171

Figure 4-109. PIPP Unit 8 Inlet CEMS System Background Calibration Factor, 3Q06..... 4-172

Figure 4-110. PIPP Unit 8 Inlet Mercury Probe Converter Temperature; June 30, 2006. 4-172

Figure 4-111. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q06. 4-173

Figure 4-112. PIPP Unit 7 Inlet Mercury Extraction Probe with Actuator Valve. 4-174

Figure 4-113. PIPP Unit 7 Inlet Mercury CEMS Probe Actuator Valve and Stem. 4-175

Figure 4-114. PIPP Units 7–9 Inlet Mercury CEMS, Hydra Configuration..... 4-176

Figure 4-115. PIPP Units 7 and 8 Inlet Mercury Probe Dilution Ratio, 3Q06. 4-178

Figure 4-116. PIPP Unit 8 Inlet Mercury Probe Orifice Pressure and Dilution Ratio..... 4-180

Figure 4-117. PIPP Units 7 and 8 Inlet Mercury Probe Dilution Pressure; September 14–17, 2006. 4-181

Figure 4-118. PIPP Unit 8 Inlet Mercury Probe Dilution Air Flow Rate; September 26-30, 2006. 4-182

Figure 4-119. PIPP Units 7 and 8 Inlet Mercury Probe Temperature; August 27–30, 2006. 4-182

Figure 4-120. PIPP Units 7–9 Inlet Analyzer Internal Temperature; July 31–August 1, 2006. 4-183

Figure 4-121. PIPP Units 7–9 Inlet Analyzer PMT Voltage; September 22, 2006. 4-183

Figure 4-122. PIPP Units 7–9 Inlet Mercury CEMS Corrected Data, August–September 2006. 4-185

Figure 4-123. PIPP Units 7–9 Inlet Total Mercury Concentrations, 4Q06. 4-186

Figure 4-124. PIPP Unit 7 Inlet CEMS Probe and Failsafe Temperatures; November 2–6, 2006. 4-188

Figure 4-125. PIPP Unit 8 Inlet Chamber Pressure, October–November 2006. 4-189

Figure 4-126. PIPP Unit 8 Inlet Total and Elemental Mercury; October 1–11, 2006. 4-189

Figure 4-127. PIPP Units 7–9 Inlet Total Mercury Corrected Concentrations, 4Q06. 4-191

Figure 4-128. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q07. 4-192

Figure 4-129. PIPP Unit 7 Probe Bench Temperature Comparisons; February 26, 2007. 4-193

Figure 4-130. PIPP Units 7–9 Mercury Analyzer Lamp Intensity; February 24, 2007. ... 4-194

Figure 4-131. PIPP Units 7–9 Mercury Analyzer PMT Voltage Adjustment, February 2007. 4-195

Figure 4-132. PIPP Units 7 and 8 Simultaneous Total Mercury, March 2007. 4-197

Figure 4-133. PIPP Units 7 and 9 Simultaneous Total Mercury, March 2007. 4-197

Figure 4-134. PIPP Units 7–9 Inlet Total Mercury Concentrations, 2Q07. 4-198

Figure 4-135. PIPP Units 7 and 9 Total Mercury Concentrations; April 11–21, 2007. ... 4-200

Figure 4-136. PIPP Unit 9 Mercury and Lamp Intensity Comparison, May 2007. 4-201

Figure 4-137. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q07. 4-202

Figure 4-138. PIPP Unit 8 Total and Elemental Mercury, 3Q07. 4-205

Figure 4-139. PIPP Unit 8 Total Mercury and Internal Temperature; September 4–7, 2007. 4-207

Figure 4-140. PIPP Units 7–9 Inlet Total Mercury, 4Q07. 4-208

Figure 4-141. PIPP Units 7–9 Inlet Mercury CEMS Nitrogen Generator. 4-210

Figure 4-142. PIPP Unit 9 Total Mercury with Nitrogen Generator; October 9, 2007. ... 4-211

Figure 4-143. PIPP Units 7–9 Inlet Mercury CEMS Calibration Gas Hydrator. 4-212

Figure 4-144. PIPP Unit 8 Total Mercury with Lamp Upgrade, December 2007. 4-213

Figure 4-145. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q08. 4-213

Figure 4-146. PIPP Unit 7 Total Mercury Degradation; February 2–10, 2008. 4-215

Figure 4-147. PIPP Units 7–9 Inlet Analyzer Sample Flow Rate; February 22, 2008. 4-216

Figure 4-148. PIPP Unit 7 Inlet Umbilical Set Point Temperature; March 12, 2008. 4-217

Figure 4-149. PIPP Units 7–9 Inlet Total Mercury, 2Q08. 4-218

Figure 4-150. PIPP Units 7–9 Inlet Mercury Lamp Intensity; May 20, 2008. 4-220

Figure 4-151. PIPP Unit 7 Inlet Probe Eductor Pressure; May 20–June 4, 2008. 4-221

Figure 4-152. PIPP Unit 7 Inlet Eductor and Blowback Pressures; June 4, 2008. 4-221

Figure 4-153. PIPP Units 7–9 Inlet Internal and Lamp Temperatures; May 6, 2008. 4-222

Figure 4-154. PIPP Units 7–9 Inlet Calibrator Cooler Temperature;
June 22–26, 2008. 4-222

Figure 4-155. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q08. 4-223

Figure 4-156. PIPP Units 7–9 Inlet Mercury Lamp Intensity; May–July 2008. 4-225

Figure 4-157. PIPP Unit 7 Inlet Total and Elemental Mercury; July 17–20, 2008. 4-225

Figure 4-158. PIPP Unit 8 Inlet Total Mercury; August 17, 2008. 4-226

Figure 4-159. PIPP Units 7–9 Inlet Internal Temperatures;
August 30–September 3, 2006. 4-227

Figure 4-160. PIPP Units 7–9 Inlet Total Mercury Concentrations, 4Q08. 4-227

Figure 4-161. PIPP Units 7–9 Inlet Mercury Analyzer Lamp Intensity,
August–October 2008. 4-231

Figure 4-162. PIPP Unit 8 Inlet Mercury Probe Bench Temperature;
November 3–4, 2008. 4-231

Figure 4-163. PIPP Unit 7 Inlet Mercury Probe Temperature; November 25, 2008. 4-232

Figure 4-164. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q09. 4-233

Figure 4-165. PIPP Units 7 and 8 Total Mercury Concentrations;
January 30–February 2, 2009. 4-237

Figure 4-166. PIPP Units 7 and 8 Total Mercury Concentrations; February 4–9, 2009. 4-238

Figure 4-167. PIPP Units 7 and 9 Total Mercury Concentrations; March 25–30, 2009. 4-239

Figure 4-168. PIPP Units 7–9 Inlet Total Mercury Concentrations, 2Q09. 4-239

Figure 4-169. PIPP Units 7–9 Inlet Analyzer Chamber Pressure; January 1–April 30, 2009. 4-242

Figure 4-170. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q09. 4-243

Figure 4-171. PIPP Outlet Total Mercury Concentrations, 1Q06. 4-249

Figure 4-172. PIPP Outlet Total Mercury Concentrations; January 8–February 12, 2006. 4-252

Figure 4-173. PIPP Outlet Total Mercury CEMS-Ontario Hydro; February 14, 2006. ... 4-252

Figure 4-174. PIPP Outlet Total Mercury; February 20–March 2, 2006. 4-253

Figure 4-175. PIPP Outlet Total Mercury, 2Q06. 4-255

Figure 4-176. PIPP Outlet Total Mercury; May 10–30, 2006. 4-255

Figure 4-177. PIPP Outlet Total Mercury; May 29–June 11, 2006. 4-257

Figure 4-178. PIPP Outlet Total Mercury; June 11–30, 2006. 4-257

Figure 4-179. PIPP Outlet Total and Elemental Mercury, 3Q06. 4-260

Figure 4-180. PIPP Outlet Total and Elemental Mercury; September 29–30, 2006. 4-263

Figure 4-181. PIPP Outlet Total and Elemental Mercury, 4Q06. 4-264

Figure 4-182. PIPP Outlet Total Mercury Corrected Concentrations; December 1–21, 2006. 4-266

Figure 4-183. PIPP Outlet Total and Elemental Mercury, 1Q07. 4-267

Figure 4-184. PIPP Outlet Mercury Analyzer Lamp Intensity; February 24–27, 2007. .. 4-269

Figure 4-185. PIPP Outlet Total Mercury Measurements without Solar Blind Filter. 4-270

Figure 4-186. PIPP Outlet Prototype Mercuric Chloride Generator. 4-272

Figure 4-187. PIPP Outlet Total and Elemental Mercury, 2Q07. 4-273

Figure 4-188. PIPP Outlet Total Mercury Measurements with Solar Blind Filter. 4-274

Figure 4-189. PIPP Outlet Mercury System Nitrogen Generator. 4-275

Figure 4-190. PIPP Outlet Total Mercury with Nitrogen Generator; May 22–24, 2007. 4-275

Figure 4-191. PIPP Outlet Total Mercury with Optical Upgrade; May 24–25, 2007. 4-276

Figure 4-192. PIPP Outlet Total and Elemental Mercury, 3Q07..... 4-278

Figure 4-193. PIPP Outlet Mercury Analyzer Chamber Pressure, 3Q2007. 4-281

Figure 4-194. PIPP Outlet Total and Elemental Mercury, 4Q07..... 4-282

Figure 4-195. PIPP Outlet Mercury Analyzer Lamp Temperature; December 12, 2007. 4-283

Figure 4-196. PIPP Outlet CEMS Probe Mercuric Chloride Generator; October 13, 2007..... 4-284

Figure 4-197. PIPP Outlet Total and Elemental Mercury, 1Q08..... 4-285

Figure 4-198. PIPP Outlet Mercury CEMS System Integrity Check; January 24, 2008. 4-286

Figure 4-199. PIPP Outlet Mercury Analyzer Chamber Pressure, February–March 2008..... 4-287

Figure 4-200. PIPP Outlet Total and Elemental Mercury, 2Q08..... 4-288

Figure 4-201. PIPP Outlet Mercury CEMS System Integrity Check; June 10, 2008..... 4-290

Figure 4-202. PIPP Outlet Total and Elemental Mercury, 3Q08..... 4-291

Figure 4-203. PIPP Outlet Mercury CEMS System Integrity Check; July 25, 2008..... 4-293

Figure 4-204. PIPP Outlet Mercury System Eductor Pressure, August–September 2008. 4-296

Figure 4-205. PIPP Outlet Total and Elemental Mercury, 4Q08..... 4-297

Figure 4-206. PIPP Outlet Mercury Probe Temperature; December 31, 2008..... 4-300

Figure 4-207. PIPP Outlet Total and Elemental Mercury, 1Q09..... 4-301

Figure 4-208. PIPP Outlet Mercury Probe Converter Core Replacement, January 2009. 4-303

Figure 4-209. PIPP Outlet Mercury Probe Temperature Error; January 15, 2009. 4-304

Figure 4-210. PIPP Outlet Total and Elemental Mercury Concentrations, 2Q09. 4-305

Figure 4-211. PIPP Outlet Total Mercury Concentrations, 3Q09. 4-308

Figure 4-212. Daily System Calibration Zero and Span Check Profile..... 4-317

Figure 4-213. Weekly System Integrity Check with Mercuric Chloride Generator..... 4-320

Figure 4-214. Monthly System Linearity Check. 4-320

Figure 4-215. Thermo Mercury CEMS for Instrumental Reference Method..... 4-326

Figure 4-216. Emission Sampling Locations. 4-327

Figure 4-217. Test Bag Layout at Startup of the Baghouse. 4-345

Figure 4-218. Test Bag Layout – August 2009. 4-346

Figure 4-219. Portable Drag Tester. 4-348

Figure 4-220. Picture of Compartment 8 Tube Sheet on February 28, 2007. 4-350

Figure 4-221. OEM Bag as it is being Removed from the Tube Sheet on February 26, 2007. 4-351

Figure 4-222. Picture of Test and PPS Swatches Removed from Compartment 8. 4-352

Figure 4-223. Compartment 8 Tube Sheet with Replacement OEM Bags Installed; 2009. 4-353

Figure 4-224. Bundle B in Compartment 8 Showing Discoloration of Bags and Replacement OEM Bag; 2009. 4-353

Figure 4-225. Precipitate in Compartment 1 J-Tubes. 4-361

Figure 4-226. Close-Up of Precipitate from Compartment 1. 4-361

Figure 4-227. Interior Wall J-Tubes in Compartment 1. 4-362

Figure 4-228. Pulse Pipes before Insulation. 4-363

Figure 4-229. Enclosed Pulse Pipes. 4-363

Figure 4-230. Connection of Upper and Lower Baghouse Cages. 4-365

Figure 4-231. Baghouse Cage Upper Section. 4-365

Figure 4-232. Supply Duct: March 28, 2006. 4-367

Figure 4-233. Unit 7 Return Duct Corrosion: March 28, 2006. 4-368

Figure 4-234. Supply Duct Corrosion: February 25, 2007. 4-369

Figure 4-235. Corrosion on Return Duct Riser before Unit 7 Diverter: February 25, 2007. 4-369

Figure 4-236. May 2008 Duct Inspection Showing Corrosion on Walls and Floor. 4-370

Figure 4-237. Duct Corrosion: December 2008 Inspection. 4-371

Figure 4-238. Duct Wall Temperature during Unit Outages. 4-374

Figure 4-239. Duct Flue Gas Temperatures during Unit Outages. 4-374

Figure 4-240. Duct Wall Temperatures during Diverter Damper Test. 4-375

Figure 4-241. Corroded Lagging. 4-376

Figure 4-242. Hole in Fitting in the PAC Fluidizing System. 4-377
Figure 4-243. Dust Emissions during Ash Silo Unloading 2Q06. 4-379
Figure 4-244. TOXECON™ Ash Silo Dust Curtain. 4-381
Figure 4-245. Operator Enclosure for Ash Unloading (Prior to Shelter Being Built). 4-384
Figure 4-246. Dust-Free TOXECON™ Ash Unloading. 4-385
Figure 4-247. Staging Area for Trona Injection Equipment 4-393
Figure 4-248. Trona Injection Trailer Blowers and Controls. 4-393
Figure 4-249. Trona Injection Ports. 4-394
Figure 4-250. Baseline SO_2 and NO_x Data. 4-396
Figure 4-251. Unloading Reacted Trona/PAC/Ash Mixture 4-398
Figure 4-252. Removal vs. Trona Injection Rate. 4-400
Figure 4-253. SO_2 Removal Profiles. 4-401
Figure 4-254. NO_x Removal During Trona Injection. 4-401
Figure 4-255. Effect of 5926 lb/hr Trona Injection on SO_2, NO_x, and Opacity. 4-403
Figure 4-256. Effect of 5926 lb/hr Trona Injection without PAC Injection. 4-404
Figure 4-257. Baghouse Operation During Trona Injection Testing. 4-406
Figure 4-258. Schematic of the Trona Injection Equipment at PIPP Units 7, 8, and 9. ... 4-410
Figure 4-259. SEM Images of the PAC/Ash. 4-426
Figure 4-260. Large Batch Reactor. 4-427
Figure 4-261. Fertilizer Production Process Flow Diagram. 4-433
Figure 4-262. Schematic Diagram for the Mercury Separation Experiment. 4-436
Figure 4-263. Apparatus of Microwave Experiment. 4-437
Figure 4-264. The Crystals Condensed on the Connecting Tube and Liquid Droplets. ... 4-438
Figure 4-265. SEM Image of the Condensed White Crystals. 4-439
Figure 4-266. EDS Spectrum of the Condensed White Crystals. 4-440
Figure 4-267. EDS Standardless Analysis of the Condensed Crystals. 4-440
Figure 4-268. (a) The dark precipitates in the scrubbed solution with sodium sulfide addition on the left, and (b) the original solution with the addition of sodium sulfide on the right. 4-441

Figure 4-269. SEM Images of the Sulfide Precipitates in the Scrubbed Solution. 4-442

Figure 4-270. Spectrum of the Sulfide Precipitates in the Scrubbed Solution. 4-443

Figure 4-271. EDS Standardless Analysis of the Sulfide Precipitates in the Scrubbed Solution. 4-443

Figure 4-272. Conductive Adhesive. 4-450

Figure 4-273. Electrical Test Wiring Schematic. 4-451

Figure 4-274. DC Electrical Test Set-Up. 4-452

Figure 4-275. High-Frequency Test Wiring Schematic. 4-453

Figure 4-276. W/C Ratio versus DC Resistance. 4-456

Figure 4-277. W/C Ratio versus AC Resistance. 4-456

Figure 4-278. Percent Fly Ash Replacement to DC Resistance, Units 7–9 Ash. 4-459

Figure 4-279. Frequency versus Resistance for a 10Ω Test Circuit. 4-460

Figure 4-280. Frequency versus Resistance for a 100Ω Test Circuit. 4-460

Figure 4-281. System Calibration/Measurement Integrity. 4-461

Figure 4-282. System Calibration/Measurement Integrity with ± 2% Error Band. 4-462

Figure 4-283. Frequency versus Resistance for a 100Ω Test Circuit 0 Hz–25 kHz. 4-463

Figure 4-284. High-Frequency 1.0% LOI. 4-464

Figure 4-285. High-Frequency 23.0% LOI. 4-465

Figure 4-286. High-Frequency 30.0% LOI. 4-466

Figure 4-287. Alternate High-Frequency Test Circuit Setup. 4-467

Figure 4-288. Variable-Speed Concrete Mixer. 4-475

Figure 4-289. Forney Type B Air Meter. 4-476

Figure 4-290. Correlations between Slump and Percent Air in Concrete. 4-478

Figure 4-291. Percent Air versus Unit Weight at 20% Cementitious Replacement. 4-479

Figure 4-292. Laboratory Concrete Compressive Strength Results. 4-480

Figure 4-293. Effect of w/c Ratio on Concrete Strength. 4-481

Figure 4-294. TOXECON™ Ash Added during Concrete Mixing at Sky Ute Sand and Gravel. 4-482

Figure 4-295. Compressive Strength Data—Field Test at Sky Ute Sand and Gravel. 4-483

Figure 4-296. Completed Push Wall and Support Steel for High-Carbon Concrete Pad. 4-484

Figure 4-297. Unloading Dry TOXECON™ Ash for Concrete Preparation. 4-484

Figure 4-298. First Successful High-Carbon Concrete Placement. 4-486

Figure 4-299. Completion of the Drainage Area with High-Carbon Concrete..... 4-486

Figure 4-300. Completed High-Carbon Concrete Pad; June 5, 2009. 4-487

Figure 4-301. Compressive Strength Results for High-Carbon Concrete Pad. 4-488

Figure 4-302. High-Carbon Concrete Pad used for Bottom Ash Dewatering. 4-488

Figure 5-1. Mercury Loading on the PAC/Ash Mixture..... 5-2

Figure 5-2. Mercury Loading on the PAC Fraction of the Baghouse Mixture. 5-3

Figure 6-1. Inlet Mercury CEM Data Variation. 6-8

Figure 6-2. Mercury Removal Test Results for Norit Hg-LH. 6-9

Figure 6-3. Mercury Emission Rate Test Results for Norit Hg-LH. 6-9

List of Abbreviations

AC	Alternating current
A/C	Air-to-cloth ratio
acfm	Actual cubic feet per minute
ACI	Activated carbon injection
ADA-ES	ADA Environmental Solutions
A/E	Architect/Engineer
ASTM	American Society for Testing and Materials
BOP	Balance-of-plant
CCPI	Clean Coal Power Initiative
CEM	Continuous emissions monitor
COHPAC®	Compact hybrid particulate collector
CVAA	Cold vapor atomic absorption
DC	Direct current
DCS	Distributed control system
DOE	Department of Energy
DOT	Department of Transportation
EPRI	Electric Power Research Institute
ESP	Electrostatic precipitator
gr/acf	Grains per actual cubic foot
HESP	Hot-side electrostatic precipitator
Hg	Mercury
HP	Horsepower
HVAC	Heating ventilation air conditioning
Hz	Hertz
ID	Induced draft
I/O	Input/output
kHz	Kilohertz
lb/hr	Pounds per hour
LOI	Loss on ignition
MCC	Motor control center
MMacf	Million actual cubic feet

MW	Megawatts
NEP	National Energy Policy
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NO_x	Oxides of nitrogen
NFPA	National Fire Protection Association
NSR	Normalized stoichiometric ratio
O_2	Oxygen
O&M	Operation and Maintenance
OEM	Original equipment manufacturer
PAC	Powdered activated carbon
PIPP	Presque Isle Power Plant
PM	Particulate matter
ppm	Parts per million
PPS	Polyphenylene sulfide
ppt	Parts per trillion
PRB	Powder River Basin
psig	Pounds per square inch gauge
RATA	Relative Accuracy Test Audit
RIO	Remote I/O
rpm	Revolutions per minute
scfm	Standard cubic feet per minute
SO_2	Sulfur dioxide
UBC	Unburned carbon produced in the combustion process in the boiler
VAC	Volts alternating current
VIV	Variable inlet vane
WAPC	Wheelabrator Air Pollution Control
W/C	Water-to-cement ratio
” w.c.	Inches of water column
We Energies	Wisconsin Energy

Glossary of Terms

The following information provides the reader with an introduction to common terminology related to fabric filters and the TOXECON™ technology.

Pressure Drop/Drag – Pressure drop and drag are both used to monitor the permeability of the filter and filter cake. Pressure drop is a direct measurement of the pressure difference across the fabric filters. Drag is a calculated number that normalizes pressure drop to flow by dividing pressure drop by the A/C ratio. These values are a function of inlet grain loading, filtering characteristics of the particulate matter, flue gas flow rate, and time between cleaning. The particulate matter, or dust, adhering to the outside of the bags is usually referred to as "cake," which acts as a filtering medium and presents a resistance to flow. A greater inlet loading or longer bag cleaning cycle time will result in deposition of a thicker cake collected on the bag surface. A thicker cake on the surface results in a higher pressure drop. Excessive pressure drop is undesirable because of the energy required to overcome it. Fans need to be sized to compensate for this expected pressure drop and higher pressure drops require larger fans and subsequently more horsepower. Once a system is designed and in operation, excessive pressure drop is a problem if the pressure drop exceeds the fan capacity. In this case, a generating unit becomes load limited due to insufficient fan capacity to run at full load. In addition, the cleaning system needs to run more often, which consumes additional compressed air motor energy, and the bag life is shortened due to having to more cleaning cycles. Bags flex when they are cleaned because they are made of a fabric material, and this flexing eventually causes a failure of the material (McKenna, 1989).

Cleaning Frequency – Pressure drop and drag are controlled in a baghouse by the cleaning frequency. Higher inlet loading causes increased pressure drop and subsequent increased cleaning frequency. Cleaning cycles are initiated by a set pressure drop value for the system. When the system pressure drop increases to this point a cleaning cycle is initiated (see "Cleaning Modes" below). Cleaning frequency increases with the increased particulate loading from sorbent injection.

Opacity/Emissions – Cleaning frequency and particulate matter characteristics can affect collection efficiency across the baghouse. Most emissions occur immediately following cleaning, so increasing the cleaning frequency can increase outlet emissions. The emissions could also increase if the particulate does not form a high-efficiency filter, but tends to work through the fabrics.

Air-to-Cloth (A/C) Ratio – The ratio between flue gas flow (acfm) and total fabric surface area (ft^2), expressed in ft/min. A lower A/C ratio indicates a larger, more conservative design. Typically, pulse-jet fabric filters are designed with A/C ratios between 3 and 4 ft/min. COHPAC® and TOXECON™ applications target a higher, more economical design between 5 and 8 ft/min.

Cleaning Modes – Pulse-jet fabric filters are generally cleaned with either "online" or "offline" cleaning. In either case, cleaning is usually initiated when a predetermined pressure drop or drag set point is reached. In the case of offline cleaning, when the setpoint is reached, inlet and/or outlet dampers close, isolating a single compartment. This compartment is then systematically pulsed, row-by-row, until it has been entirely cleaned. The isolating dampers are then opened and flue gas reenters the compartment. In the case of online cleaning, when the setpoint is reached single rows are cleaned around the various compartments without any isolation. Because flue gas continues to flow through the bags being cleaned during online cleaning, the degree of cleaning is reduced. The benefits of online cleaning are that there is not a pressure spike (from isolating a compartment) and there is not a sudden very clean area in the fabric filter. When a compartment is cleaned offline, it creates a "hole" in the fabric filter, which can temporarily reduce particulate control and potentially mercury control.

Executive Summary

This document provides a summary of the performance and economics of the demonstration project *"TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers"* that was completed on September 30, 2009. This U.S. Department of Energy (DOE) Clean Coal Power Initiative (CCPI) project was based on a cooperative agreement between We Energies and the DOE Office of Fossil Energy's National Energy Technology Laboratory (NETL) to design, install, evaluate, and demonstrate the EPRI-patented TOXECON™ air pollution control process. Project partners included Cummins & Barnard, ADA Environmental Solutions (ADA-ES), and the Electric Power Research Institute (EPRI).

The primary goal of this project was to reduce mercury emissions from three 90-MW units that burn Powder River Basin (PRB) coal at the We Energies Presque Isle Power Plant in Marquette, Michigan. Additional goals were to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter emissions; allow reuse and sale of fly ash; advance commercialization of the technology; demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use at power plants; and demonstrate recovery of mercury from the sorbent.

The project was chosen for award in 2003 with Budget Period 1 taking place in 2004 and early 2005. Budget Period 2 of the project began in 2005 and came to a close in September 2009. Budget Period 1 included activities of project definition, design and engineering, prototype testing, major equipment procurement, and foundation installation. Budget Period 2 activities included CEMs demonstration, TOXECON™ erection, TOXECON™ operation, and carbon ash management demonstration.

Technology Overview

We Energies and the project team designed, installed, evaluated, and operated an integrated emissions control system for mercury and particulate matter that treated the flue gases of three 90-MW subbituminous coal-fired units. This was the first commercial full-scale TOXECON™ demonstration using activated carbon injection (ACI) for mercury removal.

TOXECON™ is an EPRI-patented process (U.S. Patent 5505766) for removing pollutants from combustion flue gas by injecting sorbent between an existing particulate collector and a fabric filter (baghouse) installed downstream for control of toxic species. At Presque Isle, the existing collectors are hot-side electrostatic precipitators (HESPs). The TOXECON™ configuration, shown in Figure 1, allows for separate treatment or disposal of the ash collected in the hot-side ESP (99% or greater) and the ash/sorbent collected in the TOXECON™ baghouse.

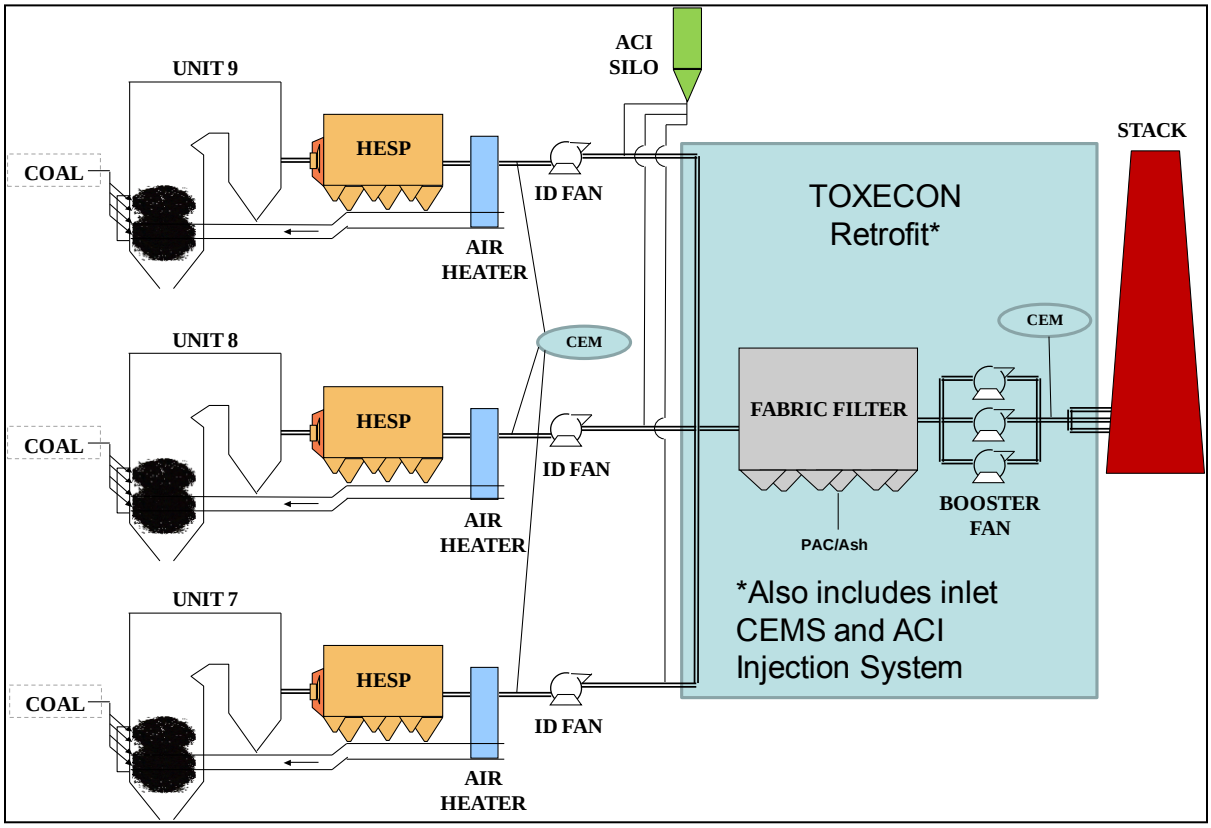


Figure 1. Process Flow Diagram.

The TOXECON™ system at Presque Isle consists of a modification of the flue gas ductwork from each of the three units into a single duct that leads to the new baghouse. A single duct exits the baghouse and is then split into three individual ducts, each with a new booster fan. The ducts exiting the booster fans are then recombined into a single duct back to the existing stack where the combined duct is again separated into three branches that supply the three existing individual unit stack flues. The design condition for the combined three-unit flue

gas system flow is 1,200,000 acfm @ 350 °F with approximately 14" w.c. of pressure drop between the exit of the ID fan discharges to the stack.

Also included in the TOXECON™ system are the powdered activated carbon (PAC) storage silo and injection system, and a new ash storage silo and ash unloading system for the PAC/ash collected in the baghouse.

Design and Engineering Considerations

A full evaluation of the commercial potential of TOXECON™ required long-term data on an installation that was specifically designed for both sorbent injection for mercury control and increased particulate control. The installation also needed to have the flexibility to handle variability in particulate loading due to mercury control parametric and optimization testing, as well as increased loading from injecting sodium sorbents for the SO_2 reduction tests. The design specifications for the pulse-jet style baghouse are listed in Table 1.

Table 1. Baghouse Design Specifications.

Item	Specification
Total Compartments	10
Bags per Compartment	648
Total Bags in Baghouse	6480
Air-to-Cloth Ratio (gross)	5.2
Design Gas Volume	1,200,000 acfm
Cleaning Method	On-line

The bag fabric chosen was 18 oz/yd^2, 2.7 denier PPS (polyphenylene sulfide fiber) felt. The bags were 26 feet long and 5 inches in diameter. Several test bags made from newer materials were also installed and tested throughout the demonstration project.

Norit Americas DARCO® Hg and Hg-LH were the two primary sorbents tested during the project. The activated carbon injection (ACI) system installed was designed by ADA-ES and equipment was provided by Norit Americas. The design injection rate was 216 lb/hr

(3 lb/MMacf total) and there were three injection trains (one per duct upstream of where the inlet ducts combined). The maximum capacity of the injection system was 600 lb/hr. The silo storage capacity was 4,490 cu ft. Several other experimental and/or imported carbons from Norit and ADA-ES were also tested full-scale using temporary injection equipment.

In addition to the baghouse and PAC injection equipment, balance-of-plant design considerations were addressed. These include booster fans, compressed air system, ash handling system, ductwork, electrical, and instrumentation and controls. A task in the project was devoted to advancing a monitoring system that would reliably measure mercury in flue gas from coal-fired power plants. Design considerations for the mercury continuous emissions monitors, including reporting and monitoring needs were also included.

Commercialization Potential

This demonstration confirmed that TOXECON™ is a viable option for obtaining high, consistent mercury removal. This technology can be applied to either new plants or retrofit applications. Capital and installation costs for this project were relatively high ($34.6 million). This installation was a retrofit application which represents higher costs than would be required for a new plant application. However, it is felt that new plant applications of the TOXECON™ technology as demonstrated at this site are unlikely. This is because hot-side ESP installations on units burning PRB coal are no longer being considered. It is expected that additional retrofits using TOXECON™ technology will continue.

Equipment and Installation Costs

The costs of equipment and installation for the TOXECON™ and balance-of-plant systems were $34.6 million, including the engineering effort. The cost of the additions and modifications after construction were $413,500.

Conclusions

The specific objectives of this project were to demonstrate the operation of the TOXECON™ multi-pollutant control system and achieve the following:

- *90% mercury removal from flue gas through activated carbon injection (ACI).*
  - This objective was met during 30 of the 34 months of long-term testing. One of the months that did not meet the criteria was due to alternative PAC testing, which bypassed the main PAC injection equipment. The other three months did not meet the criteria due to operational issues with the outlet CEM.
- *Evaluation of the potential for 70% SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection.*
  - The goal of 70% SO_2 removal was achieved during short-term tests when injecting 5926 lb/hr of trona. This corresponds to an average normalized stoichiometric ratio (NSR) of 1.02. The highest removal was 74.1% with PAC injection at 3.8 lb/MMacf.
  - There was very little reduction in NO_x during the test period. In addition, the effect of a side reaction, where NO is oxidized to produce NO_2, was observed on one test day when PAC injection was turned off. This indicates that there is some conversion of NO to NO_2. The NO_2 level from the conversion was high enough to be visible and cause an increase in opacity of almost 3%. On days with simultaneous injection of PAC and sodium sorbents, the opacity increased by a maximum of 0.75% with no visible plume.
  - Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. This effect was seen whenever trona was injected. When trona injection was discontinued, mercury removal slowly recovered over a ten-hour period to the pre-test level of > 90%. On the last two days of testing, PAC injection was increased to attempt to regain the > 90% removal rate. Test conditions and schedule did not allow sufficient time to achieve this target rate while injecting trona. An estimate of the required PAC is 3X the pre-trona test rate.

- *Reduced PM emission through collection by the TOXECON™ baghouse*
  - The main long-term co-benefit of the TOXECON™ process was the reduction in particulate matter (PM) emissions. With full-load conditions and all three units directed to the baghouse, the inlet particulate flow was 117 lb/hr and outlet flow was 17 lb/hr, which was an 85% reduction. The inlet particulates consisted of small ash particles that exited the main HESPs.
- *Recovery of 90% of the mercury captured in the sorbent*
  - Two thermal desorption methods were successful in removing mercury from the TOXECON™ PAC/ash material. The first method utilized the "air slide" technology patented by We Energies and licensed by United E & E. This is a patented technology (U.S. Patent 7217401, Mercury Removal from Activated Carbon and/or Fly Ash). Sorbent and/or fly ash with affixed mercury compounds is exposed to heated flowing air until the sorbent reaches a temperature of at least 700 ºF (372 ºC).
  - The second technology used microwave energy to selectively heat the PAC particles, thereby saving on energy costs. This technology was demonstrated under this project by UP Steel.
  - In addition, ADA-ES developed a new approach to using PAC-containing ash for structural concrete. This method utilized the combination of a specific batch design (developed by ADA-ES) with a foam-based AEA that was modified specifically for this application (developed by Miracon™ Technologies, Inc.). This combined technology was tested on concrete mixtures with ash containing < 1% to as much as 30% LOI from PAC. A successful field demonstration using 30% LOI ash to make a large concrete pad at the Presque Isle plant was completed in June 2009. Leaching tests on concrete samples showed a reduction in leached mercury and chromium from the high-PAC samples, although all samples were well below the TCLP reporting criteria. All samples showed that only a very small amount of bromide was leachable.

- *100% availability for utilization of fly ash collected in the existing electrostatic precipitator.*
  - Throughout the demonstration project, the ash from the existing ESPs was not affected by the TOXECON™ process, resulting in 100% beneficial utilization.
- *Demonstration of a reliable, accurate mercury CEMS suitable for use in the power plant environment.*
  - At the beginning of the CCPI project, several mercury analyzers were commercially available for ambient and laboratory mercury measurements but they were not designed to operate in a power plant environment in an automated fashion to produce reliable and accurate data continuously over long periods of time. In December 2005, two commercial Thermo Mercury Freedom™ CEMs were installed at the inlet and outlet of the baghouse. These systems were monitored remotely and provided mercury removal data for the demonstration project.
- *Successful system integration and optimization of TOXECON™ operation for mercury and multi-pollutant control.*
  - The TOXECON™ baghouse and associated equipment was successfully integrated into plant operations. The equipment and operation of the system were upgraded and optimized during the demonstration project.

In addition to successfully meeting the objectives of the project, several other issues were addressed on this project. Early in the testing phase of the project, hopper fires occurred due to auto-ignition of the PAC/ash mixture. After extensive laboratory testing to understand the mechanism and operational changes at the plant, several recommendations were made to help minimize the risk of overheating high carbon ash in hoppers.

1.0 INTRODUCTION

1.1 Purpose of the Project Performance and Economics Report

This Project Performance and Economics Report provides non-proprietary information on the performance and economics of the TOXECON™ air pollution control system installed at the We Energies Presque Isle Power Plant (PIPP) located in Marquette, Michigan, under U.S. Department of Energy Cooperative Agreement No. DE-FC26-04NT41766. This report describes the design, construction, performance, and economics of the TOXECON™ multi-pollutant system. This is the first of two final documents describing the installation at PIPP. The second document is the Final Public Design Report.

1.2 Overview of the Project

The project described in this report was conducted under the Department of Energy's (DOE) Clean Coal Power Initiative (CCPI). CCPI is an industry/government cost-shared partnership to implement clean coal technologies.

CCPI was initiated in 2002 with a goal of accelerating commercial deployment of advanced technologies to ensure the United States has clean, reliable, and affordable electricity. CCPI builds upon the advancements made by previous and continuing clean coal research and ensures the ongoing development of advanced systems for commercial power production.

1.2.1 Background and History of the Technology

1.2.1.1 Full-Scale TOXECON™ Testing at E.C. Gaston Station Unit 3

DOE/NETL began supporting full-scale evaluations of sorbent injection for mercury control in 2000. The first site tested in 2001 was Alabama Power's E.C. Gaston Station (Gaston) Unit 3 (Bustard, et al., 2001). In this short-term test, activated carbon was injected upstream of a compact hybrid particulate collector (COHPAC®) fabric filter. COHPAC®, also an EPRI technology, is a fabric filter installed downstream of the existing particulate control device and is used to capture particles escaping from the primary particulate control device; however, with COHPAC® there is no sorbent injection for control of toxic species. Although this unit was designed as a COHPAC® fabric filter, when ACI was added, the test was

actually similar to the TOXECON™ configuration. Detailed results of the test program are in Appendix A.

1.2.1.1.1 Gaston Test Description

Figure 1-1 presents the results from parametric tests, which evaluated mercury removal at different PAC concentrations. The tests showed that 90% mercury removal could be achieved at relatively low injection concentrations (< 3 lb/MMacf); however, they also showed that baghouse cleaning frequency increased proportionally with injection rate.

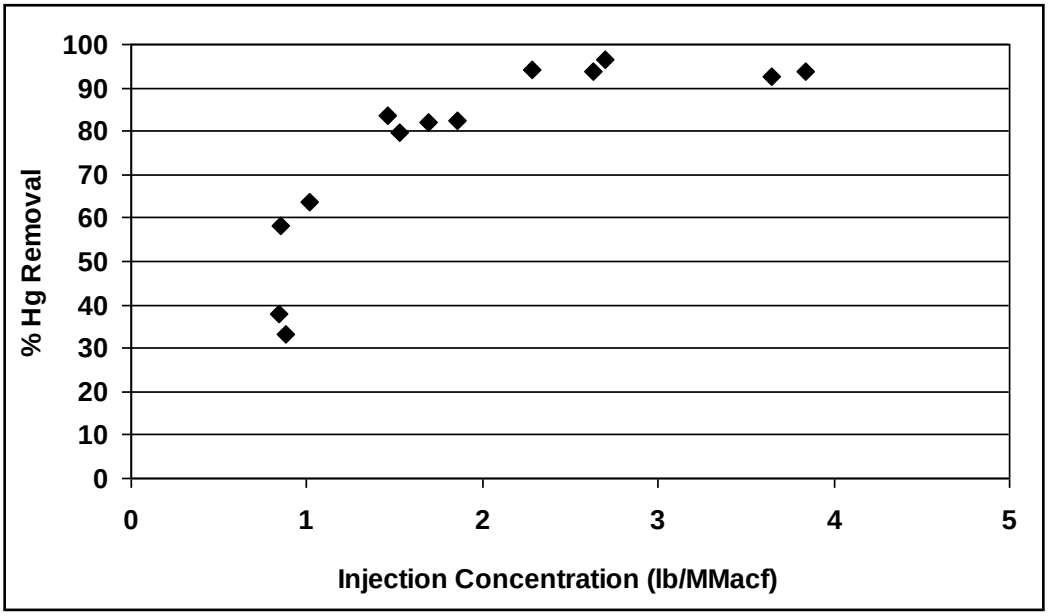


Figure 1-1. Mercury Removal with ACI Upstream of COHPAC® at Gaston, 2001.

The results from this 2001 field test program at Gaston provided a good indication of the capability (high mercury removal) and limitations (high cleaning frequency) of the COHPAC® configuration modified as a TOXECON™ configuration for controlling mercury. However, the tests were performed for a limited amount of time (< 200 hours of continuous operation) and did not allow for a thorough operational analysis of the use of this technology for mercury control. The tests also suggested that designing the baghouse for a lower air-to-cloth (A/C) ratio might allow carbon injection at a rate consistent with high removals without excessive pressure drop or excessive cleaning frequency.

In the fall of 2002, NETL selected ADA Environmental Solutions (ADA-ES) to conduct a long-term evaluation of ACI into the COHPAC® fabric filter at Gaston (Berry, et al., 2004). The overall objectives of this yearlong mercury control program were to assess the operational impacts to COHPAC® and the ability to effectively control mercury over varying operational and seasonal conditions.

The test program was designed with three test periods plus a short-term test evaluating performance at a lower A/C ratio. The purpose of each test is described below:

1. Baseline: Testing in this period was dedicated to understanding fabric filter operation and mercury removal with no carbon injection.
2. Optimization: The tests in 2001 showed that carbon injection directly impacted fabric filter cleaning frequency (Bustard, et al., 2001). This period was included to find a carbon injection scheme that achieved the highest mercury removal within the operational limits of the system.
3. Long-Term Testing: Operate continuously at optimized injection conditions.
4. Low A/C Test: Obtain operating data at an A/C ratio deemed appropriate for a TOXECON™ fabric filter.

1.2.1.1.2 Gaston Test Results and Conclusions

During baseline and parametric testing, the particle loading and LOI of the ash were highly variable. There were times during baseline testing when the fabric filter was cleaning continuously at 4.4 p/b/h. In this second round of tests, mercury removal varied between 0 and 90%, and was dependent on inlet mass loading.

Because of the highly variable baseline conditions and the already poor performance of the fabric filter, the ability to inject activated carbon was severely limited. To overcome this, an injection scheme was implemented that balanced the need to decrease carbon injection during times when inlet loading to the fabric filter was high and increase carbon injection when inlet loading and mercury removal were low. When inlet loading was higher, between 0.07 and 0.14 gr/acf, the injection rate was lowered to 10 lb/hr (0.35 lb/MMacf). When inlet loading

was greater than 0.14 gr/acf, the baghouse was often in a state of continuous cleaning and carbon injection was turned off. Removal efficiency was not significantly impacted at the lower ACI rates because the natural LOI loading and subsequent mercury removal efficiency were higher.

During long-term testing, inlet mass loading varied from 0.03 gr/acf to 0.19 gr/acf and carbon injection concentration was adjusted to adjust to these changes. For most of this period the baghouse was in continuous clean, even when carbon injection was turned off. For a four-month period the average inlet mercury concentration was 14.3 $\mu g/Nm^3$, with daily average concentrations varying between nominally 5.1 to 25.6 $\mu g/Nm^3$. The average outlet mercury concentration for the same period was 2.1 $\mu g/Nm^3$, with daily average concentrations varying between 0.24 and 6.2 $\mu g/Nm^3$. Average mercury removal was 85.6%, with a minimum daily average of 63.5% and a maximum daily average of 98.1%. The maximum carbon injection concentration was 0.66 lb/MMacf, and at times carbon injection was turned off. The average injection concentration was 0.55 lb/MMacf, which was much lower than what was needed in the 2001 test to obtain similar removal efficiencies (Bustard, et al., 2001).

One thing that was clear from these tests was that the A/C ratio was too high to inject sufficient carbon to achieve 90% mercury control. A new TOXECON™ baghouse would have to be designed at a lower A/C ratio. One way to overcome the operating limitations at this site was to operate at low load/lower flow for an extended period. While at these conditions, carbon injection could be increased and performance data could be tracked. The primary objectives of these short tests were to 1) determine the injection concentration necessary to achieve 90% removal, and 2) determine the impact of carbon injection on cleaning frequency at this lower A/C ratio. An educated estimate of the ideal A/C ratio was about 6.0 ft/min.

Alabama Power was able to schedule an extended period of low load operation for Gaston Unit 3. Full load at Gaston was nominally 270 MW. The flow rate was split into two baghouses so that at full load the flow into 3B baghouse is nominally 520,000 acfm. In

November 2003, Unit 3 was operated at 195 MW for a 72-hour block of time. ADA-ES measured the flow rate into Unit 3B at 375,000 acfm using a mass flow meter.

The results from this test, including inlet and outlet mercury concentrations, mercury removal, and cleaning frequency are presented in Table 1-1. At an injection concentration of 0.9 lb/MMacf, mercury removal was between 80 and 90%. When injection concentration was increased above 2 lb/MMacf, mercury removal was well above 90%, and there were no episodes when the removal dropped below this level. Cleaning frequency was acceptable at all injection rates during these short duration tests (baghouse pressure drops normally increase over long operational periods requiring increased cleaning frequency).

Table 1-1. Results Summary from Gaston Low Load Tests, November 2003.

Injection Rate (lb/hr)	Injection Concentration (lb/MMacf)	Inlet Hg Concentration (µg/Nm^3)	Outlet Hg Concentration (µg/Nm^3)	Removal Efficiency (%)	Cleaning Frequency (pulses/bag/hr)
20	0.9	20.6	3.2	84.2	0.6
45[a]	2.0	22.2	1.0	94.6	0.8
70	3.3	21.4	0.61	97.1	1.4

a. The last 18-hour time period of 45 lb/hr test.

The results of the tests performed at Gaston showed that activated carbon injection in a COHPAC® baghouse could remove particulate and up to 90% of the mercury in the flue gas streams. Testing the existing COHPAC® unit provided inferences as to the TOXECON™ concept viability at full scale, but was not flexible enough to provide the information needed to assess a full-scale, commercial installation. The Gaston tests were not sufficient to evaluate the commercial potential due to the size of the COHPAC® unit, which was designed to filter only the particulate loading from the HESP unit and not additional sorbent particles, which is the TOXECON™ contribution. However, Gaston testing provided valuable information in designing the full-scale TOXECON™ unit, such as a maximum A/C ratio of 6, desired carbon injection rate, etc.

Over the years, EPRI has conducted numerous pilot- and bench-scale tests of TOXECON™ (Sjostrom, et al., 2002). Figure 1-2 summarizes results from these tests showing mercury

removal trends on both bituminous and PRB coals. Since no full-scale COHPAC® or TOXECON™ fabric filters existed on units firing PRB coals, the best data available to predict performance at Presque Isle were shown in this Figure. Both trends indicated that high mercury removal, 90%, can be achieved with an injection concentration less than 3 lb/MMacf.

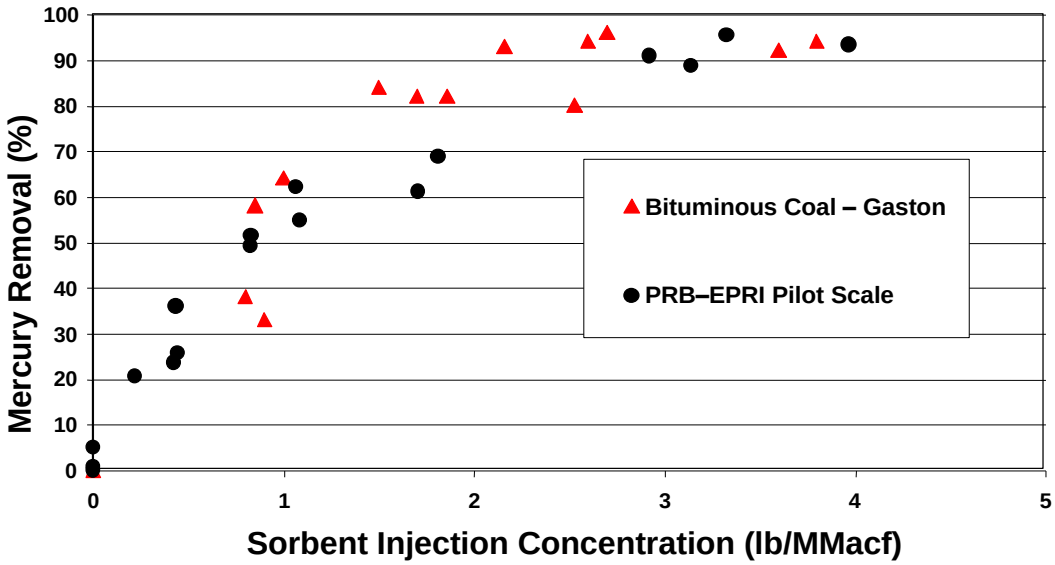


Figure 1-2. Mercury Removal in TOXECON™ Tests on Bituminous and PRB Coals.

1.2.2 Project Organization

The project team included We Energies, ADA-ES, Cummins & Barnard (C&B), and the Electric Power Research Institute (EPRI). We Energies provided and operated the demonstration site, as well as provided project management, environmental permitting, and reporting. ADA-ES was the project management interface with DOE's National Energy Technology Laboratory (NETL), and was responsible for design of the mercury control system, design of the mercury monitoring system, demonstration testing of the overall process, and reporting. Wheelabrator was responsible for the design and construction of the baghouse, support of baghouse installation, and provided startup support under a subcontract to We Energies. C&B provided architect and engineering services, construction management, design and specification of equipment, equipment installation, and startup training for plant operators. EPRI provided technical advice to We Energies. Figure 1-3 is a simplified organizational chart for the project.

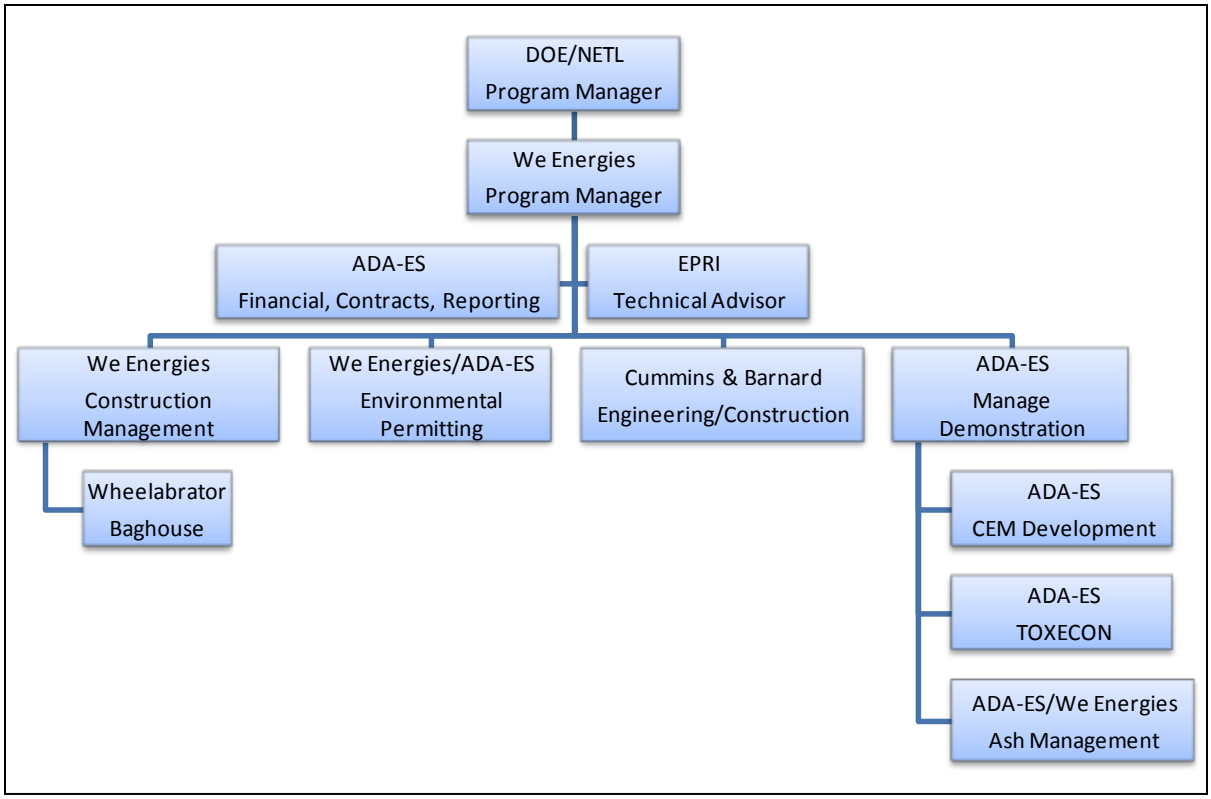


Figure 1-3. Organizational Chart.

1.2.3 Project Description

We Energies and the project team designed, installed, evaluated, and operated an integrated emissions control system for mercury and particulate matter that treated the flue gases of three 90-MW subbituminous coal-fired units. This was the first commercial full-scale TOXECON™ demonstration using activated carbon injection (ACI) for mercury removal. TOXECON™ is an EPRI-patented process (U.S. Patent 5505766) for removing pollutants from combustion flue gas by injecting sorbent in between an existing particulate collector (at Presque Isle, the existing collectors are hot-side electrostatic precipitators) and a new fabric filter (baghouse) installed downstream of the existing collector for control of toxic species. The TOXECON™ configuration, shown in Figure 1-4, allows for separate treatment or disposal of the ash collected in the hot-side ESP (99% or greater) and the ash/sorbent collected in the TOXECON™ baghouse.

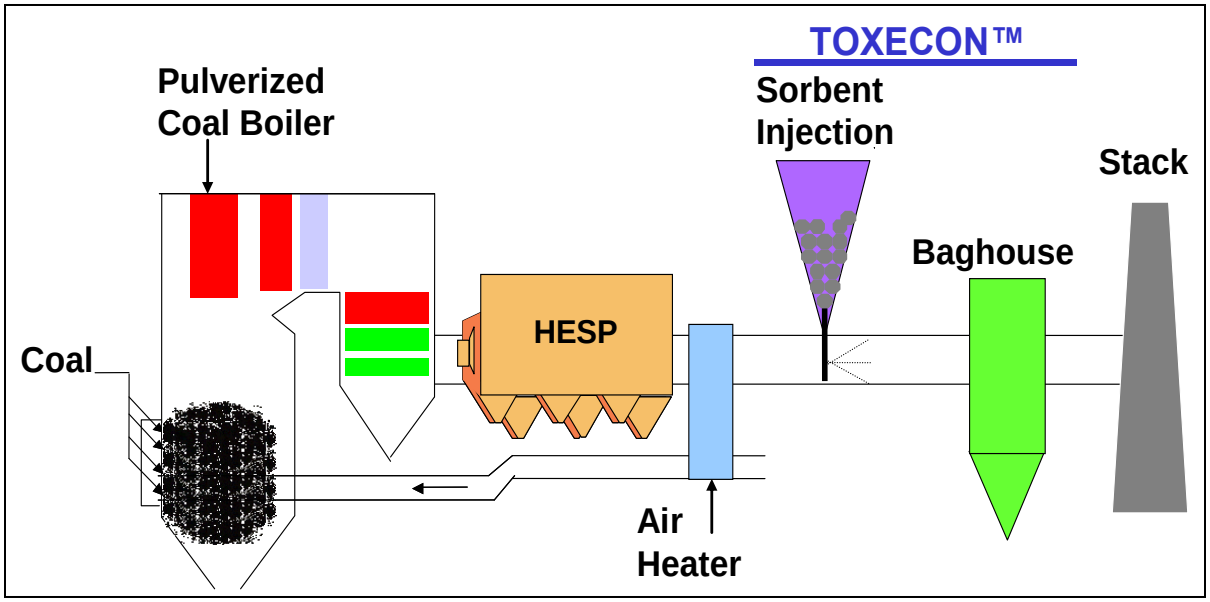


Figure 1-4. TOXECON™ Configuration.

The project advanced the ancillary processes that are significant to mercury control, such as mercury measurement technology and waste minimization. As a secondary priority, the project also investigated SO_2 and NO_x control after mercury control issues had been addressed.

1.2.4 Project Location

The project took place at We Energies' Presque Isle Power Plant (PIPP) located in Marquette, Michigan. PIPP had nine boilers and this project applied to Units 7, 8, and 9. These three units were 90-MW boilers with an individual hot-side electrostatic precipitator (HESP) as the primary particulate matter (PM) control device. The exhausts from the three HESPs were ducted into individual flues of a common stack. The project involved controlling the emissions from the three units using a single baghouse. Integrating the three units into one project and structure provided significant cost savings over treating the units separately, and optimized the use of space.

The TOXECON™ process was ideal for PIPP because the existing HESP exhausts benefitted from the additional PM control, especially during startup and shutdown. Also, the existing HESPs used for PM control did not have the ability to remove mercury from the flue gas, and injection of powdered activated carbon (PAC) into these HESPs was not feasible due to the

high flue gas temperatures. The TOXECON™ process also allowed We Energies to continue to sell its fly ash from the HESPs because the carbon was injected downstream of these units.

The PIPP Units 7, 8, and 9 were placed in service in 1978, 1978, and 1979 respectively by Upper Peninsula Power Company to meet the needs of Cleveland–Cliffs Iron Co. Wisconsin Electric purchased the plant in 1988. The boilers were Riley Turbo units rated for a maximum continuous capacity of 615,000 lb/hr steam flow at 1625 psig superheater outlet pressure and 1005 ºF. Reheater steam flow was 555,000 lb/hr at 390 psig and 1005 ºF. Each unit was fired by two 10’ x 13’ Riley Ball Tube Mills and Directional Flame Burners.

The precipitators were designed and built by Joy-Western and were designed as HESPs with an operating range of 565–745 ºF. The units were two chambers wide and were weighted wire units consisting of six mechanical fields per chamber and twelve electrical frames, six per chamber powered by six full wave T/Rs. The units were designed to collect fly ash from a pulverized coal boiler with a gross rating of 93 MW and a design gas volumetric flow rate of 530,000 acfm. The design collection efficiency was 99.20%.

The combustion process was controlled by an Emerson Distributed Control System (EDS) with a Smart “Combustion Optimization” software package to optimize NO_x and Loss on Ignition (LOI).

PIPP burns Powder River Basin (PRB) subbituminous coal in Units 7–9. Table 1-2 provides an analysis of this fuel. Analysis of the coal sampled at PIPP in 2001 showed a mercury concentration of 0.046 µg/g. PRB coal was supplied by several mines in Wyoming and Montana (dependent on the price of the fuel) and shipped by rail to Superior, Wisconsin, where it was then loaded onto a lake boat for delivery to the PIPP.

Table 1-2. Compositional Analysis of Subbituminous Coal Used at PIPP.

Characteristic	Typical Value (as-received)
Higher Heating Value, Btu/lb	9,052
Analysis, percent by weight	
Moisture	25.85
Carbon	52.49
Hydrogen	3.65
Nitrogen	0.75
Sulfur	0.28
Ash	4.64
Oxygen	12.33
Chlorine	0.01

Typical flow rates and gas components in the flue gas exiting the HESPs of Units 7–9 are shown in Table 1-3.

Table 1-3. Flue Gas Composition Downstream of HESPs in Flues 7, 8, and 9 at PIPP.

Characteristic	Flue 7	Flue 8	Flue 9
Gas Volumetric Flow Rate, acfm	377,719	375,014	335,439
Average Gas Temperature, ºF	364.6	344.8	366.6
Flue Gas Moisture, % by volume	12.1	13.3	12.7
Average % CO_2 by volume, dry basis	12.8	13.0	13.0
Average % O_2 by volume, dry basis	6.2	6.0	6.0
Filterable PM, lb/hr	15.13	9.99	20.35
NO_x, lb/hr	407.8	410.5	406.8
SO_2, lb/hr	461.9	464.7	474.7
Mercury, ppm dry (Average Units 7–9)	0.062	0.062	0.062

1.2.5 Project Schedule

The project was chosen for award in 2003 with Budget Period 1 taking place in 2004 and early 2005. Budget Period 2 of the project began in 2005 and came to a close in September

2009. Budget Period 1 included activities of project definition, design & engineering, prototype testing, major equipment procurement, and foundation installation. Budget Period 2 activities included CEMS demonstration, TOXECON™ erection, TOXECON™ operation, and carbon ash management demonstration.

1.3 Objectives of the Project

The primary goal of this project was to reduce mercury emissions from three 90-MW units at the We Energies Presque Isle Power Plant. Additional objectives were to reduce NO_x, SO_2, and particulate matter (PM) emissions; allow for reuse and sale of fly ash; develop and demonstrate a reliable mercury CEMS suitable for use in the power plant environment; and demonstrate methods for sorbent regeneration and/or by-product reuse. This demonstration provided for the use of a novel multi-pollutant control system to reduce emissions of mercury and other air pollutants while minimizing waste, from a coal-fired power generation system.

The specific objectives of this project were to demonstrate the operation of the TOXECON™ multi-pollutant control system and achieve:

- 90% mercury removal from flue gas through ACI.
- Evaluation of the potential for 70% SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection.
- Reduced PM emission through collection by the TOXECON™ baghouse,
- Recovery of 90% of the mercury captured in the sorbent.
- 100% availability for utilization of fly ash collected in the existing electrostatic precipitator.
- Demonstration of a reliable, accurate mercury CEMS suitable for use in the power plant environment.
- Successful system integration and optimization of TOXECON™ operation for mercury and multi-pollutant control.

1.4 Significance of the Project

The CCPI demonstration of the TOXECON™ process was important to the industry because it provided long-term operational experience directly applicable to power plants that burn western subbituminous coal. With its proven ability to reduce mercury emissions, the process offers a significant benefit to operators of subbituminous-fueled units in that mercury in flue gas produced by these units exists primarily in the elemental vapor form that is insoluble in water and, as such, will pass through most types of other air pollution control devices. As a result of this project the TOXECON™ process is in the position to become a leading mercury control choice for western coals, especially for units that use a HESP.

A primary benefit of this project was the long-term demonstration of 90% mercury removal from the stack emissions. The project also demonstrated emission control of particulate matter and sulfur dioxide. In addition, the process is able to maintain the beneficial use of fly ash as a concrete additive.

A very important additional benefit has been identifying and solving the technical hurdles as they were discovered. One of the most notable issues was the overheating and autoignition of the high carbon ash in the baghouse hoppers. The subsequent investigation into the mechanism and development of operational guidelines has proven to be useful to other utilities using the TOXECON™ configuration. Optimization testing also provided important data on reducing sorbent costs and maximizing the life of the bags in the baghouse.

The project was able to significantly reduce the rate of carbon injection needed for achieving an average 90% mercury removal rate. The results of numerous test runs pointed out the importance of various factors that impacted mercury removal efficiency. These factors included the temperature of the flue gas, the amount of time PAC remained on the bags, the amount of PAC on the bags, and the amount of carbon in the fly ash. The result led to a revised control scheme for cleaning the baghouse that reduced operating costs while not impacting emissions or maintenance costs.

1.5 DOE's Role in the Project

The TOXECON™ project is part of the DOE CCPI which is an industry/government cost-shared partnership. Under the CCPI the DOE provides up to 50% of the funding for the projects. The total cost for this project was just under $48 million with the DOE contributing about $24 million and industry contributing about $24 million.

In 2003, a management plan was prepared to provide a suitable plan for use in tracking project progress at the task level using an Earned Value Management system. The management plan included final work breakdown structure, final statement of project objectives, schedule baseline, cost baseline, technology baseline, and management controls. As part of the management plan the DOE had oversight of the project while We Energies communicated project results to DOE to keep DOE fully informed of all aspects of the project. We Energies provided quarterly Technical Progress Reports summarizing technical progress, quarterly Cost Status Reports summarizing financial status, and quarterly Schedule Status Reports summarizing schedule status.

The extended project team, including the DOE, EPRI, We Energies and ADA-ES personnel participated in weekly phone meetings to coordinate project activities and to discuss relevant project management and technical issues on the project. In this way all participants including the DOE were able to provide value-added input to the success of the project.

2.0 TECHNOLOGY DESCRIPTION

2.1 Description of the Demonstrated Technology

Injecting a sorbent such as PAC into the flue gas represents one of the simplest and most thoroughly studied approaches to controlling mercury emissions from coal-fired boilers (Government Accountability Office, 2005). The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with attached mercury is then collected by the existing particle control device—either an electrostatic precipitator (ESP) or in the case of a TOXECON™ technology, a fabric filter. Over the past several years, the results from numerous full-scale evaluations of ACI for mercury removal indicate that activated carbon is a viable technology for mercury control on many coal-fired power plants (Durham, et al., 2003; Bustard, et al., 2001).

For some plants, one of the disadvantages of injecting activated carbon is its impact on the salability of ash for making concrete. Tests have shown that the activated carbon interferes with chemicals used in making concrete (Bustard, 2003). This has also been confirmed under the project described in this report. One straightforward, cost-effective approach to achieving high mercury removal without contaminating the fly ash is the use of the EPRI TOXECON™ process. With the TOXECON™ configuration, the ash collected upstream of the carbon injection remains acceptable for sale. The addition of a secondary fabric filter provides an effective mechanism for the activated carbon to have intimate contact with vapor-phase mercury, resulting in high levels of mercury control at relatively low sorbent injection rates.

The advantages of the TOXECON™ configuration are:

- Sorbents are mixed with a small fraction of the ash (the less than 1% that exits the primary PM device), which reduces the impact on ash reuse and waste disposal.
- Full-scale field tests have confirmed that fabric filters require significantly less sorbent than ESPs to achieve similar mercury removal efficiencies (Bustard, 2004). This was also confirmed on the CCPI project.

- Outage time can be significantly reduced with TOXECON™ systems in comparison to major ESP rebuilds/upgrades that might be required to handle the increased loading and greater collection difficulty of the injected carbon. Since the TOXECON™ unit is added downstream of the ESP, experience shows that it can be built, installed, and checked while the ESP is still in full operation, thus keeping outage time to a minimum.

Baghouse types include shaker-cleaned, reverse-air-cleaned, pulse-jet-cleaned, and sonic-cleaned. A pulse-jet-cleaned baghouse was chosen for this project. Pulse jet baghouses use fabric filtration media shaped like tubes called bags, which are usually 4–6 inches in diameter and 10 to 26 ft. long, to remove the particulate matter from the flue gas stream. The bags are mounted (hung) from a tube sheet and the gas stream flows from the outside of the bag through the bag, depositing particulate matter on the outside of the bag. The particulate matter is removed from the bag by a cleaning system that employs compressed air (systems are designed to use compressed air from 30–120 psig) to back flush the bags (McKenna, 1989).

One of the critical variables that affected mercury removal was flue gas temperature. Higher temperatures reduced the mercury loading on the PAC particles. Another critical variable was bag cleaning frequency. Once the PAC particles were at equilibrium with the mercury in the flue gas, removal of this older PAC from the bags resulted in better overall mercury removal because this prevented re-emission of mercury from these particles.

2.2 Description of the Demonstration Facilities

The TOXECON™ installation completed under this CCPI project consisted of equipment associated with: a 10-compartment baghouse for collecting sorbent and ash and the associated ductwork; a fan building; an ash silo with an upgraded wet unloading system; a PAC silo and injection lances; and two mercury CEMs for measuring mercury upstream and downstream of the baghouse (Figure 2-1). More detailed information on the installation can be found in the Public Design Report (We Energies, 2009).

Figure 2-1. Picture of the TOXECON™ Installation after Startup.

2.3 Proprietary Information

The results of full-scale injection of several proprietary sorbents provided by Norit and ADA-ES are given in this report, but the details of the sorbents themselves are proprietary. Under the Ash Management task, ADA-ES developed and tested a proprietary batch design used for making structural concrete containing high carbon ash. Proprietary chemicals supplied by Benetech were used in the trona injection testing.

2.4 Simplified Process Flow Diagram

Figure 2-2 is a process flow diagram showing the TOXECON™ retrofit equipment. The inlet CEM probes and lines were integrated into the three ducts upstream of the ID fans. The ACI lances were installed in each duct downstream of the ID fans and just before the ducts exit the building envelope. Mercury data was taken upstream of PAC injection and downstream of the baghouse, and occasionally, at the stack.

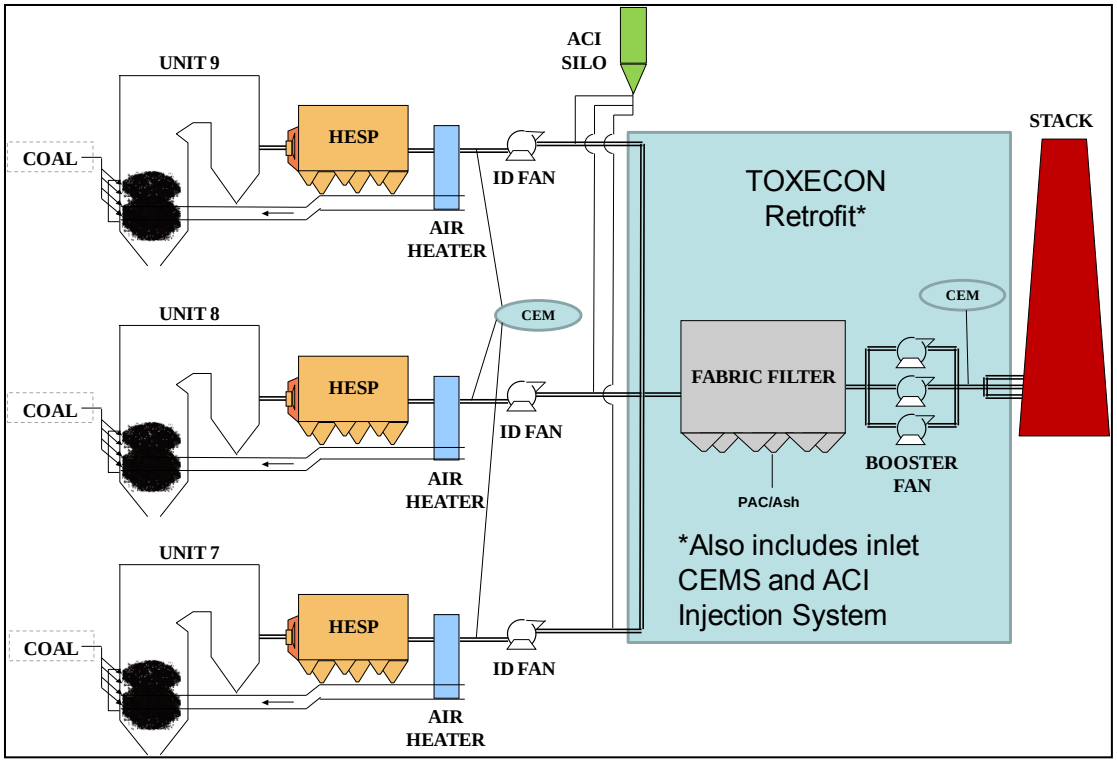


Figure 2-2. Process Flow Diagram.

2.5 Stream Data

Table 2-1 shows some of the process stream data for the TOXECON™ baghouse. Many stream components remained unchanged, such as gas flow rate and all major flue gas components. Mercury concentration in the flue gas was reduced by an average of 90%. Particulates were significantly reduced through the baghouse also. The flue gas temperature was reduced slightly as it passed through the baghouse. More detailed information can be found in the Public Design Report (We Energies, 2009).

Table 2-1. Stream Data at PIPP.

Stream Parameter	Baghouse Inlet	Baghouse Outlet	TOXECON™ Ash
Volumetric Flow Rate	1,200,000 acfm	1,200,000 acfm	-
Mercury Concentration	5.5–7.0 ug/m^3	< 1 ug/m^3	40–80 ppm
Temperature	320–375 ºF	5 ºF below inlet	-
Particulates	0.0116 gr/acf	0.0016 gr/acf	Approx. 200 lb/hr PAC/ash mixture
Loss on Ignition (LOI)	< 1%	-	40–50%

3.0 UPDATE OF THE PUBLIC DESIGN REPORT

3.1 Design and Equipment Changes

After the construction was complete and throughout the demonstration portion of the project, several modifications to the equipment and structures were required. Further details are given in the Final Public Design Report (We Energies, 2009).

3.1.1 Baghouse Modifications

Several modifications were incorporated to gain more optimal temperature control in the baghouse and booster fan building including: larger ventilation fans and louvered windows at the top of the baghouse; additional walls in the upper and lower baghouse areas to block flow of hot air from the fan building; addition of louvered windows at the booster fan inlet gate level and modified temperature controls; and additional walls and larger heaters in the lower baghouse area.

Additional modifications were added to improve structural integrity and maintenance access: The baghouse covers were rebuilt with checker plate and angle iron, and additional stiffeners were added across the width of the covers to improve strength; a redesigned lifting spreader for the covers was provided to keep from bending the covers when trying to open under negative pressure; platforms were added to access the booster fan outlet; and ice breaks were added to the top of the baghouse vent louvers.

3.1.2 Ash Handling System Modifications

Excessive dusting was occurring during the use of the wet unloading system, especially when starting the pin mixer. Several modifications were incorporated in to the original pin mixer. Finally, a larger pin mixer had to be installed because the modifications still did not allow for a dust-free unloading process. This helped to eliminate the dusting and equipment issues seen during the demonstration. The main differences between the original mixer and the new mixer were additional fogging and spray nozzles and the motor was increased from 7.5 HP to 10 HP, thereby increasing the mixer speed at 60 Hz motor frequency from 76 RPM to 100 RPM.

Additional modifications were made to improve flow of the PAC/ash mixture from the silo into the pin mixer: a new rotary valve was added to replace the original butterfly valve; and although fluidization at the silo discharge is normally not required, the original fluidization valves were replaced by three large air cannons.

Other modifications to improve operability of the ash unloading system were: a rubber skirt was added to the wet unloading spout to improve dust control; the sequencing of the exhauster and system relief valves was optimized to allow dust to be purged from the vacuum relief piping; and an extension to the unloading shelter to the east of the silo was installed, which reduced the wind tunneling effect and protected the area from other elements.

3.1.3 Ductwork Modifications

Two inches of insulation was added to the exterior of all expansion joints on the baghouse ductwork (approximately 28 places) to minimize corrosion due to flue gas condensation on cold spots in and around the joints.

3.1.4 Access Platform Additions

Four access platforms were added to the baghouse discharge ducts. Three platforms (one for each unit) were located underneath the ductwork at the 90° elbows just upstream of the diverter damper. The fourth additional platform was added on top of the Unit 8 ductwork to provide access to the baghouse.

3.2 Demonstration Plant Capital Cost Update

The cost of the additions and modifications after construction were $413,500.

3.3 Demonstration Plant Operating Costs Update

The operating costs for TOXECON™ were determined based on actual project expenditures associated with long-term, ongoing operation. This does not include costs associated with testing, technology demonstration, or other costs not directly related to standard utility

practice. These costs are in 2008 dollars and are summarized in Table 3-1. The operation is assumed to target an average 90% mercury removal level on a long-term basis.

Table 3-1. Summary of Operating and Maintenance Costs.

TOXECON™ Summary of Operating & Maintenance Costs				
Annual Fixed O&M Cost			**Cost, $/yr**	
Operating Labor			27,851	
Maintenance Labor			18,574	
Maintenance Material			255,719	
Administration/Support Labor			43,586	
Subtotal Annual Fixed O&M Cost			360,786	
Variable Operating Cost				
Commodity	**Unit**	**$/Unit**	**Qty/hr**	**Cost $/hr**
Powdered Activated Carbon	lb	1.009	72.80	73
Electric Power	kW	0.020	3000.00	60
Waste Disposal Charges	ton	81.500	0.07	11
Subtotal Annual Variable Cost				145

The startup of the TOXECON™ facility began on December 17, 2005, and was completed on February 12, 2006. The costs associated with this activity are shown in Table 3-2 and were $360,000 (based on year of occurrence dollars).

Table 3-2. Summary of Startup Costs.

TOXECON™ Summary of Startup Costs	
Description	**Cost**
Internal Labor	$50,563
Miscellaneous Expenses	$62,332
Contractor Support	$148,145
Electrical Power	$83,520
PAC	$33,004
Waste Disposal	$15,405
TOTAL	**$359,965**

4.0 DEMONSTRATION PROGRAM

BUDGET PERIOD 1

A pre-award kickoff meeting was held in Pittsburgh in February 2003. At this meeting, a Milestone Schedule with tasks that needed to be completed prior to contract award was distributed. A project conference call meeting was held on each Wednesday from March until September 2003, when all of the tasks were completed.

Between October 2003 and March 2004, when the Cooperative Agreement was signed, minimal work was performed on the project, with the exception of activities on Task 7.

After the contract was awarded in March 2004, all activities fell under one of nineteen tasks outlined in the statement of project objectives (SOPO). The following describes the status and activities conducted in each of the tasks in Budget Period 1.

4.1 Task 1: Design Review Meeting

A design review meetings was held June 21–22, 2004, at Cummins & Barnard's office in Ann Arbor, Michigan to discuss the project, system hardware components, costs, and schedules. The meeting was attended by We Energies, DOE, EPRI, ADA-ES, Cummins & Barnard, and CaTS (Cummins & Barnard's construction manager).

4.2 Task 2: Project Management Plan

The Project Management Plan was prepared and submitted to DOE on July 23, 2004. This Management Plan was updated based on information provided at the Design Review Meeting held under Task 1. The plan was used in tracking project progress at the task level using the earned value management system and included the following information.

- Final Work Breakdown Structure
- Final Statement of Project Objectives
- Schedule Baseline
- Cost Baseline

- Technology Baseline
- Management Control

4.3 Task 3: Provide NEPA Documentation, Environmental Approvals Documentation, and Regulatory Approval Documentation

An Environmental Assessment was prepared in compliance with the National Environmental Policy Act (NEPA) and submitted to DOE. DOE issued a Finding of No Significant Impact for this project in September 2003. This document can be obtained or questions answered by contacting Mr. Ralph P. Detwiler, NEPA Compliance Officer, U.S. DOE/NETL, at ralph.detwiler@netl.doe.gov.

4.4 Task 4: Balance-of-Plant (BOP) Engineering

In addition to the major process equipment, ductwork, and DCS systems, a substantial balance-of-plant (BOP) engineering and design effort was required. C&B was responsible for the BOP scope. This included the foundation design, civil and structural design, miscellaneous buildings, identification and relocation of below grade equipment, and evaluation of existing plant electrical systems. The BOP scope also included the design of required upgrades to accommodate new electrical loads, tie ins to plant water, service air and instrument air systems, design of necessary stiffening and reinforcement of boiler and ductwork, and expansion of miscellaneous plant subsystems such as fire suppression and intercoms. The BOP engineering and design scope included the following items:

- Demolition, excavation, underground utility relocation design
- Baghouse arrangement and plant equipment general arrangement design
- Foundation design
- Civil, structural, and ductwork design
- Baghouse and building enclosure design

- Mechanical design, including fans, ductwork, dampers, sorbent handling silo, and air compressors
- Electrical system study, motor control center (MCC) and electrical design
- Plant controls, instrumentation design and CEM integration design
- Piping and instrumentation diagrams, and piping design for activated carbon, water, air, sorbent/ash, and flue gas subsystems.
- Activated carbon injection skid systems design

In the second quarter of 2004 began preparations and issuances of the specifications for the baghouse procurement package, the ash silo and ash handling systems, dampers, and booster fans. Preparation of preliminary P&IDs also began in this quarter as did the development of preliminary general arrangements, ductwork and support steel design, and an electrical system load study.

Design work continued the third quarter of 2004 on the baghouse, fans, dampers, PAC system, ash handling system, and foundation design. Design work on isolation dampers, static mixer, and expansion joints was completed. The electrical systems load design work began just after the study completed this quarter. Design work of the air compressors and air dryers also began this quarter.

The baghouse vendor General Arrangement Drawings (GAs), flow diagrams, and single lines were all reviewed in the third quarter of 2004. The initial issue of C&B preparation of TOXECON™ project GAs was completed in August 2004. The equipment layout included the location of ash silo, the PAC equipment, fan room, electrical equipment, distributed control system (DCS) cabinets, and air compressor within the available site area for the project.

The additional electrical work included the specification for installing the CEMS from We Energies' Port Washington Power Plant, preparation of electrical single lines and preparation of the preliminary Load List. Control engineering work including DCS continued in the third

quarter of 2004 with the location of test ports, definition of I/O for the project, and defining field instrumentation requirements.

In the fourth quarter of 2004 design work continued on the baghouse, ash handling system, compressed air system, major foundations, ductwork, structural steel, auxiliary electrical systems, electrical equipment enclosure, and DCS I/O development. The additional electrical work continued this quarter with the preparation of the equipment specifications, upgrade of the 2.4 kV switchgear, and the bus work design. Control engineering design continued with DCS architecture definitions, definitions of I/O, defining field instrumentation, and logic for various systems. The electrical construction contract package specification began being developed this quarter to be sent out the following quarter. The balance-of-plant electrical system design also began in the fourth quarter of 2004.

Baghouse vendor drawings, booster fan vendor drawings, fly ash system vendor drawings, and damper vendor drawings were all reviewed this quarter.

The ductwork design and foundation design was completed the fourth quarter of 2004. The ductwork and baghouse model testing was completed. The foundation design for the booster fans, PAC silo, and ash silo was also completed this quarter. All of the major structural steel design was completed as well. Designs were completed and released for the construction drawings of superstructure foundations this quarter. The electrical equipment enclosure specification was completed as was the PAC system scope. Miscellaneous equipment pads, foundations, and steel design including landing platforms continued this quarter.

The superstructure construction contract package specification and drawings were completed and issued for bids in two packages in the first quarter of 2005. One package was for the erection of the ductwork under the baghouse, the second package was for all other superstructure work. Bids were evaluated and both contracts awarded to the same contractor. Design on ductwork expansion joints was completed as well and issued for bids, bids were evaluated, and a contract awarded all in this quarter. The PAC system scope of work and design was also finalized and fabrication began this quarter.

Booster fan vendor drawing reviews were completed. The design of the air compressor and air dryer were also completed and issued for bids, bids were evaluated, and a contract awarded this quarter. Miscellaneous steel designs including various platforms were completed, as well as miscellaneous steel equipment pads and foundations.

Electrical detail design was reviewed in the first quarter of 2005. The additional electrical work included evaluating and awarding the 2.4 kV switchgear, and 480V MCC contracts. Control engineering work regarding DCS finished with the definitions of I/O for the project, draft of logic, and defining required field instrumentation.

In the first quarter of 2005, the electrical system balance-of-plant design and 2.4 kV electrical system upgrade was complete as well as the preparation of the electrical construction package specification. Development of drawings and specification for the Balance-of-Plant Electrical Construction Package was also completed and issuance for bids required a significant effort in the electrical and instrumentation areas.

The following major construction contract packages were awarded during the first quarter of 2005:

- Superstructure Phase 1 ductwork erection: February 2005
- Superstructure Construction Package: March 2005

All remaining design work with in this task was completed by the beginning of the second quarter of 2005.

4.5 Task 5: Process Equipment Design and Major Equipment Procurement

Formal specifications and bid packages for the TOXECON™ technology were prepared under this task. C&B worked with We Energies to assure that contractor bids were evaluated fairly and that contractors met all We Energies requirements.

During the second quarter of 2004 the baghouse package was sent out for bid, four bidders responded and a detailed evaluation resulted in a baghouse vendor (Wheelabrator) being

selected. A limited notice to proceed was authorized by We Energies on June 23, 2004. Preparations and issuance of the specification for the baghouse procurement package was completed by C&B in this same quarter. By the third quarter of 2004 a review of the baghouse vendor General Arrangement Drawings (GAs), flow diagrams, and single lines was completed. In the fourth quarter of 2004 C&B reviewed the baghouse vendor drawings.

In the third quarter of 2004 the ID Booster Fan specifications were prepared and three bids were received, the contract was pre-awarded in September to Fläkt Woods for three fans. The foundation installation work was also awarded this quarter. With three bidders responding, the award was made in September to Boldt for the foundation work.

The Unit 7 tie-in damper work was issued in the third quarter of 2004 for bid. With three bidders responding, Jamar was awarded the contract for installation. Early delivery of the Unit 7 damper was required to take advantage of the outage at this time. This work was originally planned for Budget Period 2, but was allowed per agreement with DOE NETL to be conducted during Budget Period 1.

The ash silo and ash handling systems specification and drawings were prepared and issued for bid late in the second quarter of 2004, four bidders responded and the contract was awarded in September 2004. The DCS equipment contract was also awarded in September.

Design work continued in the third quarter of 2004 with the awards of the baghouse and selection of fan, damper, and ash handling suppliers. The structural steel and ductwork design was initiated this quarter. Ductwork and support steel designs, drawings, and bid packages were completed and sent out for bid in September 2004. Eight bids were received for structural steel fabrication and seven bids for ductwork and fan enclosure fabrication, bids were evaluated and contracts awarded to Merrill Iron and Steel for the ductwork and Cives Steel Company for the structural steel in December 2004.

The electrical equipment enclosure contract was issued for bid in the fourth quarter of 2004. Three bidders responded. The bids were evaluated and an award made to Atkinson Industries in December 2004.

The superstructure construction contract specification package and drawings were completed in the fourth quarter of 2004. Four bids were received and the contract was awarded to Jamar in the first quarter of 2005.

In the fourth quarter of 2004 the superstructure construction specification package and drawings, specification for air compressors and air dryer, ductwork expansion joint work, and equipment procurement packages for electrical motor control centers and the 2.4 kV switchgear fabrication were all completed and sent out for bid. The superstructure construction contract received 4 bids, and the contract was awarded in the first quarter of 2005. The ductwork expansion joints work was awarded in January of 2005, as was the PAC equipment contract which was awarded to Norit. The electrical 2.4 kV switchgear contract was awarded in February of 2005 as was the compressed air package contract, and the electrical reserve bus duct contract. The electrical 480V MCC contract was awarded in March 2005 as was the electrical medium voltage starter contract. In the final quarter of 2004 the submitted Wheelabrator Air Pollution Control (WAPC) drawings for the baghouse were reviewed. All remaining major work within this task was completed by the first quarter of 2005.

4.6 Task 6: Prepare Construction Plan

C&B developed a comprehensive plan that integrated all crucial activities required for an on-time completion of the design, procurement, construction, and startup phases of the project. Central to this was a detailed project plan and Primavera-type schedule with all critical path items and milestones identified.

Work on the construction plan and reports began in second quarter of 2004. A detailed schedule was developed along with a budget monitoring report to track construction progress. This work continued through fourth quarter of 2004. Work on the construction plan was completed in the same quarter. The final construction plan was issued in January 2005.

4.7 Task 7: Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment

4.7.1 Status of Mercury Emission Monitors in 2003

At the beginning of the CCPI project, several mercury analyzers were commercially available for ambient and laboratory mercury measurements but they were not designed to operate in a power plant environment in an automated fashion to produce reliable and accurate data continuously over long periods of time. Measuring mercury in the parts-per-billion level in flue gas created significant difficulties in extracting and sampling from the duct, eliminating sampling artifacts due to loss of vapor-phase mercury to particulate matter such as fly ash and carbon, conditioning the sample to provide a form acceptable to the analyzer, and transporting the sample to the analyzer.

In the early 1990s, DOE NETL provided funding to develop mercury analyzers for coal combustion flue gas. The efforts identified the difficulties associated with mercury measurement but also identified techniques to overcome the challenges. At the start of the CCPI project in 2003, there were no mercury CEMS available that had passed the EPA certification tests nor could be operated without full-time support from experienced technical staff.

4.7.2 ADA-ES Mercury Semi-Continuous Emission Monitors

ADA-ES designed and built several prototype mercury analyzers that had been used in the field evaluations conducted since the start of the CCPI project. The ADA-ES / Emissions Monitoring and Control (EMC) semi-continuous mercury analyzer consisted of a cold vapor atomic absorption (CVAA) spectrometer coupled with a gold amalgamation system. The mercury in the gas amalgamated with the gold in the trap as the flue gas from the duct was drawn through the analyzer. After the gold was allowed to collect mercury for a specific period of time, the gold was heated to more than 850 °F to desorb the mercury. The desorbed vapor-phase mercury passed through a detector cell where UV light from a mercury lamp was supplied. The UV energy absorbed by the mercury was then quantified to determine the concentration of mercury in the flue gas.

The collection and analysis of mercury with this technology was difficult at power plants that burned high-sulfur bituminous coal because the flue gas fouled the gold and reduced its effectiveness in capturing mercury. Several technologies from other companies were considered to replace the ADA-ES mercury analyzer but many of them used the same gold amalgamation technology that proved insufficient for widespread use within the U.S. coal-fired utility boiler market. Because of this limitation, ADA-ES decided to move away from gold amalgamation instruments and pursued other technologies.

We Energies and ADA-ES worked with commercial suppliers to advance the most current design of the mercury CEMS. Mercury analyzers were identified as a key component for the mercury process control required for this project but the technology did not exist in a form that could be practically integrated into a power plant control system. Under previous projects and through published test reports, it was proven that reliable data could be obtained with the semi-continuous emission monitor (SCEM) when it is maintained and manned by experienced personnel. Although reliable measurements were possible with this technology, the manpower effort required to operate and maintain the instruments available at that time was considered significant.

In order for a mercury CEMS or SCEM to be considered a commercial product, the instrument had to demonstrate that it could operate within a power plant environment in an automated fashion and produce reliable and accurate data continuously over a long period of time. To be successful in this endeavor, the development and demonstration of new components that reduced the maintenance effort and automated analyzer functions was required. The system had to be optimized for long-term operation and reliability, and the mercury CEMS package had to meet specifications similar to existing plant CEMS for other emissions, such as SO_2 and NO_x. A description of the requirements is as follows:

- Mercury Measurement – Several common methods could be used to measure mercury concentrations. Some of those methods included cold vapor atomic adsorption (CVAA), cold vapor atomic fluorescence (CVAF), and atomic emission spectroscopy (AES). Only elemental mercury could be measured with all of these technologies. All methods were effective as long as the sample was conditioned and did not contain any

moisture to interfere with the measurement technique. Some of the techniques required the mercury be concentrated using gold amalgamation and take place in an inert gas (argon). Other techniques were especially sensitive to SO_2 interference. The general capabilities and limitations of the different measurement options were assessed during the program.

- Calibration – The instrument had to be designed to check the calibration responses daily and be recalibrated if necessary. In order to be a commercially viable product, the calibration routine had to be an automated process that provided the entire sampling system and analyzer with zero gas and a known span gas. Several approaches to the calibration of the systems were considered, including permeation tubes, diffusion vials, cylinder gas samples, or headspace syringe samples.

- Sample Extraction – Mercury is present in flue gas as both a particulate and in vapor phase. The mercury analyzers that were commercially available only measured the vapor-phase mercury. Particulates had to be removed from the sample before the gas entered the measurement chamber. In order to minimize the contact between the mercury and the ash, it was recommended that a system based on inertial filters be used for mercury extraction.

- Conversion/Speciation – Vapor-phase mercury exists in the flue gas as elemental (Hg^0) or oxidized (Hg^{2+}). All mercury analyzers measure only elemental mercury. In order to measure the total mercury concentration in flue gas, the sample containing all forms of vapor-phase mercury had to pass through a converter in order to change all of the species of mercury into the elemental form. The most common method for converting the non-elemental fraction used wet chemistry with a reduction solution of stannous chloride in hydrochloric acid or sodium hydroxide. When the analyzer was allowed to measure both a non-converted sample and a converted sample, the difference between the two measurements represented the oxidized fraction in the flue gas. Wet chemistry was considered too labor intensive and messy. This required efforts to develop a dry-based catalytic converter for mercury analysis; however, in the early 2000s, no dry conversion system had been proven effective or reliable.

- Sample Transport – The sample had to be transported from the extraction probe to the mercury analyzer. The distance of transport could exceed several hundred feet. As mercury is transported over long distances, it is common for the oxidized mercury to "drop out" or become adsorbed on the inside of the transport tube. Other problems could occur, involving chemical interactions between the mercury and other flue gas components or simple dilution of the sample during transport. At the time of this project, heated PTFE lines had been used for flue gas mercury sample transport; these had been proven to be effective over short distances with flue gases produced by burning low-sulfur coals.

4.7.3 Thermo Electron Mercury System Description

ADA-ES began discussions with Thermo Electron Corporation (Thermo), a company that appeared to offer the best option for directly measuring mercury using atomic fluorescence. Thermo was willing to dedicate a large amount of resources toward the development and manufacture of a reliable mercury analyzer. To expedite the integration of the components and to assure that a CEMS would be ready by summer of 2005, ADA-ES teamed with Thermo to perform a field evaluation of its components.

Thermo approached the development of the Thermo Mercury CEMS by focusing on several key components to overcome the difficulty of measuring mercury in flue gas. Many of these components were already in the design phase at the start of the procurement process but others still required more research and development to prove fully functional components that were ready for commercial use. The initial objective of the development process was to determine the best technologies for mercury detection, conversion, extraction, and calibration by performing various lab and field evaluations.

- Mercury Measurement – The vapor-phase (elemental) mercury was measured directly in the analyzer using CVAFS, which was incorporated into the design of the mercury analyzer because of its increased sensitivity over other measurement technologies. This would be beneficial for a dilution-based extraction probe as well as for the anticipated low levels of mercury present in flue gas produced by coal-fired power plants. The sample was passed through the fluorescence chamber where UV light

from the mercury lamp excited the mercury atoms at a wavelength of 254 nm. As the excited mercury atoms returned to a ground state, the light emitted by the atoms was measured directly by the solar-blind photomultiplier tube. This direct measurement of reemitted UV light as the sample passed through the chamber allowed for continuous and real-time mercury concentration measurements.

- Mercury Calibrator – The calibrator module used a temperature-controlled saturated mercury vapor source to control the output concentration of elemental mercury used for calibration of the mercury CEMS. The calibrator adjusted the flow rates of the saturated mercury flow and mercury-free dilution air to emit the desired concentration of elemental mercury. The calibrator was developed using Peltier cooler/vapor pressure control and mass flow controllers. The calibrator could change the output concentration of elemental mercury by changing the flow rate of the mercury air and dilution air at a precise temperature and pressure. The calibrator had the functionality to send zero or span gas directly to the analyzer, to the sample port between the inertial filter and the critical orifice, or upstream of the inertial filter. The range of the calibrator was between 0.1 and 300 $\mu g/m^3$.

- Sample Extraction Probe – Because fly ash and other particulates could capture or convert vapor-phase mercury if present on a sampling filter upstream of a mercury measurements system, inertial separation probes were the best option to separate particulates from the gas sample while minimizing gas-particle interactions that could cause sampling artifacts. In addition, the design of the inertial filter and high-velocity movement of flue gas across the surface prevented ash and particle buildup on the filter. In January 2003, Thermo acquired Netherlands-based EPM Environmental, a supplier of dilution probe sampling systems for CEM applications. The acquisition was completed in order to secure the rights to an inertial filter dilution-based probe that could be used with the mercury CEMS.

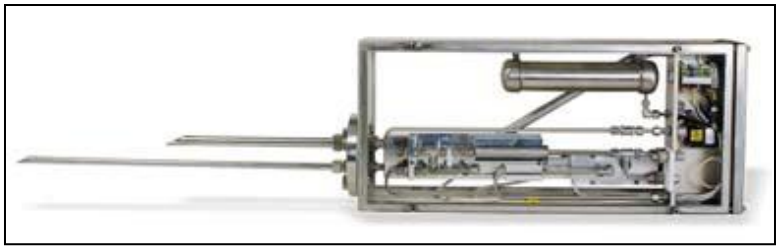


Figure 4-1. EPM Environmental Inertial Filter Extraction Probe.

- Mercury Converter – Since the analyzer could only observe the concentration of mercury in the elemental form, conversion of all mercury cations into the elemental form was required and best performed at the extraction location to facilitate transportation of the mercury atoms to the analyzer. At the start of this project, the converter was still in the design phase and had not been incorporated into the extraction probe.

4.7.4 Thermo Electron Mercury CEMS – Prototype Stage

Development of the mercury CEMS began in June 2003. As described earlier, there were mercury vapor measurement systems commercially available that could accurately measure mercury in flue gas, but more development was needed in order to reliably extract, pretreat, and transport the mercury from the sampling location to the analyzer.

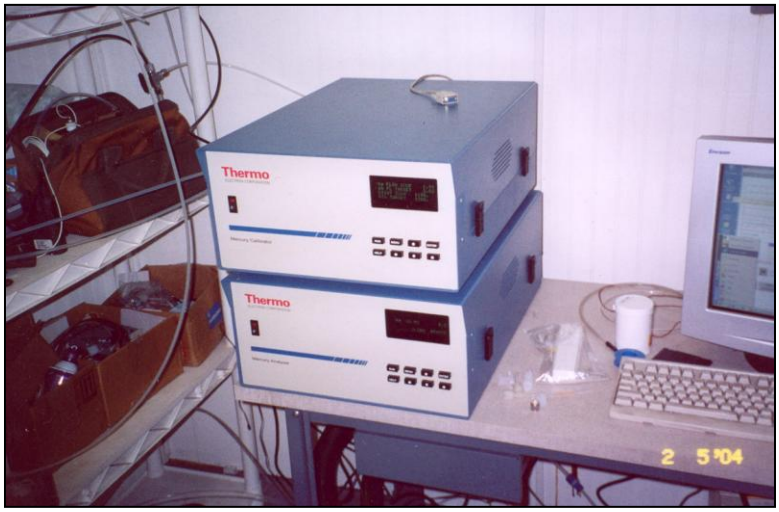


Figure 4-2. Typical Thermo Prototype Mercury Analyzer and Calibrator.

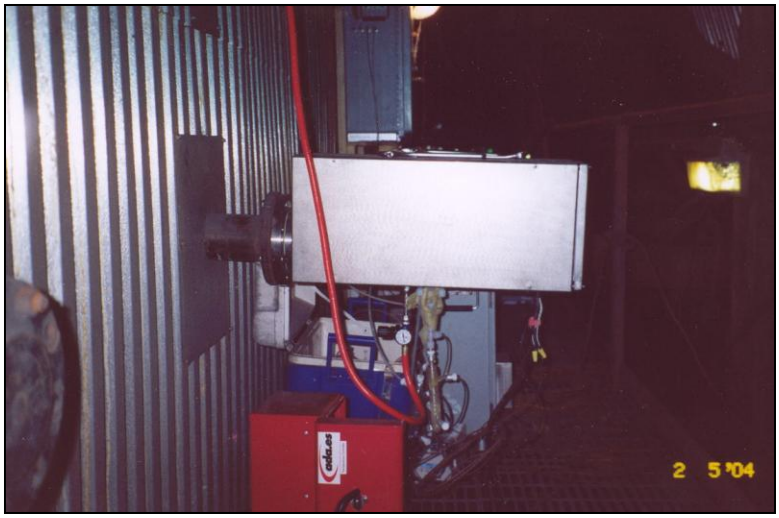


Figure 4-3. Typical Thermo Prototype Mercury Extraction Probe.

From January to June 2004, testing of the new Thermo prototype mercury analyzer was conducted at three plant sites that burned bituminous coal and three sites that burned PRB coal. Examples of the measurement data collected from some of the sites are included in the following sections.

4.7.4.1 Alabama Power Company, Gaston Testing, February 2004

Alabama Power Company, a subsidiary of Southern Company, owns and operates Gaston located in Wilsonville, Alabama. While ADA-ES was on site to perform mercury-monitoring activities using the SCEM, a prototype Thermo mercury analyzer was installed to determine the ability of the instrument to sample and measure mercury downstream of the hot-side ESP and COHPAC® baghouse on Unit 3. Although the two systems were only compared over a four-day period, the new Thermo mercury CEMS matched the concentrations measured by the ADA-ES mercury SCEM very closely.

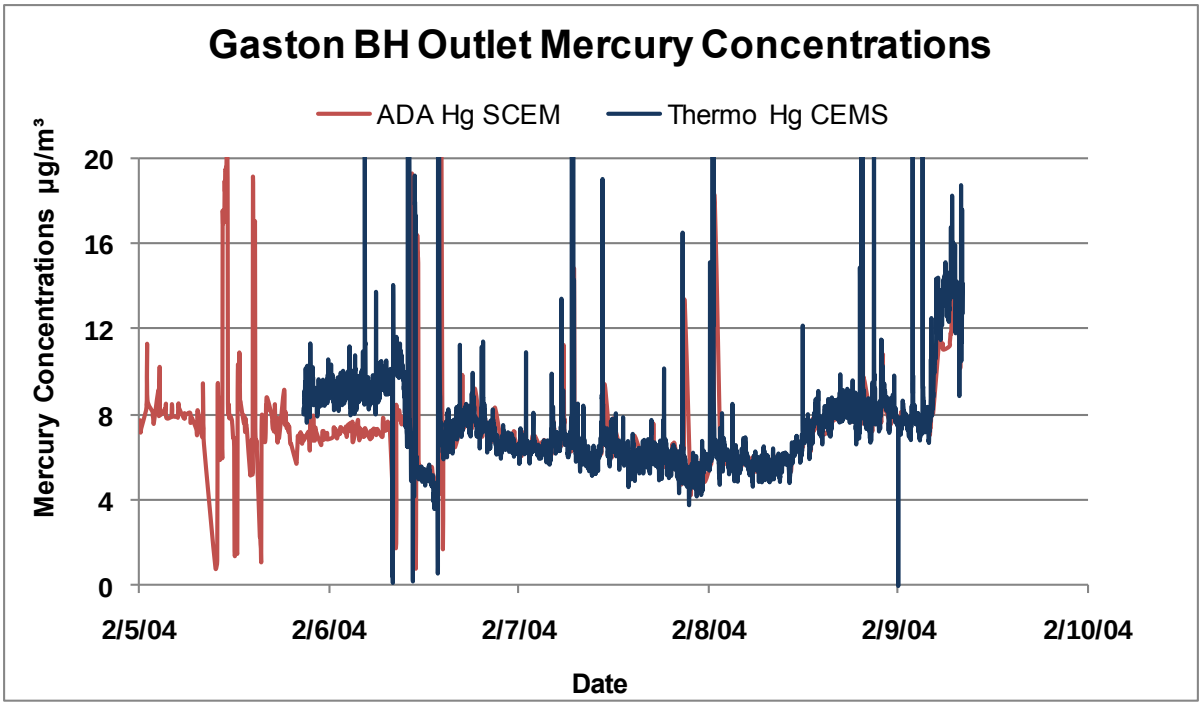


Figure 4-4. Mercury Measurement at Gaston Baghouse Outlet, February 2004.

In addition to the performance tests using a prototype CEMS, a prototype calibrator was tested at Gaston in April 2004. Several tests were performed using dry compressed air and dry compressed nitrogen using the ADA-ES mercury SCEM as the measurement instrument. Tests were also performed to determine if an oven/heater located inside the prototype calibrator improved performance. The results of the tests can be found in Table 4-1 and indicate that the output of the calibrator was higher when using nitrogen as the source gas and more accurate when the mercury oven/heater was turned off.

Table 4-1. Prototype Thermo Mercury Calibrator Performance Tests.

Date	Gas	Oven	Setpoint	Output	Response	Difference
4/14/2009	Air	On	10.0	9.9	16.3	+65%
4/14/2009	Air	On	5.0	4.6	7.5	+63%
4/14/2009	Nitrogen	On	10.0	9.7	18.7	+93%
4/16/2009	Nitrogen	Off	0.0	0.0	0.5	N/A
4/16/2009	Nitrogen	Off	10.0	9.8	12.5	+28%
4/16/2009	Air	Off	5.0	4.8	4.5	-7%
4/16/2009	Air	Off	10.0	9.7	9.7	0%
4/16/2009	Air	Off	20.0	19.4	18.2	-6%
4/16/2009	Air	Off	40.0	39.0	35.1	-10%

4.7.4.2 Sunflower Electric Holcomb Station, June 2004

The prototype Thermo mercury CEMS was also tested at Holcomb Station located near Garden City, Kansas. The single 360-MW unit at Holcomb Station burned PRB coal and was equipped with three spray dry absorber (SDA) modules followed by two very low air/cloth ratio reverse air fabric filter (FF) baghouses. The prototype CEMS were tested at several duct locations at the plant, including upstream of the SDA and downstream of the FF baghouse. ADA-ES also had one of the mercury SCEMS at each location to compare the data collected by the Thermo CEMS. The prototype Thermo CEMS was also tested at a location downstream of the SDA but an ADA-ES SCEM was not installed at this location for comparison.

Comparative mercury concentrations for the SDA Inlet are shown in Figure 4-5. The Thermo CEMS #33 experienced some problems with regulating the detection chamber temperature during the day as the ambient temperature increased. This unstable temperature caused fluctuations in the mercury measurements and calibration responses but the output of the two different types of analyzers was comparable.

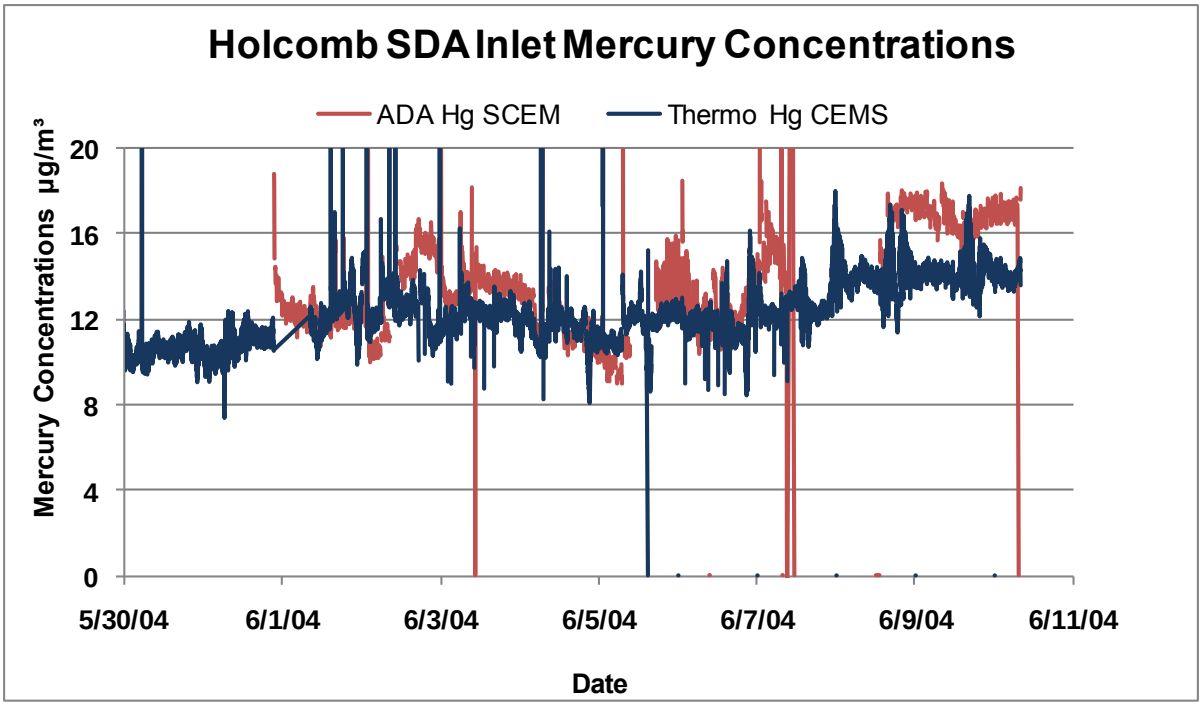


Figure 4-5. Mercury Measurement at Holcomb SDA Inlet, June 2004.

Comparative mercury concentrations for the baghouse outlet are shown in Figure 4-6. The Thermo CEMS #32 compared well with the ADA-ES SCEM but experienced problems with some of the PFA tubing inside the 250 °C probe wherein tube melting occurred at the higher temperatures. For this system, a P S Analytical Cavkit mercury calibrator was used and there were questions about the performance and accuracy of this instrument during calibrations of the system. However, the concentrations measured at this location by the Thermo CEMS compared very well with the measurements of the ADA-ES SCEM despite the temporary technical difficulties with this system.

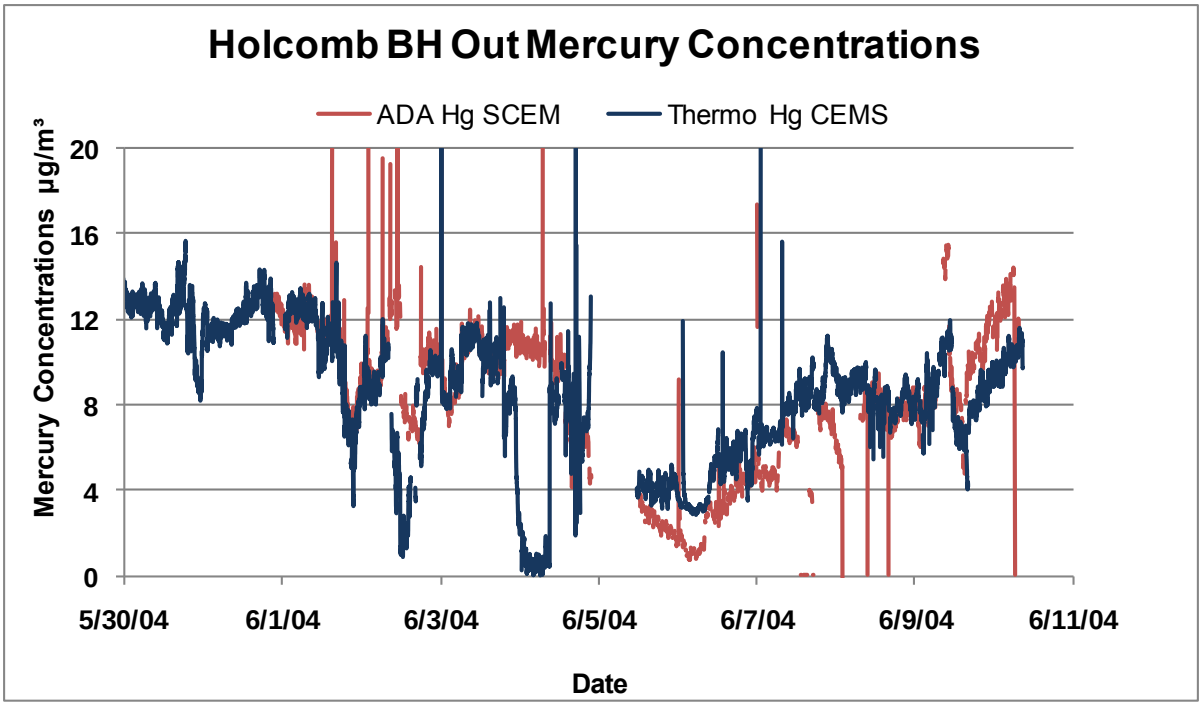


Figure 4-6. Mercury Measurement at Holcomb Baghouse Outlet, June 2004.

A prototype Thermo CEMS #34 was also installed downstream of the SDA outlet to test the operational integrity of the instruments under different conditions. Data collected from this installation are shown in Figure 4-7 and demonstrate a reasonable amount of stability for this installation. Near the end of the weeklong test, there were some questions about the stability of the instrument since occasional flushing of the probe with compressed air did not seem to improve performance.

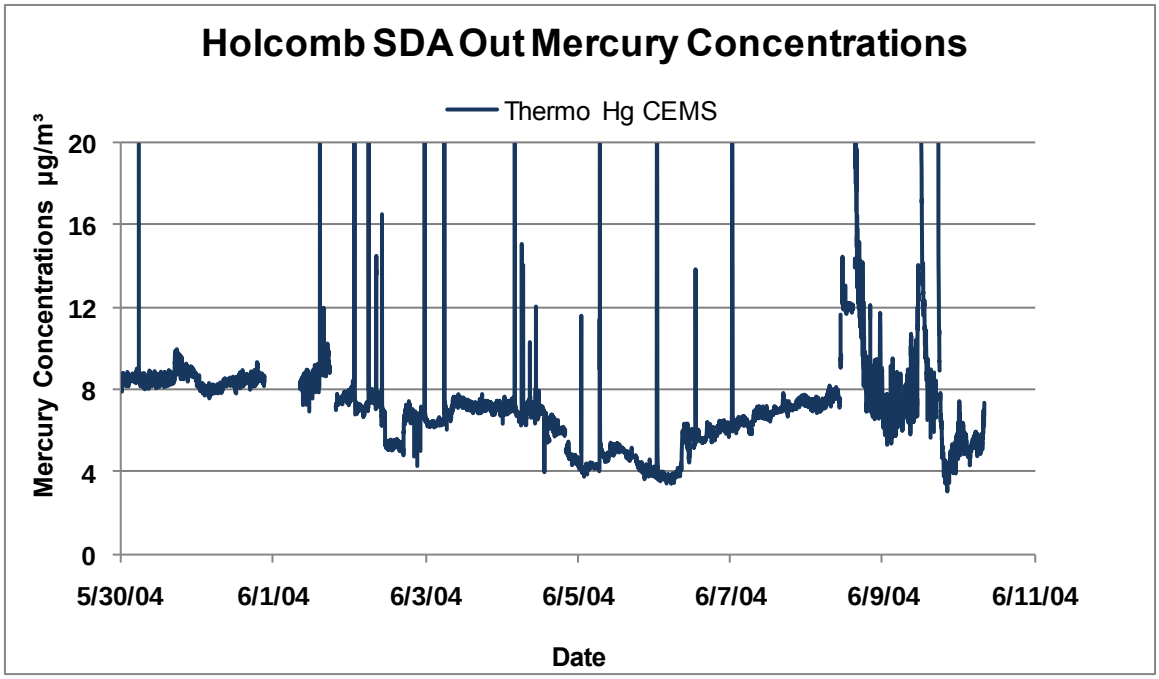


Figure 4-7. Mercury Measurement at Holcomb SDA Outlet, June 2004.

4.7.5 Thermo Electron Mercury CEMS – Alpha Stage

As the Thermo mercury CEMS prototypes showed improved performance at a number of different locations within power plants that burned different coals, development of the instruments entered the alpha stage of testing. The alpha stage represented the testing of equipment that could be properly evaluated during field tests but still required development to resolve major issues. The CEM is still referred to as a prototype up to the point of installation of the commercial iSeries. The mercury CEMS entered this evaluation in the third quarter of 2004, although each component of the mercury system entered this stage on slightly different schedules.

4.7.5.1 Thermo Electron Mercury CEMS – Mercury Extraction Probe

The original EPM extraction probe design purchased by Thermo in 2003 featured an inertial separation probe to reduce ash entrainment by the probe. Other modifications were necessary to improve the performance of the probe when sampling mercury in flue gas.

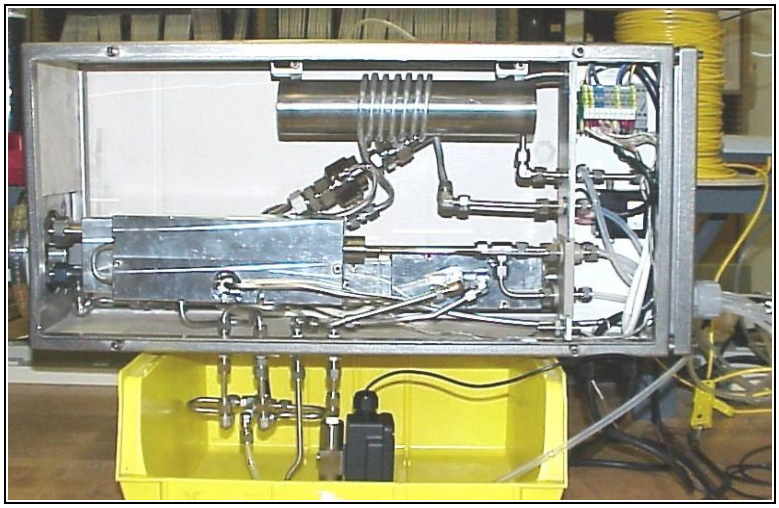


Figure 4-8. Thermo Prototype Mercury Extraction Probe (Redesigned EPM Probe).

The probe was redesigned to increase the ability to be serviced during long-term installations. All of the components exposed to mercury were glass-coated to reduce the potential of the stainless steel components to remove and oxidize mercury in the sample gas. Additional components were added to the probe, including a flow measurement device on the "fast loop" and a location to introduce calibration gas to the probe through a spike port immediately upstream of the inertial filter.

4.7.5.2 Sunflower Electric Holcomb Station, July and August 2004

Evaluation of the prototype Thermo mercury CEMS continued at Holcomb Station in August 2004 after some design changes and other modifications to the equipment. A fourth Thermo CEMS #56 was installed in the stack. The significance of this test period was to collect data and provide feedback of the mercury CEMS at a variety of installation locations at the plant, with updated and modified system components.

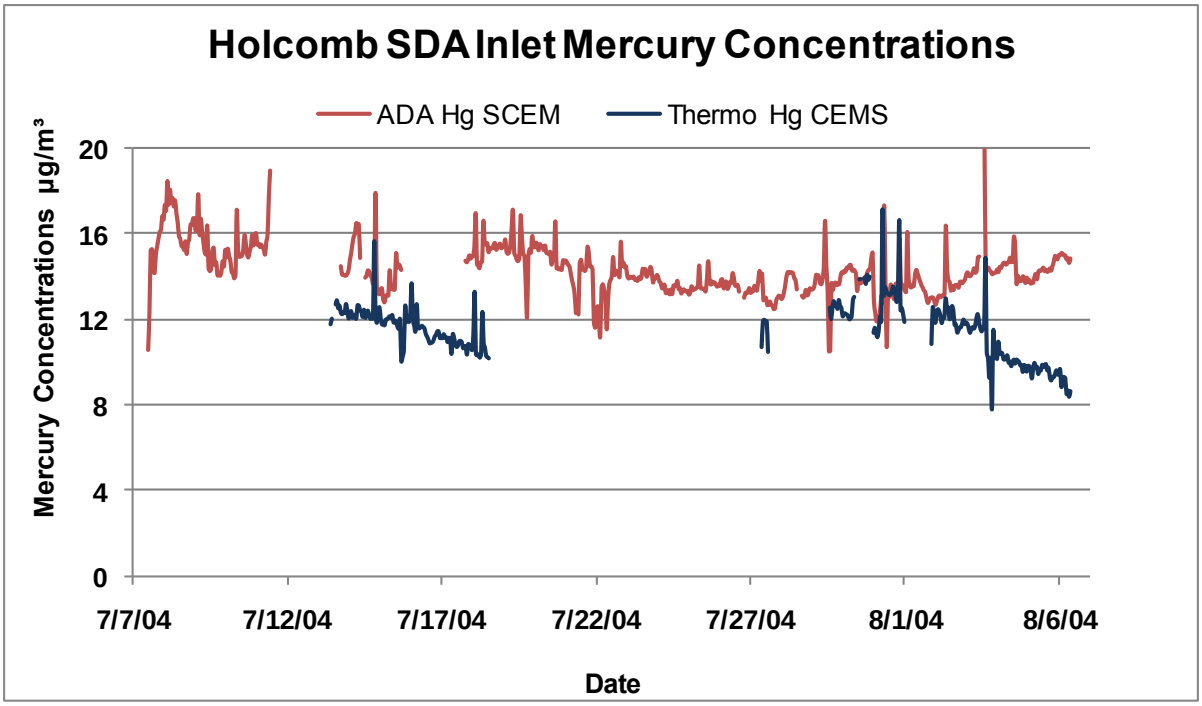


Figure 4-9. Mercury Measurement at Holcomb at SDA Inlet, July 2004.

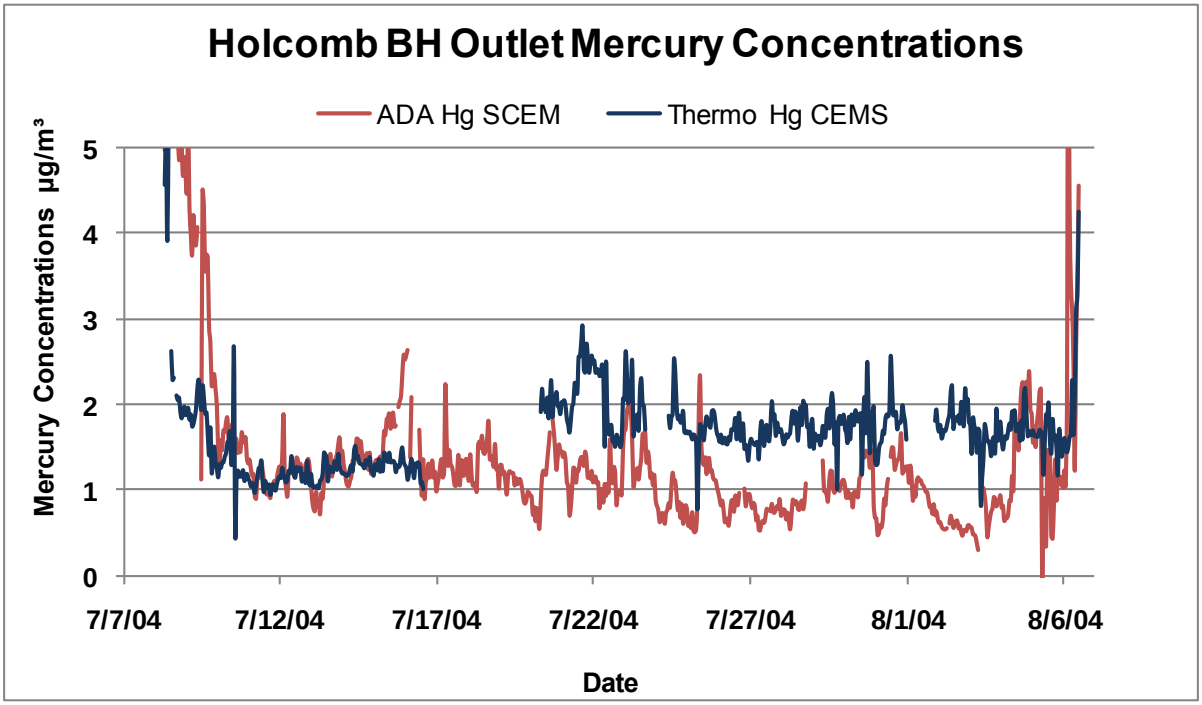


Figure 4-10. Mercury Measurement at Holcomb Baghouse Outlet, July 2004.

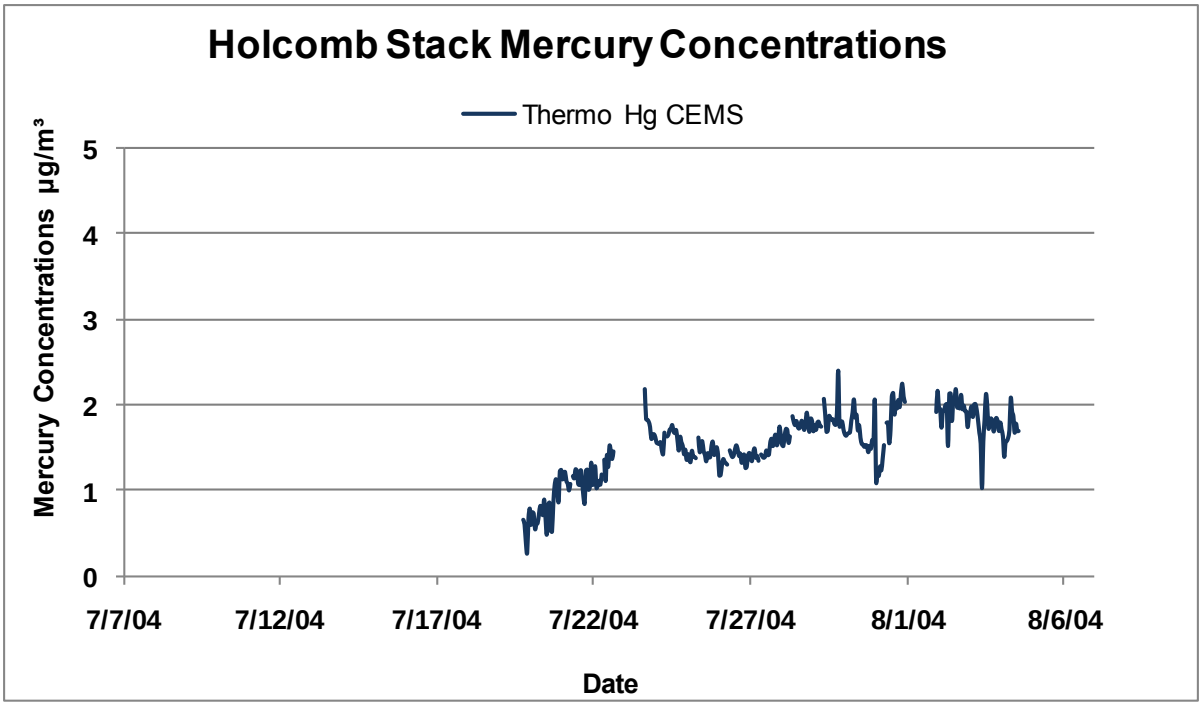


Figure 4-11. Mercury Measurement at Holcomb Stack, July 2004.

4.7.5.3 AEP Conesville Power Plant, August 2004

One of the biggest concerns with the gold-amalgamation technology was that the analyzers had a very difficult time collecting and measuring mercury from flue gas that contained high levels of sulfur trioxide (SO_3), ammonia (NH_3), and selenium (Se). The 400-MW Conesville Power Plant fires high-sulfur Ohio Basin eastern bituminous coal and a field test of the Thermo mercury CEMS allowed the technology to be tested under a worst-case scenario.

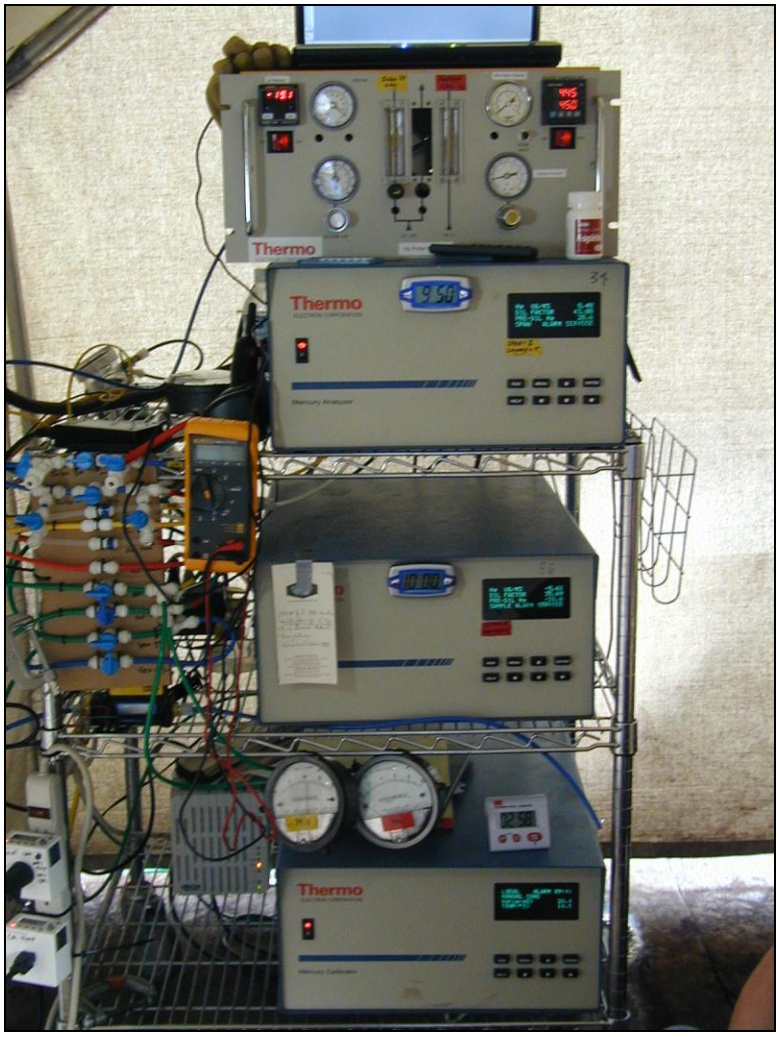


Figure 4-12. Prototype Thermo Electron Mercury CEMS at AEP Conesville.

Thermo CEMS #34 was installed on Unit 5 at the Conesville Power Plant in August 2004. Thermo had completed modifications to their mercury calibrator after the testing at Holcomb. The purpose of the Conesville field test was to compare the output of the calibrator with an established commercial model from another company (PSA Cavkit). The analyzer was operated with the Cavkit connected to the span port of the probe and the Thermo calibrator connected to the sample port. Both calibrators were set to output 10.0 µg/m³ of mercury and the analyzer allowed switching between both calibrators overnight from August 18 to August 19. The results of the test are shown in Figure 4-13 and demonstrate that the outputs of both calibrators tracked very well for almost ten hours. The shift in concentrations was attributed to the function of the analyzer as the measurements changed equally for both calibrators.

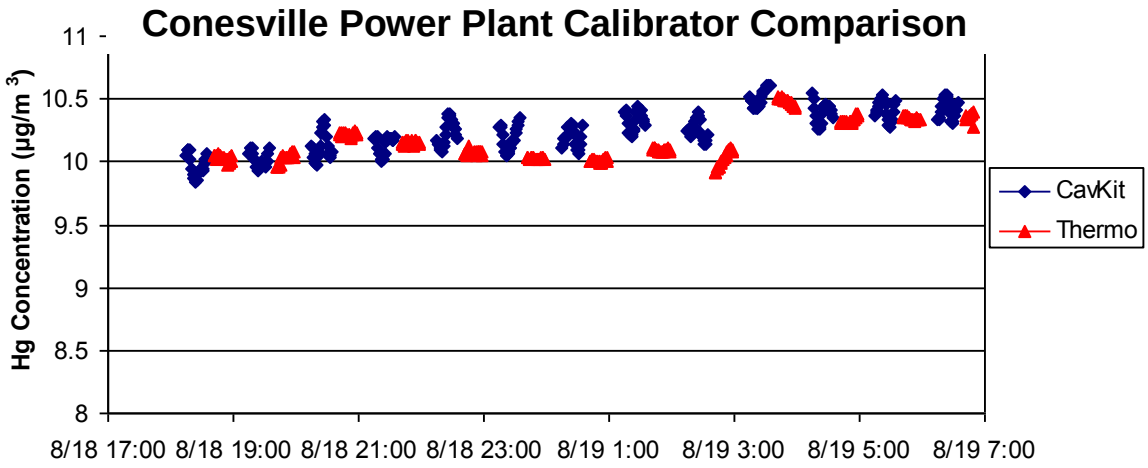


Figure 4-13. Comparison of Thermo Calibrator to PSA Cavkit at Conesville, August 2004.

4.7.6 Thermo Electron Mercury CEMS – Mercury Converter/Speciation

The prototype Thermo mercury CEMS was unable to convert oxidized mercury to elemental mercury at the sampling location. Conversion of the oxidized mercury was required to measure total mercury concentrations because the analyzer could only measure elemental mercury in the sample. Development of the converter had continued until field tests of the assembly were performed at Conesville Power Plant in August 2004.

Prior to the field tests, many lab experiments were performed to prove the effectiveness of the new Thermo mercury dry converter. The proprietary design combined a very high operating temperature of 750 °C with a chemical reaction that takes place at about 350 °C. These evaluations compared the effectiveness of the converter by running the converter in parallel with a FAMS™ (Flue-Gas Adsorbent Mercury Speciation) trap from Frontier GeoSciences. While the FAMS™ trap measured a concentration of 10.17 µg/m³ of oxidized mercury (mercuric chloride, $HgCl_2$), the new Thermo converter was able to measure a total mercury concentration (oxidized converted to elemental) of 10.70 µg/m³. The difference between the two methods was less than 5%.

The first field tests performed at Holcomb Station demonstrated the possibility to convert oxidized mercury to elemental; however, Holcomb produced a very low amount of Hg^{2+} to react with the converter. By contrast, Conesville provided an opportunity to test the

converter under more difficult conditions since this plant's flue gas had a very high amount of Hg^{2+}.

The converter was connected to the sample port and a critical orifice was connected to the span port. The mercury concentration measured through the converter was within the range expected at this site and the elemental fraction was similar to the total fraction. The elemental and zero measurements were adjusted by zeroing and spanning through the dilution orifice while sampling from the respective sampling trains (elemental or total). Some variability in the measurements was likely due to the thermal drift with this particular prototype analyzer. The analyzer was zeroed every hour and the measurement was corrected for thermal drift using the hourly zeroes. The results of this field test are presented in Figure 4-14.

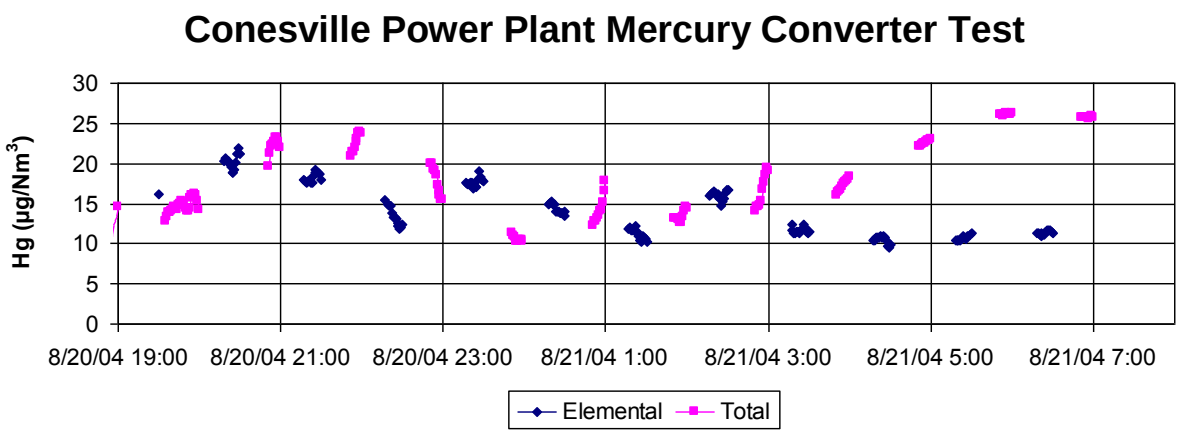


Figure 4-14. Function of the Thermo Mercury Converter at Conesville SCR Inlet, August 2004.

There were still some problems with sampling flue gas with the Thermo CEMS under high-SO_3 conditions at Conesville. Acid deposition in the transport lines likely caused additional mercury conversion and removal before being measured by the analyzer. This caused direct measurement of the elemental mercury to be impossible with the acid in the umbilical. However, there was a large elemental bias measured by the analyzer when an SO_3 scrubbing material was introduced into the system. The wet chemistry put in place for testing under high-SO_3 conditions did not have any problems measuring speciated mercury at the SCR inlet. However, the wet-chemistry method proved to be ineffective when the flue gas contained high levels of NH_3 at the SCR Outlet.

Changes were made to the converter and the assembly was tested at the Brayton Point Power Station in November 2004 and the Meramec Plant in December 2004. Data from the Brayton Point test showing the capability to measure both total and elemental mercury are included in Figure 4-15. The Thermo CEMS with the new converter assembly was installed downstream of the ESP on Unit 3. Brayton Point typically burns eastern bituminous coal but has been known to burn a wide variety of coals from multiple locations. Typical oxidation of mercury measured at Brayton Point was 55–70% at the stack.

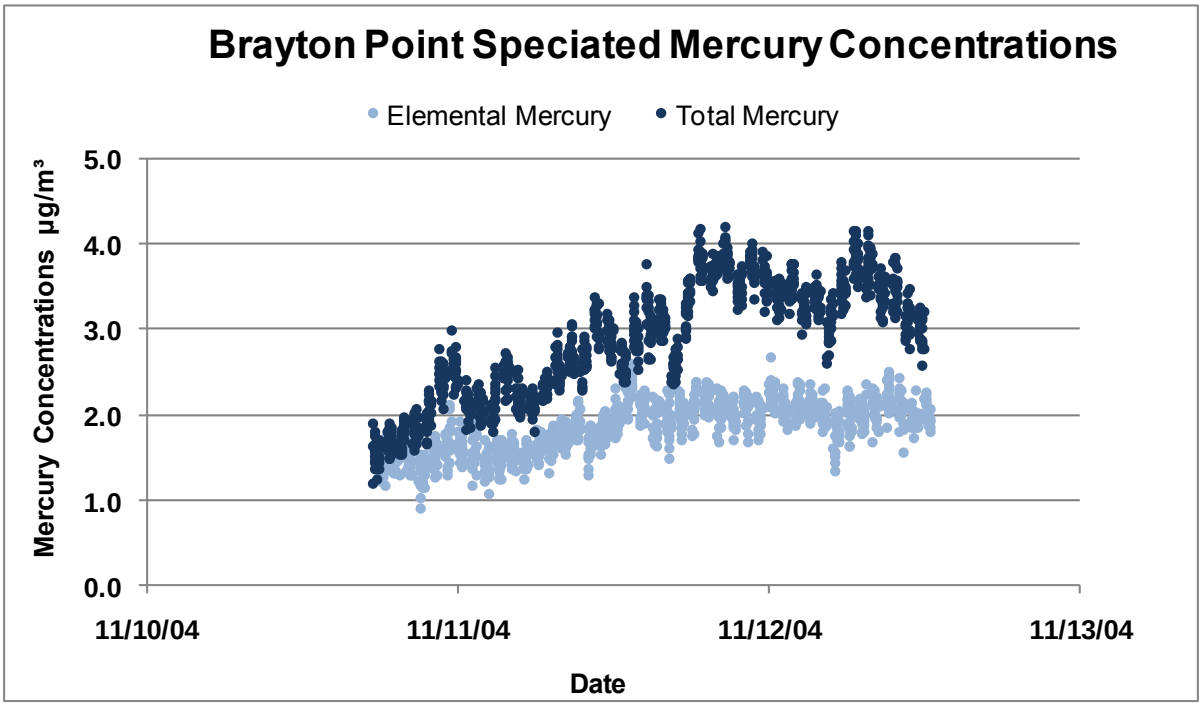


Figure 4-15. Speciated Mercury Measurements at Brayton Point Unit 3, November 2004.

A Relative Accuracy Test Audit (RATA) verification was performed on the Thermo CEMS installed at Brayton Point during the field evaluation. TRC Environmental Corporation performed three runs of the Ontario Hydro Method (ASTM D6784-02) in November 2004 and the average difference between the measurements of the two methods for all mercury species was very small and within acceptable error. The results of the comparison are presented in Table 4-2.

Table 4-2. Ontario Hydro RATA Verification of Thermo CEMS, November 2004.

	OH Run 1	CEMS Run 1	OH Run 2	CEMS Run 2	OH Run 3	CEMS Run 3	Average Difference
Hg(P)	0.10	--	0.01	--	0.01	--	--
Hg(0)	0.92	1.04	0.85	1.10	0.84	1.21	-0.25
Hg(2+)	3.04	3.06	2.93	3.05	3.08	3.35	-0.14
Hg(t)	4.06	4.10	3.79	4.15	3.93	4.56	-0.34

Mercury concentrations, µg/m³.

4.7.7 Thermo Electron Mercury CEMS – Beta Stage

4.7.7.1 Xcel Energy Cherokee Station, January 2005

ADA-ES installed a Thermo prototype mercury CEMS at the Xcel Energy Cherokee Station Unit 1 in January 2005. ADA-ES installed an EMC analyzer next to the Thermo system at the sodium injection ports to compare the results of the measurements collected by each system. Testing was completed on March 14. The prototype Thermo CEMS that was ultimately installed at Presque Isle was very close to the design that was installed and evaluated at Cherokee Station.

Figure 4-16. Prototype Thermo Mercury CEMS Instruments at Cherokee Station.

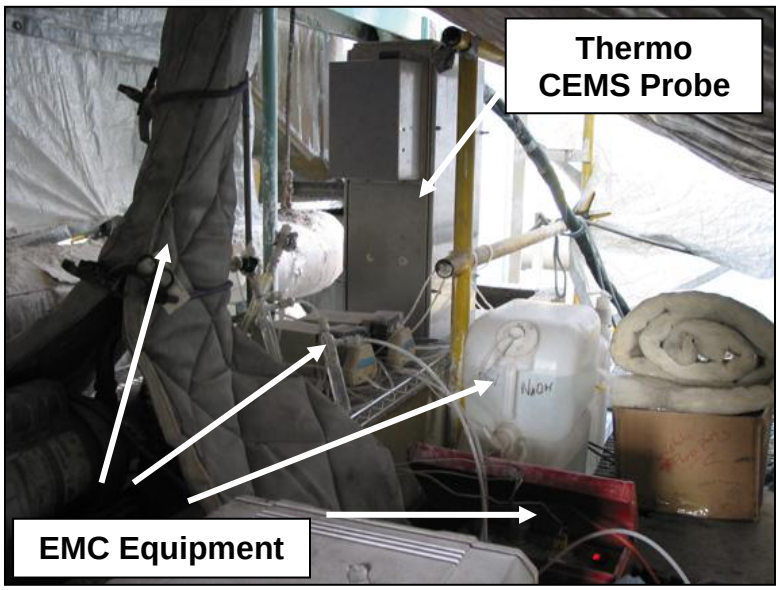


Figure 4-17. Comparison of the Prototype Thermo Extraction Probe and the EMC SCEM Probe.

The Thermo CEMS performed very well with little daily drift in the response to zero and span gas. The measurements by the Thermo CEMS tracked the measurements of the EMC analyzer very closely for most of the testing.

4.7.7.2 Clean Air Mercury Rule (CAMR)

The EPA determined that mercury emissions from coal-fired power plants total about 48 tons per year, or 43 percent of mercury emissions in the United States. Therefore, the U.S. EPA finalized a rule called the Clean Air Mercury Rule (CAMR) on May 18, 2005, to permanently cap and reduce mercury emissions from coal-fired power plants that supply more than 25 megawatts of electricity for sale. The rule was designed to create annual mercury emissions limits for the coal-fired power plants, as well as a cap-and-trade mercury program to aid in compliance with federally enforceable mercury limits. The national cap created by this rule set the amount of mercury released by utilities at 38 tons per year in 2010 and 15 tons in 2018. The Continuous Emission Monitoring section (40 CFR Part 75) was amended to include mercury in the requirements for continuous emissions monitoring and all coal-fired power plants had to begin monitoring mercury by January 1, 2009. Regulation limits and compliance with CAMR were to begin in 2010. However, the CAMR was vacated by the D.C. Circuit Court in February 2008.

The new requirements for mercury CEMS were outlined in Part 75. The intent of the demonstration project at Presque Isle was to configure the mercury CEMS to automatically follow the QA/QC procedures for a compliance mercury CEMS as defined in CAMR. The procedures that would be followed were outlined in 40 CFR Part 75.20 and 75.21. Appendix A of Part 75 detailed the certification requirements for the installation of a mercury monitor, and Appendix B of Part 75 outlined the on-going QA/QC procedures that needed to be followed for accurate collection of data. Many of the certification tests were performed on an on-going basis as part of the QA/QC requirements. While the tests performed were the same, the success criteria for certification could be tighter than what was required for the on-going QA/QC activities.

For the mercury CEMS to complete initial performance specifications, a series of tests and evaluations were performed and compared with QA/QC criteria. The CEMS had to pass a

seven-day calibration error test with elemental mercury, a three-level linearity check with elemental mercury, a cycle time test, and a RATA (bias) test. If the mercury CEMS used a converter to measure total mercury, then the system also had to pass the criteria of a three-level system integrity check with oxidized mercury. The certification tests and criteria are outlined in Table 4-3.

Table 4-3. CAMR 40 CFR Part §75.20(c)(1) Mercury CEMS Certification Tests.

Performance Test	Test Specifications	Criteria	CAMR Reference
Seven-Day Calibration Error Test	Two-point calibration check (zero and upscale) for seven consecutive days.	< 5.0% of span (or ≤ 1.0 µg/m³ if span is 10 µg/m³)	Part Part 75, Appendix A, Section 6.3
Linearity Check	Challenge monitor three times with each reference gas (low, mid, high).	< 10% (or < 1.0 µg/m³) of reference gas value	Part Part 75, Appendix A, Section 6.2
Cycle Time Test	Zero and upscale.	< 15 minutes to 95%	Part Part 75, Appendix A, Section 6.4
System Integrity Check*	Three-point converter efficiency test.	< 5.0% of span	Part Part 75, Appendix A, Section 6.2
Relative Accuracy Test Audit (RATA) and Bias Test	One set of 12 test runs.	< 20% difference (or < 1.0 µg/m³ for low emitters).	Part Part 75, Appendix A, Section 6.5

After certification was complete, the mercury CEMS also had to satisfy the requirements of on-going quality assurance and quality control checks. The mercury CEMS calibration needed to be checked daily with elemental or oxidized mercury. A one-level system integrity check had to be performed weekly if the system used a mercury converter. A three-level, three-run linearity check also needed to be performed quarterly, and a RATA and bias test needed to be completed annually. The on-going quality control requirements are outlined in Table 4-4.

Table 4-4. CAMR 40 CFR Part §75.21 Mercury CEMS On-Going QA/QC Tests.

Performance Test	Test Specifications	Criteria	CAMR Reference
Daily Calibration Error Test	Two-point calibration check (zero and upscale).	< 5.0% of span (or ≤ 1.0 µg/m³ if span is 10 µg/m³)	Part Part 75, Appendix B, Section 2.1.1
Weekly System Integrity Check*	Single-point converter efficiency test.	< 5.0% of span	Part Part 75, Appendix B, Section 2.6
Quarterly Linearity Check	Challenge monitor three times with each reference gas (low, mid, high).	< 10% (or < 1.0 µg/m³) of reference gas value	Part Part 75, Appendix B, Section 2.2.1
Relative Accuracy Test Audit (RATA) and Bias Test	One set of 12 test runs.	< 20% difference (or < 1.0 µg/m³ for low emitters)	Part Part 75, Appendix B, Section 2.3.1

The requirements specified by CAMR were used as a general guideline for the minimum level of testing considered acceptable for the mercury CEMS used for the duration of the project.

4.7.7.3 Long-Term Field Evaluation of the Prototype Thermo Mercury CEMS

In February 2005, Midwest Research Institute (MRI) completed a field evaluation of the Thermo mercury CEMS for the U.S. Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards. The purpose of the test program was to assess the ability of different mercury CEMS to provide reliable and accurate information over an extended time period, while meeting durability, data availability, and set-up/maintenance requirements. Thermo provided a beta version of the mercury system for testing at Louisville Gas and Electric's Trimble County Station.

Initial certification of the Thermo CEMS included tests to determine the seven-day calibration error test, linearity check, converter efficiency, cycle time, and relative accuracy test as described in EPA Performance Specification 12A and the proposed CAMR. The criteria for these tests are outlined in Table 4-3. The results of the EPA Initial Certification Tests for the Thermo CEMS are summarized in Table 4-5.

Table 4-5. Results from U.S. EPA Mercury CEMS Field Tests, February 2005.

Performance 12A Compliance Test	Test Result
Day Calibration Error Test: 2 points, zero and upscale Passing criteria: < 5% span or < 1.0 µg/m³	Pass
Linearity Check: 3 points, low, mid, high Passing criteria: < 10% of reference gas or < 1.0 µg/m³	Pass
Cycle Time Passing criteria: < 15 minutes to 95%	Pass
Converter Efficiency Passing criteria: < 5% of span	Pass
Relative Accuracy Test* Passing criteria: < 20% of mean reference Method (OH)	Pass

* 9 of 12 "valid" duplicate simultaneous pairs of Ontario Hydro runs are required for a complete RATA. Only 8 of the 12 Ontario Hydro pairs met this criterion of matching the paired Ontario Hydro within 20%. Therefore, this test was considered an "incomplete" RATA due to inaccuracies in the Ontario Hydro.

4.7.7.4 Thermo Electron Mercury Freedom System™

After the successful completion of the Long-Term Field Evaluation for the EPA, Thermo publically introduced their mercury CEMS for coal-fired power plants at EPRI's User Group Meeting and Exhibit on May 3, 2005. A press release announced that purchase orders for the system could now be placed and that delivery of orders was expected to take place in November 2005.

The most noticeable modification to the design was the switch from a "C-Series" instrument to a new "iSeries" platform. The iSeries platform featured flexible communications, increased serviceability, and an easier-to-use interface over its predecessors. Ethernet connectivity provided efficient remote access, allowing the user to download measurement information directly from the instrument without having to be on site. Captive hardware and slide-apart modules allowed easy access for service and periodic maintenance. The instrument featured a larger interface screen that could display up to five lines of measurement information while the primary reporting screen remained visible.

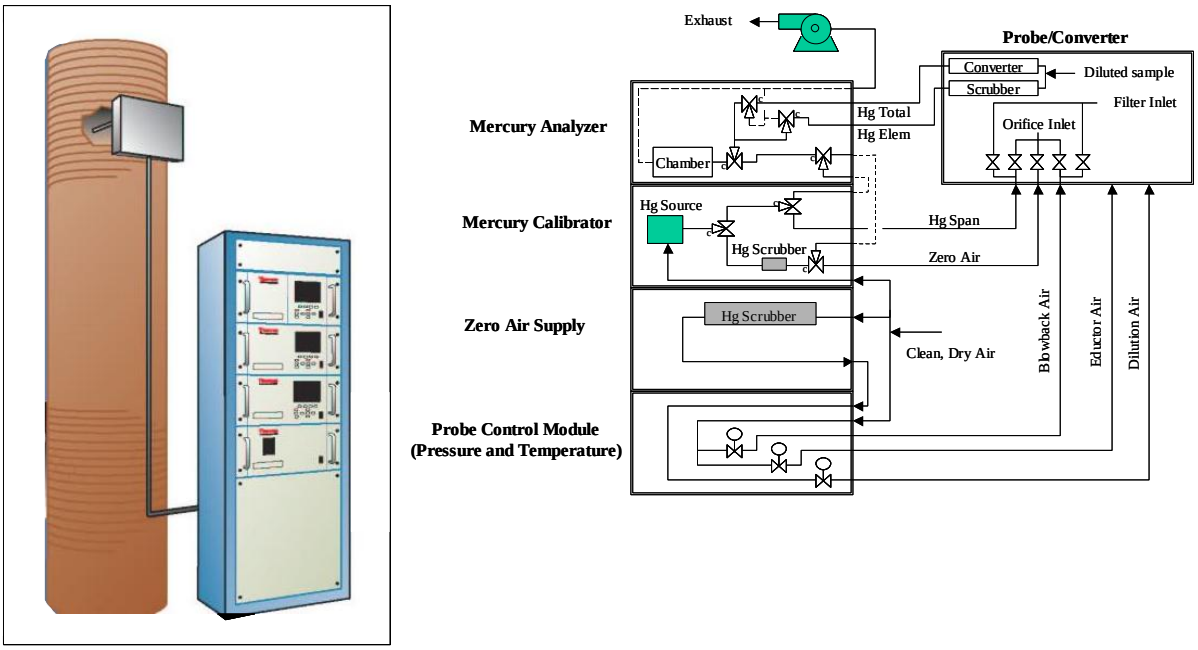


Figure 4-18. Schematic of Thermo Electron iSeries Mercury Freedom System™.

In addition to the integration into the new iSeries platform, Thermo continued to make modifications to the design as a result of the previous two years of lab testing and field evaluation results.

- Mercury Analyzer – The mercury analyzer was based upon atomic fluorescence. An advanced CVAF design provided continuous sample measurement with no additional gases or pre-concentration required and virtually no interference from SO_2. Detection limits down to 1.0 ng/m³ allowed high sample dilution (100:1) minimizing moisture, heat, and interfering pollutants. The mercury analyzer software was designed to interact with the mercury calibrator and probe controller to provide complete control over the function of the Mercury Freedom System™.

- Mercury Calibrator – The elemental mercury calibrator was developed using a Peltier cooler/vapor pressure control and mass flow controllers. The mercury concentration output range was 0.1 µg/m³ to 300 µg/m³. This range allowed the operator to directly calibrate the analyzer at post-dilution concentrations and dynamically spike into the sampling probe. The calibrator software allowed for automatic zero/span checks and adjustable mercury concentration output.

- Zero Air Supply – The mercury analyzer was designed for use with a dilution probe. The zero air supply provided dry, mercury-free dilution air to the probe and air to the mercury calibrator for sensitive and accurate analyzer calibrations.

- Stack Probe and Inertial Filter – The extraction probe used a high-flow, sintered-metal inertial filter to separate a particulate-free vapor-phase sample while minimizing the interactions with fly ash. All components that were exposed to sample gas were glass-coated to prevent reactions with mercury. The probe incorporated a dilution assembly and calibration gas that could be introduced either upstream or downstream of the inertial filter.

- Mercury Converter – A high-temperature module converted all vapor-phase species of mercury into elemental mercury for analysis. The proprietary, high-efficiency conversion technology has been demonstrated to meet the U.S. EPA PS-12A criteria of less than 5% of span value deviation from the certified gas value.

- Probe Control Box – The probe control box (controller) was located in the CEMS shelter with the other instruments of the system. An umbilical connected the probe to the microprocessor-driven probe controller and mercury converter. The unit allowed dynamic mercury spiking and auto-dilution conformation, monitored probe temperatures and pressures, automated probe calibration and dynamic spiking via calibrator microprocessor, measured fast loop flow, and automated inertial filter and probe blowback via analyzer software.

4.7.7.5 We Energies Presque Isle Power Plant, June 2005

Although Thermo announced the manufacture and sale of the new Mercury Freedom System™, the product was not available for delivery until November 2005. ADA-ES and Thermo personnel installed the prototype (non-commercial) C-Series mercury CEMS at Presque Isle for the first long-term installation of a mercury system on June 25, 2005, in order to test the assembly for an extended field evaluation. The C-Series instrument was identical in design to the units installed at the two EPA test sites and had been demonstrated to be accurate and reliable in measuring mercury concentrations. The system was installed

with the understanding that the prototype instruments would later be replaced by new iSeries instruments when they became available.

The prototype analyzer, calibrator, probe control box, pump, and zero air supply were installed into the CEMS Shelter 4, Rack 5, next to the Unit 8 FD fan inside the plant. The in-stack mercury probe was installed in a 4-inch duct port located downstream of the Unit 8 air preheater. The 130-foot heated sample line connecting the analyzer to the probe was temporarily routed from the CEMS shelter to the probe location.

Figure 4-19. Thermo Electron Prototype C-Series Mercury CEMS installed at PIPP Unit 8 Inlet, June 2005.

Figure 4-20. Thermo Electron Prototype C-Series Mercury Probe Installed at PIPP Unit 8 Inlet, June 2005.

The prototype mercury analyzer was placed in operation on June 30, 2005. That version of the software was not developed to automatically check the calibration through the dilution module and converter, so arrangements were made to connect to the system remotely via phone line and initiate the check manually every day as well as to retrieve data collected by the system.

The majority of the measurements after installation were made with the analyzer set to measure total vapor-phase mercury. The analyzer was briefly set to measure both total and elemental mercury from July 1–7 and September 2–7, 2005. According to the measurements taken during speciation, the vapor-phase fraction of elemental mercury at Presque Isle was 70–85% elemental mercury, which appeared to indicate that the mercury converter was working correctly based on expected speciation of mercury for a unit that fires PRB coal. The system was configured to measure both total and elemental mercury on September 27.

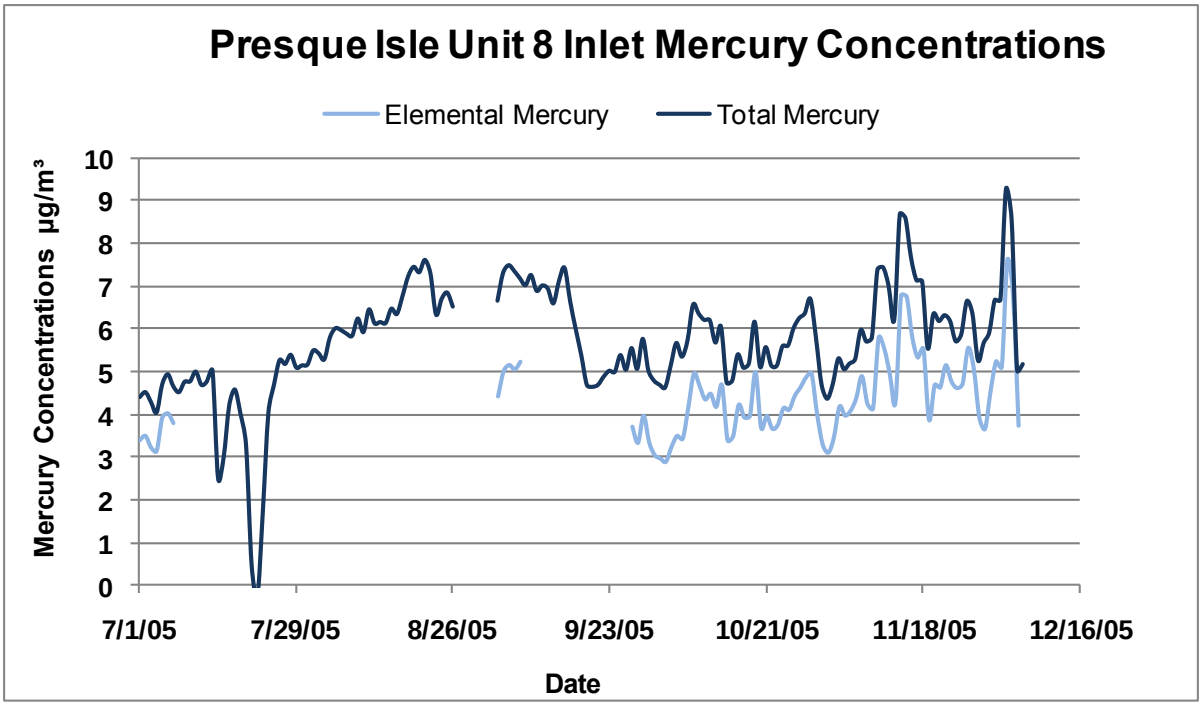


Figure 4-21. PIPP Unit 8 Inlet Mercury Concentrations, Daily Averages; July 7–12, 2005.

The mercury CEMS was put through the initial certification checks as outlined by the CAMR. The certification tests included a seven-day calibration error test with elemental mercury, a three-point linearity check with elemental mercury, a cycle time test, a RATA, a bias test, and a three-point converter check. The certification test was completed on October 27, 2005.

For the seven-day calibration error test, it was understood that only the span responses needed to be analyzed to determine if the analyzer experienced any drift over the seven days. The analyzer did experience significant zero drift over the seven days, but the zero drift was corrected over time to determine that the span response did not drift independently of the zero drift. On the last day of the seven-day drift test, the analyzer had experienced a total zero drift of 2.2 µg/m³ and would have failed the check under strict certification requirements.

The Federal Register specified that the calibration error check be determined by using elemental mercury calibration gas standards and required the calibration error check to meet a performance specification of 5.0% of the span (or an alternate specification of 1.0 µg/scm

absolute difference) between the reference gas and CEMS. The initial results of the seven-day calibration test are listed in Table 4-6.

Table 4-6. Seven-Day Calibration Error Test; October 21–27, 2005.

Day	Date	Start	End	Span	CEMS	Error	% Error	Result
1	10/21/05	06:30	07:00	9.94	9.92	0.02	0.2	PASS
2	10/22/05	12:54	13:05	10.02	10.02	0.03	0.3	PASS
3	10/23/05	16:25	16:47	9.60	9.60	0.39	3.9	PASS
4	10/24/05	16:40	16:55	9.55	9.55	0.27	2.7	PASS
5	10/25/05	13:45	14:15	9.87	9.87	0.00	0.0	PASS
6	10/26/05	15:20	15:45	10.09	10.09	0.24	2.4	PASS
7	10/27/05	14:45	15:15	10.20	10.20	0.36	3.6	PASS

The Federal Register specified that the mercury CEMS must satisfy the requirements of a three-point linearity check using elemental mercury calibration gas standards. The mercury CEMS had to meet a performance specification of 10.0% of the reference gas at each level or an alternate specification of 1.0 µg/scm absolute difference between the reference gas and CEMS. At the time of the linearity check, it was understood that the three span concentrations could include a zero-point reference gas. The initial three-point linearity test results are shown in Table 1-7.

Table 4-7. Three-Point Linearity Check; October 27, 2005.

Point	Date	Start	End	Span	CEMS	Error	% Error	Result
1	10/27/05	14:30	14:45	0.0	0.0	0.0	N/A	PASS
2	10/27/05	14:45	15:15	4.9	4.6	0.3	6.1	PASS
3	10/27/05	15:25	15:50	9.8	10.2	0.4	4.1	PASS

The cycle time test was performed by observing the amount of time that the mercury CEMS took to measure a stable span response from a stable zero response. Although this test was

performed slightly different from the Federal Register, this test, summarized in Table 4-8, showed that the system responded to calibration gas within the required 15 minutes as stated in the regulations.

Table 4-8. Cycle Time Test; November 11, 2005.

Zero Start Time	Stable Zero Response	Span Start Time	Stable Span Response	95% Response Time
11/11/05 15:40	0.00*	11/11/05 15:50	10.11	6 minutes

* Zero response adjusted before starting span response.

To complete the certification tests of the mercury CEMS, a RATA was performed to compare the measurements of the mercury system with that of an approved sampling method. The regulations specified that the RATA be performed with the Ontario Hydro method but the mercury CEMS was compared to the concentrations measured by paired trains of an STM test. These test results are provided in Table 4-9 and Figure 4-22.

Table 4-9. Comparison to STM Traps, RATA Testing; August 3, 2005.

Start Time	End Time	STM 1* µg/dNm³	STM 2 µg/dNm³	CEMS** µg/dNm³	% Error** (STM 2)
8/3/05 10:41	8/3/05 11:41	N/A	6.01	6.47	N/A
8/3/05 12:03	8/3/05 13:35	5.94	6.91	6.39	-8.1
8/3/05 14:03	8/3/05 14:42	6.48	5.98	6.51	-9.0
8/3/05 15:24	8/3/05 16:06	6.81	6.22	6.22	6.2
8/3/05 16:20	8/3/05 16:55	7.65	6.74	6.32	-1.6

Dry basis, 0 °C.

** Totalizer on STM 1 malfunctioning intermittently. All errors based on STM 2.

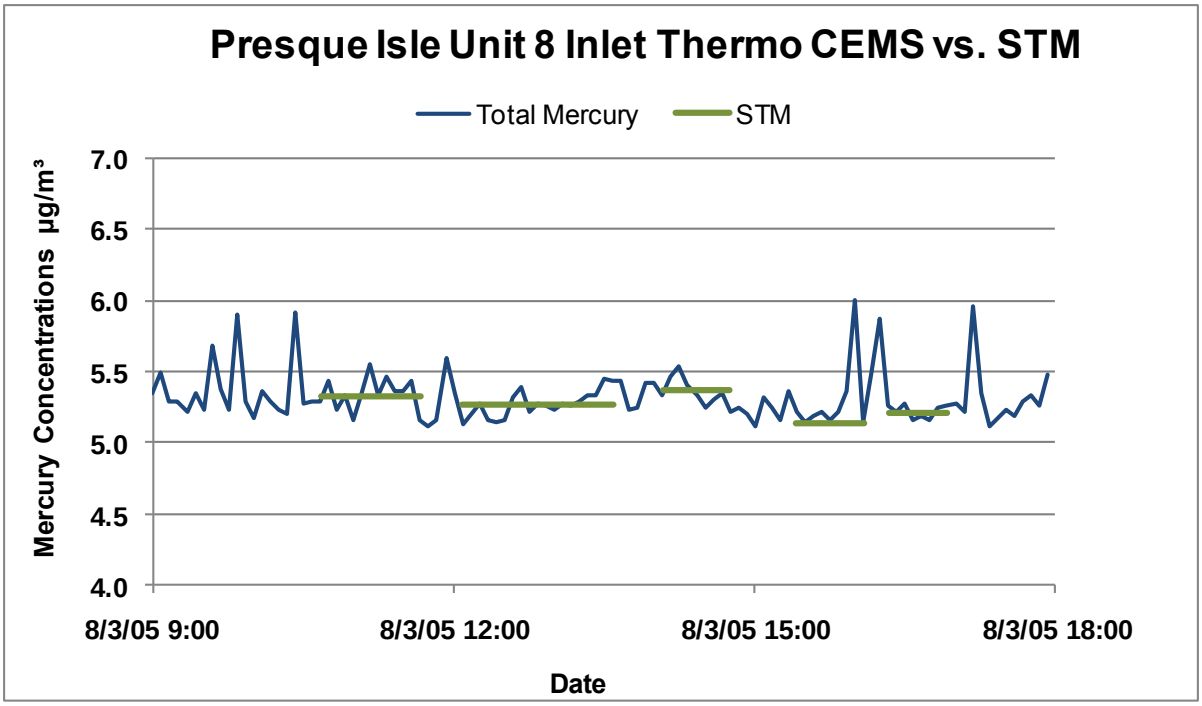


Figure 4-22. PIPP Unit 8 Inlet Thermo Mercury CEMS versus STM, August 2005.

The results of the certification test were consistent with the requirements recommended by CAMR and the system was considered "certified" as of October 27, 2005. No bias was identified in comparison to the results of the STM testing. A three-point converter check was not performed as the design of a prototype unit that produces oxidized mercury had not been completed at the time of this test.

The mercury system installed at the Unit 8 air preheater outlet was also required to undergo routine quality control and assurance procedures according to CAMR. The ongoing performance requirements included a daily two-point calibration error check with elemental mercury, a quarterly three-point linearity check, a monthly three-point converter check (not currently available), and an annual RATA and bias test.

4.7.8 Thermo Electron Mercury CEMS – Commercial Production

4.7.8.1 TXU Big Brown Steam Electric Station, October and November 2005

ADA-ES and Thermo personnel took part in a field evaluation test of the mercury CEMS at TXU's Big Brown Steam Electric Station in order to determine the ability of the mercury

system to monitor emissions from a stack. The project was partially funded through the PIPP CCPI and was designed to support ongoing development and demonstration of a commercial grade mercury CEMS.

The importance of testing at the Big Brown Unit 1 stack was to compare the performance of the Thermo CEMS against other CEMS installed at the station. Selenium concentrations are high at the stacks of coal-fired power plants that burn Texas lignite coal, and selenium has been known to cause an interference with other mercury CEMS. The unique design of the Thermo CEMS made use of a dilution module to dilute the flue gas for transport to the analyzer and a converter core design that converted the oxidized mercury into total mercury before transport.

The Thermo mercury CEMS was installed on October 17–19, 2005, and was one of the first new-generation Thermo iSeries mercury CEMS operated at a field site. The system was installed as a temporary system and the software was not in the final release, therefore the system experienced some expected operational problems during the test. The probe was installed into the Unit 1 stack at a stack elevation of 270 feet. During the testing, the performance of the mercury CEMS was carefully monitored and was able to measure total mercury accurately during the evaluation period.

Figure 4-23. Thermo Prototype iSeries Mercury CEMS at Big Brown Unit 1 Stack, October 2005.

Figure 4-24. Thermo Prototype iSeries Mercury Probe at Big Brown Unit 1 Stack, October 2005.

The calibration gas was not preheated sufficiently and it was believed that the presence of selenium or another flue gas component was diffusing into the calibration line and causing the elemental mercury to be "scrubbed" before entering the probe. The calibration line was rerouted in order to make sure it was preheated before entering the probe to eliminate this contamination problem.

The oxidized mercury scrubber was located on the elemental mercury line and was designed to scrub the oxidized mercury and other contaminants before the gas was transported to the analyzer through the heated sample line. The scrubber was originally located in a cooler section inside the probe and was causing the scrubber to capture elemental mercury as well as other contaminants to cause the elemental mercury measurements to be artificially low. The scrubber was moved to another location inside the probe and insulated to keep the component properly heated; this corrected the problems.

Other operational problems with the system were directly related to the temporary installation of the mercury system. The heated sample line was made up of four smaller sections of sample line connected together to make up the 300-foot change in elevation from the probe to the analyzer. These umbilicals were temporarily secured to the Unit 1 stack with rope, and inclement weather conditions caused the sample line to swing dramatically in the

wind. The movement of the sample lines caused intermittent leaks and electrical continuity problems in the connections between the four umbilicals. There were also significant power surges that damaged one of the solenoids in the analyzer for the calibration sequence. All of these problems were directly related to the type of temporary installation of the system and it was determined that these problems would not impact the more permanent installation at Presque Isle.

The intent of the field evaluation at Big Brown was to determine the performance of the mercury CEMS measuring stack emissions. Due to the problems listed above, the required quality control and assurance checks that would normally accompany an installation were abbreviated or not able to be strictly followed. The seven-day calibration error test was abbreviated to five days due to a loose fitting at the extraction probe and a proper linearity check was never completed because of the operational problems. A comparison to STM results was completed later in the test plan after repairs and corrections to the system improved the performance of the mercury CEMS.

Table 4-10. Seven-Day Calibration Error Test at Big Brown; October 21–27, 2005.

Day	Date	Start	Span	CEMS Zero	CEMS Span	Abs Err	% Error	Result
1	11/14/05	14:13	15.0	-0.4	14.1	0.9	4.5	PASS
2	11/15/05	08:10	15.0	0.1	14.3	0.7	3.5	PASS
3	11/16/05	06:35	15.0	-0.5	15.0	0.0	0.0	PASS
4	11/17/05	05:10	15.0	-0.2	14.2	0.8	4.0	PASS
5	11/18/05	16:41	15.0	-0.1	13.9	1.1	5.5	FAIL

According to the CAMR, the initial certification of the mercury CEMS needed to include a RATA and a bias test. A modified RATA was conducted with STMs and the results compared to the CEM to determine if a bias existed. The STMs were considered a reliable measurement of mercury in flue gas.

Three pairs of STM traps were run in order to compare the measurements recorded by the Thermo CEMS. The total mercury concentration measured by the Thermo CEMS was never

more than 12% error from the STM traps during any of the three runs. This satisfied the requirements of a maximum relative accuracy of less than 20% as specified by the CAMR.

Table 4-11. Comparison to STM Traps, RATA Testing at Big Brown, October 2005.

Start Time	End Time	STM 1* µg/dNm³	STM 2 µg/dNm³	CEM µg/dNm³	% Error (STM 2)
10/25/05 08:55	10/25/05 9:55	19.67	25.16	19.5	-4.4
10/25/05 10:40	10/25/05 11:40	27.74	26.18	22.4	11.4
10/25/05 12:07	10/25/05 13:07	24.24	25.41	23.3	6.4

* Dry basis, 0 °C.

A second check of the operation of the Thermo CEMS was conducted with three pairs of STM traps in on November 10, 2005. The results showed that the Thermo CEMS were still accurately measuring total mercury within 8% of the STM traps. This check also achieved the maximum relative accuracy of less than 20% as required by the CAMR.

Table 4-12. Comparison to STM Traps, RATA Testing at Big Brown, November 2005.

Start Time	End Time	STM 1* µg/dNm³	STM 2 µg/dNm³	CEM µg/dNm³	% Error (STM 2)
11/10/05 08:56	11/10/05 09:56	36.4	35.9	33.7	7.3
11/10/05 10:26	11/10/05 11:26	36.4	37.8	33.4	3.4
11/10/05 11:52	11/10/05 12:52	37.2	35.9	32.3	1.6

* Dry basis, 0 °C.

By using the amount of total mercury naturally contained in the coal and the mercury captured in the fly ash, ADA-ES calculated how much mercury should be contained in the flue gas and compared that to the measurements of the Thermo CEMS. Although the percent difference between the Thermo CEM system and the calculated mercury in the flue gas was high on October 23, 2005, the STMs run on that day matched very closely with the mercury measured by the Thermo analyzer. The cause of this error could be found in the fly ash collected for that comparison. This error was not seen in the repeated test on November 10.

Table 4-13. Average Coal, Flue Gas, and Fly Ash Mercury Results at Big Brown in lb/Tbtu.

Date	Coal Hg	Ash Hg	% Ash Capture	Calc. Hg Conc.	CEMS Hg Conc.	% Error
10/25/05 06:00	23.03	4.35	19	18.68	15.17	-23.1
11/10/05 06:00	28.16	6.64	23	21.52	21.54	0.1

The test results demonstrated that the Thermo Mercury Freedom System™ performed very well with measuring total mercury in a stack gas with traditionally difficult contaminants. The measurements of the mercury CEMS were proven to be very accurate and consistent from very early in the test period despite some operational problems that required quick modification and service to improve the performance by correcting temperature and leak concerns. Remote communication was used exclusively for a majority of the testing phase and was proven to be reliable for long-term testing at Presque Isle. Most importantly, the testing at Big Brown was able to identify small problems and required modifications to the system to tune the equipment and create a more robust and reliable system.

4.7.8.2 Installation of the iSeries CEMS at PIPP Unit 8 Inlet and Baghouse Outlet

Thermo supplied two production-grade iSeries Mercury Freedom Systems™ to Presque Isle in December 2005. One was installed at the outlet duct of the baghouse during the week of December 12.

The new iSeries instruments represented a significant improvement over the prototype C-Series mercury CEMS. Some of the improvements to the new iSeries instruments included the capability to communicate with the instruments through built-in Ethernet ports, shared design features with other iSeries instruments, easier user interaction through on-screen menu and display, enhanced input/output functionality to integrate into various plant operations, and data management systems.

The Unit 8 air preheater outlet mercury CEMS (inlet to the baghouse) was installed on December 12, 2005. The old C-Series instruments were removed and replaced with the new

iSeries early production units. The prototype mercury probe remained installed in the Unit 8 duct as it was designed to work with the new iSeries instruments and did not require replacement. The heated sample line also did not require replacement. In addition to the new instruments installed at the inlet location, the heated sample lines were installed on January 24, 2006, for future sampling of mercury from Unit 7and Unit 9.

Figure 4-25. Installation of new iSeries Mercury CEMS at the PIPP Baghouse Outlet, December 2005.

The baghouse outlet mercury CEMS was installed on December 19, 2005. The outlet mercury CEMS included a CVAF mercury analyzer, elemental mercury calibrator, stack probe controller, inertial filter sampling probe, zero air supply, and a 40-foot heated sample line. The mercury CEMS was installed in a CEMS shelter located in the baghouse enclosure and the probe was mounted on the duct flange above a nearby access platform.

Figure 4-26. Baghouse Outlet Duct Mercury CEMS Shelter and Installed Probe, December 2005.

Figure 4-27. Thermo iSeries Mercury CEMS Installed in the Shelter at the Outlet Location, December 2005.

Because of the new capabilities of iSeries instruments, both the Unit 8 air preheater outlet ("Inlet") and baghouse outlet ("Outlet") systems were connected to an ESC data logger and integrated with the plant DAS and DCS systems during the week of January 10, 2006. A sketch of the primary connections is shown in Figure 4-28. The mercury CEMS were connected through an ESC data logger that controlled the daily zero and span checks on the same schedule as the other plant CEMS. Mercury concentrations and status information was stored on the plant DAS with other plant CEM data. The mercury concentration output from the mercury CEMS was also connected directly into the plant DCS system to allow feedback control of the sorbent injection system in the future.

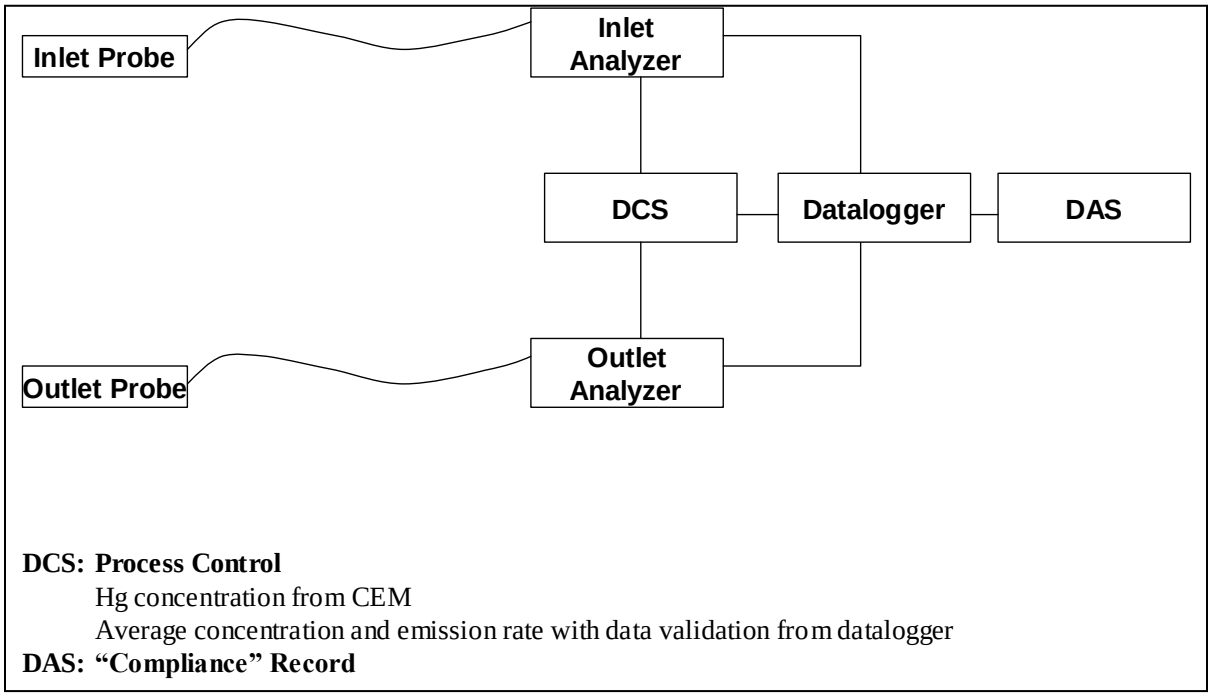


Figure 4-28. Schematic of Mercury CEMS Integration into DAS and DCS.

4.8 Task 8: Mobilize Contractors

CaTS, the project construction manager, began construction mobilization on June 28, 2004. Full mobilization was complete by the end of July 2004. Initial field pre-construction work began in July with the demolition and relocation of an existing parking lot away from the construction site. Major subcontractor mobilizations continued through August 2004.

Preliminary fieldwork, prior to subcontractors mobilizing on the site was completed in the third quarter of 2004. This work included the building of a 77,000 sq. ft. parking lot, with access roads and lighting for the subcontractors at PIPP. Trailer locations were established and temporary power was installed. A paved 33,000 sq. ft. parking lot was completed for We Energies employees in the third quarter of 2004 as well.

The foundation contractor, Boldt, was selected in September and was mobilized thereafter. The Unit 7 tie-in damper contractor, Jamar, was mobilized September 28, 2004, and planned to complete their work in early November. This work was originally planned for Budget Period 2, but was allowed per agreement with DOE NETL to be conducted during Budget Period 1.

The substructure contractor completed the fan and motor pedestal foundations, ash silo foundation, and all of the ductwork support steel foundations. All major foundations were completed by January 21, 2005. All construction work was shut down for the winter between January 22, 2005, and February 18, 2005, because of adverse weather. The superstructure contractor, Jamar, mobilized on February 18, 2005, to receive and erect the ductwork on the baghouse foundation. Wheelabrator Air Pollution Control, the baghouse erection contractor, mobilized the last week of February. Jamar performed the mechanical and structural erection work the first and second quarters of 2005.

Northland Electric mobilized in May 2005. They initiated the electrical, instrumentation, and control installation work in the second quarter of 2005.

All contractor mobilization work was completed in second quarter of 2005. All contractors—Jamar, Boldt, Northland Electric, United Anco, PCI, Wheelabrator, and CaTS—demobilized from the site in the fourth quarter of 2005.

4.9 Task 9: Foundation Erection

Boldt was the foundation contractor selected in September 2004. Work began with dewatering and then demolition of the concrete parking lot and perimeter sheet piling.

In the fourth quarter of 2004 the baghouse and PAC silo foundations were completed. The fan enclosure foundations, fan and motor pedestals and ash silo foundations were started in the fourth quarter of 2004 and finished in the first quarter of 2005. All of the ductwork foundation work also began in fourth quarter of 2004 and finished first quarter of 2005. Figure 4-29 and Figure 4-30 shows the progress of the foundation work at the site in the fourth quarter of 2004.

Figure 4-29. View of Baghouse Foundation Installation.

Figure 4-30. View of the Fan and Motor Pedestal Foundations Installation.

All major foundation work completed during the first quarter of 2005. Only minor equipment housekeeping pads, personnel landings, grouting, and paving activities were left to complete in the second quarter of 2005.

4.10 Task 10: Erect Structural Steel, Baghouse and Ductwork

Erection work for the baghouse and ductwork started in the first quarter of 2005. Initial deliveries for baghouse, structural steel, and ductwork were received at the site in the middle of February, 2005. Boldt erected baghouse support steel, the baghouse hoppers, and initiated baghouse compartment panel erection in the second quarter of 2005.

Superstructure contract erection work was also initiated by Jamar during the second quarter of 2005. Work included erection of ductwork support steel, silo support steel, the ID Booster Fan enclosure steel, and the field fabrication and erection of ductwork sections. Erection and insulation of the Phase 1 ductwork (ductwork under baghouse) was completed in the second

quarter of 2005. Insulation of the remainder of the ductwork was also initiated during this quarter and finished in the third quarter of 2005.

The Norit activated carbon injection system was delivered to the site in July 2005. The system was installed early November 2005. ADA-ES finished the first draft of the DCS code for controlling the PAC Injection system in the third quarter of 2005. Inside the code were six different control schemes to control PAC injection rates. The startup document was completed by ADA-ES and Norit. The startup schedule was also completed in the third quarter of 2005.

In the third quarter of 2005 the baghouse compartment erection, baghouse stair tower erection, inlet and outlet plenums erection, and the baghouse tube sheet erection was all completed by Boldt. The ash silo support steel erection work and booster fan enclosure were all completed in the third quarter of 2005. The ductwork support steel erection work continued during this period.

The erection of the penthouse steel and siding, installation of internal baffles and turning vanes, the inlet, outlet, and bypass dampers were all completed in the fourth quarter of 2005. The setting of the baghouse tube sheets and the installation of all the bags and cages also took place in the fourth quarter of 2005. All fabrication and erection of ductwork and ductwork support steel was finished and ductwork expansion joints were installed by the end of the fourth quarter of 2005. All major construction efforts in this task except punch list items such as the installation of access platforms were completed at the end of the fourth quarter of 2005.

The baghouse was brought on line on December 17, 2005, using flue gas from Unit 7 boiler. Although the baghouse was operational as of this date, work continued into the first quarter of 2006 involving the tie in of Units 8 and 9 (January 2006), tie in of the PAC system (January 2006), and completing the punch list items.

4.11 Task 11: Balance-of-Plant Mechanical and Civil/Structural Installations

The Unit 7 tie-in damper work started on September 28, 2004 and was completed in early November. This was a partial installation, with the turning vanes and purge air equipment installed later. This work was originally planned for Budget Period 2, but was allowed per agreement with DOE NETL to be conducted during Budget Period 1.

In the first quarter of 2005 insulation of ductwork was initiated along with preparation for Unit 8 tie-in. Jamar took responsibility of the balance-of-plant mechanical work beginning in the second quarter of 2005. Work complete in second quarter of 2005 included the erection of the ash silo structural steel, the installation of the ID booster fans, air compressor/dryer skid, and ash piping system. PAC piping began in the second quarter of 2005 and was complete in the third quarter of 2005. The diverter damper for Unit 7 and 8 was installed during scheduled plant outages which also occurred during second quarter of 2005. Unit 9's diverter damper was installed during a scheduled outage in the third quarter of 2005.

In the third quarter of 2005 the air piping system for the bag house was installed, as was the booster fan lube oil piping. The inlet and outlet guillotine damper and seal air fans were installed for the ID booster fan. The ash system equipment was also installed in the third quarter of 2005. Siding installation on booster fan enclosure began in the third quarter as did the insulation and lagging of the ductwork.

All major work was completed in the fourth quarter on 2005. This included the installation of the pulse air headers and actuators, the completion of the ductwork insulation and lagging and the siding on the booster fan enclose as well as the installation of the silo heating and ventilation system.

4.12 Task 12: Balance-of-Plant Electrical Installations

The electrical equipment enclosure and baghouse CEM enclosure were delivered to site in the first quarter of 2004. Northland Electric was selected as the electrical, control, and instrumentation contactor. Northland Electric mobilized on site in the second quarter of 2005. Their work focused on developing their construction implementation schedule and

erection of cable tray and supports in the plant and baghouse areas. In the third quarter of 2005 Northland Electric completed the installation of all the cable tray and cable, transformers, switchgears and MCCs. DCS cabinets were set in place as well. The installation of baghouse lighting began in third quarter of 2005 and was completed in the fourth quarter.

All major work was completed in the fourth quarter of 2005. This included pulling and termination of cable for the ID booster fan equipment, ash equipment, PAC equipment, and DCS equipment. Units 7 through 9's diverter dampers, seal air systems, guillotine dampers were also wired up. Wiring of the heating and ventilation systems in the baghouse was also completed. The MCCs were energized, and the baghouse lighting was completed. The GAI-Tronics PA phone system was also installed.

4.13 Task 13: Equipment Pre-Operational Testing

Checkout was performed in the third quarter of 2005 for the electrical power system. Transformers, feeders, MCCs, the UPS, and the compressed air system were all tested. Point to point wiring checks, loop checking, I/O checking, and logic checkouts were all performed in the fourth quarter of 2005. Checkouts of the baghouse ash system, fans, dampers, CEMs, electrical system and DCS was all also completed in the fourth quarter of 2005.

4.14 Task 14: Startup and Operator Training

CaTS mobilized their startup manager during in the second quarter of 2005. Startup work focused on development of the detailed startup schedule, development of the startup program outline, and developing the startup program component documents.

Finalization of the detailed startup schedule and startup program component documents was completed in the third quarter of 2005. Lockout and tag out procedure, and training on implementation of the procedure was provided to personnel on site in this quarter, as was the operator training program and two training sessions. Preliminary O&M manuals were received for the MCCs, switchgear, baghouse and ID booster fans and final O&M manuals were received for the ash system, PAC equipment, compressed air system, diverter and

guillotine dampers in the third quarter of 2005. The electrical system including transformers, feeder breakers and UPS were put into operation and the compressed air system was also started.

In the fourth quarter of 2005, ID booster fan, ash transport and wet and dry ash unloading systems were all started. Final O&M manuals were received for the MCC's, switchgear, and ID booster fans during this quarter. With baghouse being initially brought into operation on December 17, 2005, with Unit 7 flue gas, startup of all major equipment was completed in the fourth quarter of 2005. Final O&M manuals were received for most major equipment and the operator training program was all completed by the end of the fourth quarter of 2005. Initial operation of the baghouse with Unit 8 flue gas occurred on January 5, 2006, and Unit 9 on January 27, 2006.

A meeting was held in January 2006 with We Energies and ADA-ES to discuss PAC injection control strategies. Based on the meeting, the plant developed the following five control strategies:

- Constant rate injection
- Feedback with mercury removal as a setpoint
- Feedback with mercury outlet as a setpoint
- Feedback with mercury inlet as a setpoint
- Batch injection – this strategy was in its early stages at the time

The PAC silo and injection system was started and checked in January 2006. PAC was delivered to the silo on January 26, 2006. The PAC injection system was checked out in the first quarter of 2006. This included bumping all motors, checking for proper rotation, and megger tested (an electrical insulation test) all 480 VAC motors. All injection trains on the PAC system (i.e., Units 7, 8, and 9) were started and calibrated to the maximum feed rate. For each of the trains the maximum feed was 190 lb/hr, 190 lb/hr and 220 lb/hr respectively. The difference in maximum feed rate may be attributed to material flow characteristics at the time. The maximum conveying rates was tested for all injection trains. With the existing

metering augers, the maximum injection rate was 100% of the feeder speed. The eductor was sized such that, the plant had no problem feeding between 5–100% of the feeder demand.

The first PAC injection started on January 27, 2006. This was injection only into the Unit 7 duct. The injection continued for approximately four hours at varying injection rates. There was no noticeable increase in pressure drop in the baghouse during injection. The outlet mercury concentration went from 5.0 ug/m^3 to 2.1 ug/m^3.

PAC injection continued on January 28, 2006. All three injection trains were used. Each unit was brought up to 100% feed rate while the other two were kept at 10%. After this, the PAC injection was kept at 10% on all three trains.

The PAC feeders were calibrated on January 28, 2006. Table 4-14 shows that the trains were injecting less than originally calculated. The new calibration factors to convert percent feeder speed to actual feed rates were changed in the DCS logic.

Table 4-14. PAC Injection System Calibration

Unit	Feed Rate (%)	Assumed Feed Rate (lb/hr)	Sample Weight (lb)	Sample Time (min)	Actual Feed Rate (lb/hr)	Differential (%)
7	5	15	1.375	10	8.25	55.00
7	10	30	3.125	10	18.75	62.50
7	20	60	7.625	5	37.50	62.50
7	50	150	8.250	5	99.00	66.00
7	75	225	7.500	3	150.00	66.67
8	10	30	3.250	10	19.50	65.00
8	20	60	3.750	6	37.50	62.50
8	50	150	5.000	3	100.00	66.67
9	10	30	4.000	10	24.00	80.00
9	20	60	4.375	6	43.75	72.92
9	50	150	5.625	3	112.50	75.00

4.15 Task 15: Operate, Test, Data Analysis, and Optimize TOXECON™ for Mercury Control

4.15.1 Overview

This task originally consisted of several major subtasks that are described below. Results from each of these areas are described in later sections in addition to some unanticipated tests.

4.15.1.1 Optimize TOXECON™ for Mercury Control

This subtask covered the entire 3.5-year demonstration period. The original scope covered several months of baseline and parametric testing to optimize mercury removal using two commercially available sorbents. This was to be followed by a period, up to 6 months, of continuous operation to monitor performance and to conduct acceptance tests. Operating data was tracked weekly, and included pressure drop, drag (drag is pressure drop divided by flow), cleaning frequency and opacity. Spray cooling for enhanced mercury control was also to be evaluated if operating temperatures were above 350 ºF. Manual stack measurements were planned for both PM and mercury. Once operation and performance was established, the plan was then to conduct additional short-term tests where different operating strategies could be evaluated.

4.15.1.2 Develop Fabric Drag History

Periodic in-situ fabric drag measurements were planned to develop a history of fabric drag over time. Note: Baghouse performance typically degrades over time so determining the time it takes to reach expected long-term operating condition is necessary for developing optimized design criteria for other sites.

4.15.1.3 Fabric Evaluation

Bags were to be removed periodically to perform destructive strength testing and measure bags dimensions to track structural integrity. Testing included Mullen Burst which measures fabric strength by noting the pressure necessary to cause a failure in the fabric.

4.15.1.4 Continuous Mercury Measurements

Efforts to obtain CEM quality mercury measurements from the inlet and outlet of the baghouse were to be continued throughout Task 15. It was anticipated that minor improvements would be made to the CEMs, especially during the first year of operation.

4.15.2 Instrumentation and DAQ

4.15.2.1 Mercury CEM/DCS Interaction

Both the Unit 8 air preheater outlet ("Inlet") and Baghouse Outlet ("Outlet") Continuous Emissions Monitor Systems (CEMS) were connected to an ESC data logger and integrated with the plant DCS system. The mercury CEMS were connected through an ESC data logger that controlled the daily zero and span checks on the same schedule as the other plant CEMS. Mercury concentrations and status information was stored on both the ESC data logger and the plant DCS along with other plant CEM data. The mercury concentration output from the mercury CEMS was connected directly into the plant DCS system to allow feedback control of the sorbent injection.

4.15.2.2 PAC Injection Equipment

The critical instrumentation associated with the PAC injection equipment included level indicators on the storage silo and day hoppers, and a variable speed feeder. The level indicators were used to approximate the amount of sorbent material that was in the silo. The level indicators on the day hoppers were used for controlling the timing of transfer of sorbent material from the storage silo to the day hoppers. From each day hopper sorbent material went through the variable speed feeder, through an eductor and than conveyed pneumatically to the injection point. The components of the injection equipment, including the conveying air blowers, fluidization air, and feeders could be monitored and controlled manually or through the DCS.

4.15.2.3 TOXECON™ Baghouse

The TOXECON™ baghouse critical instrumentation included thermocouples, flow sensors, and pressure transmitters. The thermocouples measured the flue gas temperature at the inlet and outlet of the baghouse. One of the functions of the thermocouples that measure the flue

gas temperature at the baghouse was to indicate if the temperature was above the maximum acceptable temperature for the bags. If the flue gas temperature went above 385 °F for 30 minutes the DCS would automatically bypass the baghouse. If the flue gas temperature reached 400 °F the DCS would immediately bypass the baghouse. Normally, the control operator would begin to take action, including reducing unit load, if the flue gas temperature exceeded 375 °F.

Thermocouples were installed on the hopper walls to indicate if the hopper heaters were too hot, which could cause the ash to overheat and possibly ignite. Two thermocouples were installed on the outside of the hopper walls each of the ten hoppers. Hopper 4 also had four thermocouples installed on the inside hopper wall. The thermocouples were not effective as an early indicator of ash igniting since the heat generated from a self-ignited ash fire was contained within the insulative material and the high temperatures would not be seen at the hopper walls. However, if there happened to be an ash-overheating incident the thermocouples would eventually show that the ash had ignited once the burn reached the outer material near the hopper wall.

There were pressure transmitters at the inlet and outlet of the baghouse as well as at each compartment on the baghouse to measure differential pressures. The pressure transmitters on each compartment were used to measure differential pressure across the tube sheet. The pressure transmitters at the inlet and outlet of the baghouse were used to determine overall baghouse pressure drop or flange-to-flange pressure drop. If the baghouse differential pressure reached a specific set point based upon the number of units on line, then a cleaning of the bags would be initialized.

4.15.2.4 DCS/EDS

The plant DCS was equipped with a feature called Enterprise Data Server (EDS). EDS is an efficient system for collecting and processing plant information, giving its users access to the current and historical data collected from the DCS. EDS was accessed through Windows based PCs and reports were typically downloaded to Excel spreadsheets. The use of spreadsheets proved very efficient for analyzing and reporting results for the project.

4.15.3 Operating Procedures

4.15.3.1 Startup and Shutdown Procedures

Startup of the baghouse is typically performed one unit at a time. A single unit is diverted from the stack to the baghouse while it is off line and the fans turned off. Baghouse hopper heaters are turned on to prevent condensation on the hopper walls. Only two compartments are used during initial startup of the first unit with the other compartments bypassed. This is done to minimize corrosion damage to the baghouse. Starting with low flow from a single unit, the remaining compartments are brought on line one at a time as temperatures build up in a controllable fashion. The second and third units are then brought on line when the baghouse is at a stable operating condition.

The baghouse could be either bypassed or diverted. Bypass involved closing the poppet valves in the compartments so that the flue gas would flow only through the center duct of the baghouse and not through the compartments. The flue gas would then exit back out the return duct to the stack. The flue gas could also be diverted to the stack by moving the diverter dampers that controlled the direction of the flue gas flow where each individual duct was tied into the common baghouse inlet duct. In order to divert flue gas wither to the baghouse or to the stack, a unit was brought off line and the damper position changed. Each of the 3 units would be diverted one-by-one until there was no flow going through the ductwork or the baghouse. This scenario was necessary for duct inspections.

4.15.3.2 Process Parameters

With the exception of PAC injection rate and baghouse cleaning frequency, most process parameters were not specifically controlled throughout the demonstration project. Boiler operation was impacted as little as possible during testing.

Baghouse process parameters (e.g., flow rates, temperatures, pressures, and A/C ratio) were monitored through the DCS/EDS. These were controlled through boiler load and the number of units diverted to the baghouse. Boiler and air preheater sootblower operation would also have an effect on the flue gas temperature.

The baghouse cleaning frequency was originally set to clean on pressure drop with a default time of 72 hours if the pressure drop was still below the setpoint. During the testing process it was determined that if the PAC remained on the bags too long, the captured mercury was eventually re-emitted. Based on this and subsequent trials a decision was made that the optimum condition was for the average age of PAC on the bags to be about four hours. The default cleaning timer was adjusted to one hour, which then met the goal of four-hour average PAC age. It was found that with less than three units on the baghouse, there was not enough particulate matter being collected to maintain an adequate filter cake with a one-hour cleaning timer. An adjustment was made to the operating procedure which changed the default timer based on the number of units on line. The setpoint for cleaning on pressure drop already had an adjustment for the number of units on line. Table 4-15 shows the setpoints used. With three units on line, the baghouse initiates a clean of one-sixth of the baghouse every hour, so every bag is cleaned every six hours. With the time delay moving between compartments and how the timer was configured lead to the four-hour average PAC age rather than three-hour average one might suspect.

Table 4-15. Baghouse Cleaning Setpoints.

Baghouse Cleaning Setpoints		
Units In Service	**Default Timer (hours)**	**Pressure Differential (" w.c.)**
3	**1**	**6.5**
2	**2**	**4.6**
1	**4**	**2.3**

The PAC injection rate was controlled through the DCS. The amount of PAC being fed came from feedback signals from the variable speed feeders. The amount of gas flow came from the stack CEMs. This provided the basis for calculating the lb/MMacf value which was compared to the setpoint. During the project testing it was determined that if a unit was on line but not burning coal, the PAC injection rate would be too high and there would be over-control of mercury. To correct this, coal feed to each unit was used to trim PAC injection.

Normally, PAC injection was controlled by setting a target lb/MCF value and having DCS adjust the variable speed feeders to meet this value. The DCS logic also had provisions for controlling PAC feed using three other approaches: 1) percent mercury removed; 2) outlet mercury value; and 3) inlet mercury value. Little testing of the second and third alternatives was done. However, extensive operation using control based on percent mercury removed did occur.

The idea of controlling PAC feed based on a mercury removal setpoint had considerable interest. This would allow the DCS to continuously adjust PAC feed to meet a removal target while mercury levels in the coal varied in addition to the other process variations. However, this proved impractical because of the significant response delay to small changes in PAC feed and the resultant change in mercury removal level. It was found more useful to set PAC feed at a constant lb/MCF rate and let the long-term averaging of mercury removal levels take care of the mercury in coal variance.

4.15.4 Test Plan

A Test Plan for the demonstration testing was issued on June 15, 2006 (Appendix B). The following are several pertinent sections from the Test Plan.

Specifically, the following test program objectives were to be initially pursued:

- Determine baseline mercury levels into the new fabric filter and resulting emissions without sorbent injection.
- Quantify the sorbent injection rate versus mercury removal relationship and how it may be a function of unit load and flue gas temperature.
- Develop a chronicle of fabric filter performance over the three-year demonstration period, detailing how pressure drop, cleaning frequency, mercury removal, and bag strength change.
- Quantify the effects of air-to-cloth ratio on mercury control and required cleaning frequency. Determine a maximum design ratio.

- Develop a reliable control algorithm for controlling mercury emissions from three generating units using a common TOXECON™ fabric filter.
- Evaluate the potential for recycling the sorbent/ash mixture for improved sorbent utilization and reduced operating cost.
- Evaluate the technical and economic performances of various viable sorbents.

The testing was conducted in two major phases; optimization and long-term testing. The first priority was to conduct testing necessary to place the Presque Isle system in reliable operation. The second phase involved testing to broaden the general understanding of the process, examine new sorbents, and experiment with potential process upgrades such as ash/sorbent recycle and SO_2 and NO_x trim controls.

4.15.5 Analysis of Feed Stock, Products, and Reagents

4.15.5.1 Coal Sampling and Analysis

Coal samples were obtained throughout the demonstration period based upon the testing performed. Samples were placed in clean sample bags and sealed. Each coal sample was labeled with the date, time, and unit identification. The samples were then sent to ADA-ES for storage and analysis, as appropriate. Samples were analyzed according to the individual needs for each phase of testing, but tests included mercury, chloride, ultimate, and proximate analyses.

PIPP burns Powder River Basin (PRB) subbituminous coal in Units 7–9. Table 4-16 provides an analysis of this fuel prior to the demonstration project and the average values measured during the long-term testing.

Appendix C contains coal analysis data from baseline testing, including mercury, chlorine, ultimate, and proximate results. This appendix also contains ash analysis from baseline testing. Appendix D contains coal analysis from long-term testing.

Table 4-16. Compositional Analysis of Subbituminous Coal Used at PIPP.

Characteristic	2001	Long-Term Testing
Higher Heating Value, Btu/lb	9,052	9,113
Analysis, percent by weight		
Moisture	25.85	25.59
Carbon	52.49	52.81
Hydrogen	3.65	3.68
Nitrogen	0.75	0.43
Sulfur	0.28	0.26
Ash	4.64	4.38
Oxygen	12.33	12.85
Mercury	46 ng/g	50.6 ng/g dry
Chlorine	Approx. 100 µg/g	351 µg/g dry
Bromine	Not tested	1.99 µg/g dry

4.15.5.2 Fly Ash

Ash samples from the TOXECON™ baghouse and Units 7–9 HESPs were taken throughout the demonstration period based upon the testing needs at the time. The ash samples were analyzed for LOI and mercury content using Modified ASTM D 6722-01 for mercury and Modified ASTM C 311-04 for LOI. Appendix C contains ash analysis from baseline testing. Appendix E contains ash analysis from long-term testing. LOI and mercury varied widely, depending upon the tests being performed.

Fly ash samples were tested in 2009 using EPA Method 1311 Toxicity Characteristic Leaching Procedure (TCLP) and EPA Method 1312 Synthetic Precipitation Leaching Procedure (SPLP). Table 4-17 shows the results of leachate testing for mercury, total chromium, and bromide. For all samples tested, mercury and chromium were well below the TCLP criteria for a hazardous waste. PAC-containing ash showed a reduction in leachable chromium when compared to the low-carbon control. Hexavalent chromium showed the same trend as total chromium (not shown). Because the PAC used in the TOXECON™

baghouse was brominated, the bromide levels in the leachate were tested. The TOXECON™ ash at 42% LOI showed an increase in bromide in the leachate compared to the ESP ash.

Table 4-17. Ash Leaching Results.

Sample		Mercury (ng/L)	Total Chromium (µg/l)	Bromide (mg/l)
TCLP Criteria		200,000	5,000	
TOXECON™ Ash (42% LOI)	SPLP	19.9	1.5	63.0
	TCLP	43.7	4.8	69.6
PIPP ESP Ash (0.7% LOI)	SPLP	18.5	177.0	ND
	TCLP	8.7	628.0	ND

4.15.5.3 PAC

Activated carbon samples were taken periodically from the silo feeders. Carbon samples were also taken during the alternative PAC tests, and milling tests. Appendix F shows the results from particle size distribution testing for both DARCO® Hg and Hg-LH. These were the two primary carbons tested during the demonstration project. Alternative PAC testing was also performed and is detailed in a following section of this report.

4.15.5.4 Trona

Trona is a sodium-based, naturally occurring mineral (sodium sesquicarbonate). The trona used during this test program to reduce sulfur dioxide was obtained from Solvay Chemicals, Inc. and was mined in Green River, Wyoming. The purified SOLVAir Select 200 trona was shipped by rail to Chicago then loaded into dry hopper trucks for delivery to Marquette, Michigan. The particle size of the trona averaged 26 µm according to the Certificate of Analysis accompanying the material.

4.15.6 Startup Issues – Hopper Fires and Ash Overheating

On March 1, 2006, after several weeks of parametric testing, burning embers were found in one of the baghouse hoppers while operators were working to unplug and evacuate it. This compartment was isolated and the baghouse remained in service. All of the compartments

were then checked and embers were found in all of the hoppers. The compartments were isolated, PAC injection was discontinued, and the baghouse was put into bypass mode. The hot PAC/ash in each hopper was cooled and removed. This section documents the events that occurred and the investigation that was conducted to determine the cause of this unexpected event.

The following is a detailed timeline of the events:

- Parametric testing began on February 20, 2006, at a PAC injection rate of 0.5 lb/MMacf after a short duration at 3.0 lb/MMacf to increase the baghouse pressure drop.
- Parametric testing: PAC injection concentration increased to 2.0 lb/MMacf on Sunday, February 26.
- On Monday, February 27, some embers were found in Hopper #5 during ash sampling. On Tuesday, February 28, a report indicated that plugging of the hopper throat was occurring on Compartment 5. It was not clear what was causing the plugging or embers.
- On Wednesday, March 1, embers were again found in the hopper of Compartment 5. This compartment was isolated but the baghouse remained in service. An investigation began to determine the cause of the problem.
- On Thursday, March 2, embers were found in all the baghouse hoppers. PAC injection was stopped at approximately 2:00 a.m. when this was noticed. The baghouse was put in bypass mode and the compartments isolated. The hoppers were first flooded with water, allowed to cool, and then the ash was vacuumed out.
- There was some indication that at least one ash hopper was not completely emptying. Rat-holing, which occurs when the material packs on the sides of the hopper and leaves only a narrow funnel down the center for the material to flow, had been seen when the inspection door was opened.

- On Friday, March 3, all of the hoppers as well as the ash handling system were cleaned. The baghouse was then returned to service. All compartments were in service. Pressure drops and opacity levels looked normal, although, if there had been bag problems, they would not have been evident under these conditions.
- Samples of the activated carbon from the PAC silo were taken for testing and analysis. Samples were sent to Norit, the We Energies laboratory, and ADA-ES. Samples from the ash hoppers were also archived for later analysis.
- The only known source of external heat to the hoppers appeared to be the hopper heaters, which were normally on and maintained hopper wall temperatures between 230 ºF and 275 ºF, as measured by a thermostat bulb mounted external to the hopper.
- Some flanges on the hoppers were found to be loose. Any leakage in this area would allow air to enter the hoppers.
- No overheating problems were found in either the PAC silo or the ash silo.
- On March 7, the Compartment 4 cover was opened and the top of the tube sheet inspected. Ash was seen in some areas on the tube sheet. Bags were pulled from these areas and many showed signs of heat damage including melting, especially near the bottom of the bag. The inspection was completed on March 10. There were 117 failed bags in Compartment 4A and none in Compartment 4B.
- On March 13, Compartment 3 was opened and inspected. There were 83 failed bags in 3A and none in 3B.
- On March 16, Compartments 5 and 7 were opened and inspected. There were no failed bags seen. Three bags were taken for testing from each compartment.
- On March 17, Compartments 1 and 6 were opened and inspected. There were no failed bags seen. Three bags were taken for testing from each compartment.
- On March 20, Compartments 9 and 10 were opened and inspected. There were no failed bags seen. Three bags were taken for testing.

- On March 21, Compartments 2 and 8 were opened and inspected. There were no failed bags seen. Three bags were taken for testing from each compartment. One P84 test bag and one BHA membrane test bag was taken from Compartment 8.
- On March 24, using scaffolding placed inside the hoppers of Compartments 3, 4, and 9, a detailed inspection of the bottom of the bags and interior of the hoppers was performed. All of the bags were checked by physically examining the bottom portion of each bag to determine if they were stiff or had lost flexibility due to overheating. No problems were found. In addition, samples of deposits on the hopper walls were taken for lab analysis.

The investigation that took place to determine the cause of the hopper fires is detailed in the following sections. The investigation included analysis of the combustion properties of PAC and PAC/ash mixtures, thermocouple installation on the hoppers, balance-of-plant set point changes, and laboratory testing for autoignition characteristics of PAC and PAC/ash mixtures.

4.15.6.1 Flue Gas Temperature Comparison

A comparison was made of the inlet and outlet baghouse temperatures to determine if there was any indication of overheating. Figure 4-31 shows inlet and outlet temperatures along with flange-to-flange pressure drop across the baghouse. There did not seem to be any indication of problems with heating or pressure before or during the overheating event.

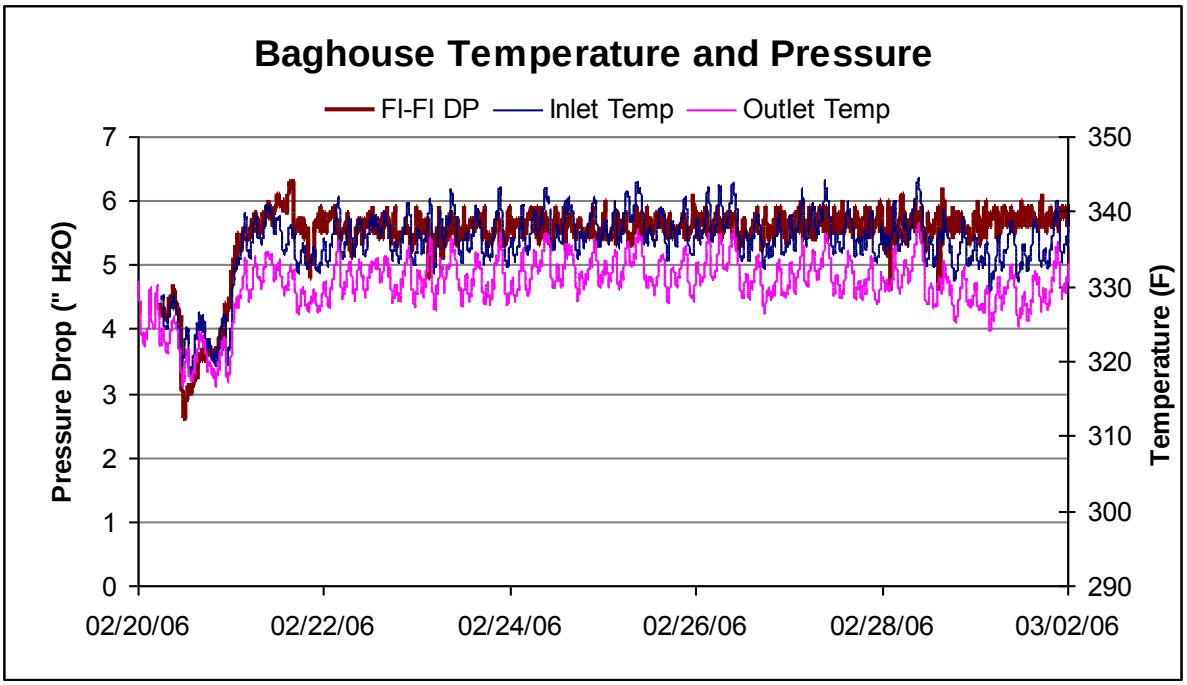


Figure 4-31. Baghouse Temperature and Pressure Conditions during Overheating Event.

4.15.6.2 PAC and Ash Analysis

A PAC sample from the silo was sent to ADA-ES and then to a local analytical laboratory for a thermogravimetric analysis (TGA). This analysis was used to determine the temperature of combustion in air. The PAC began losing significant weight at about 750 °F. The PAC had a temperature of ignition at 852 °F, which was consistent with the MSDS for this type of carbon.

PAC/ash samples taken from Compartment 4 hoppers on February 24 and February 27 were also submitted for TGA. The sample from February 24 lost approximately 5% of the total weight by 597 °F, indicating some relatively volatile material was coming off at these lower temperatures. The pure PAC from the silo did not show this trend. The PAC/ash sample from February 27 did not show the initial weight loss as might be expected, but when this sample was taken it was the first time that embers were seen in the hopper so the sample had already been heated to a high temperature, which would have driven off any volatiles.

We Energies also performed a TGA on the PAC using nitrogen gas. They found that the pure PAC from the silo lost significant weight at about 887 °F, which was similar to the test performed by ADA-ES. The TGA tests were then repeated using air as a purge gas. At 500 ºF and 550 ºF, there was no weight loss and no visual sign of embers. Initial sample weight loss began at 720 ºF and the profile was similar to the test run by ADA-ES.

We Energies also performed a series of tests using an open cup flash point determination apparatus. The apparatus consisted of a heavy cup on a hot plate with an open flame above to ignite any volatiles released as the material in the cup was heated. There was no release of combustible volatile compounds at temperatures up to 500 ºF. However, when removing the sample material from the cup after allowing several hours for cooling, it was noted that there were glowing embers in the bottom of the cup, along with a significant amount of gray/ash material, indicating that combustion had occurred at the bottom of the cup. The material on the surface of the cup had shown no evidence of combustion. This test showed that PAC can ignite on contact with a hot surface under low-oxygen conditions and maintain combustion.

We Energies performed another series of tests in the flash point apparatus. PAC/ash mixtures were placed in the cup, and thermocouples were positioned at the bottom of the cup and at approximately 0.25 inches from the bottom. There seemed to be no significant difference in the temperature at which smoldering was first observed, indicating that the presence of ash does not change the temperature of ignition of PAC. Table 4-18 shows the results of these tests.

Table 4-18. Temperature Comparisons on PAC and PAC/Ash Mixtures.

Sample	Bottom Temperature (ºF)	Bulk Sample Temperature (ºF)	Observations
PAC	650	395	No change in appearance.
	700	490	No change in appearance.
	750	560	No change in appearance.
	784	580	Smoldering occurred.
PAC/Ash 4:1	650	375	No change in appearance.
	700	445	No change in appearance.
	750	520	No change in appearance.
	779	570	Smoldering occurred.
PAC/Ash 2:1	650	430	No change in appearance.
	700	445	No change in appearance.
	750	480	No change in appearance.
	792	560	Smoldering occurred.
PAC/Ash 1:1	650	430	No change in appearance.
	700	440	No change in appearance.
	750	490	No change in appearance.
	799	535	Smoldering occurred.

ADA-ES performed two long-term tests with PAC and PAC/ash samples from the baghouse hoppers. A 50 g sample of PAC from the silo was placed in an open crucible and then in an oven set at 320 ºF. The sample was stirred every few days to check for changes (e.g., evidence of combustion) below the surface, but it showed no change in appearance or sparklers after 10 days in the oven. In addition, a sample of PAC and a sample of the PAC/ash from the hoppers were placed on a piece of rusty carbon steel and placed in the oven to see if there was any interaction with the metal. There was no change in appearance after 10 days of heating at 320 ºF.

4.15.6.3 Column Reactor Tests

ADA-ES designed and built a column reactor for testing PAC and PAC/ash to measure any increase in temperature from heat of adsorption. The reactor was a 2.0-inch diameter stainless steel construction with multiple ports for thermocouples. Figure 4-32 is a picture of the apparatus. In this reactor, PAC or PAC/ash was loaded into the column and gas (air or simulated flue gas) was introduced into the bottom of the column. Multiple thermocouples placed in the center of the bed monitored temperature. Heat tape provided the heat source for the column. The gas entering the column could be heated as needed also.

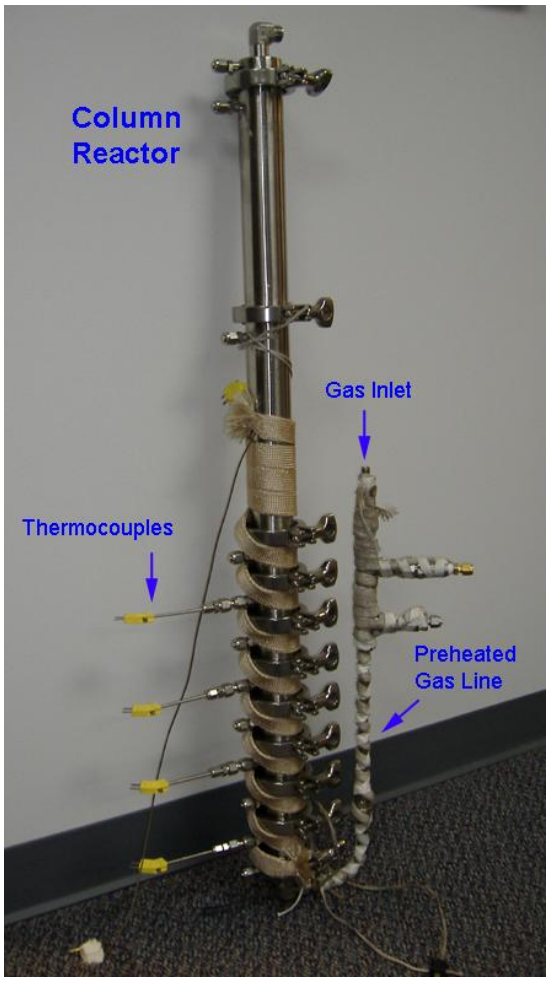


Figure 4-32. Column Reactor.

Details of the tests performed using this apparatus are listed in Table 4-19. The gas was allowed to flow upward through the bed of carbon for the determined period of time, and then the gas flow was shut off for a specified time to check for heat buildup.

Table 4-19. Column Reactor Tests.

Test #	Column Material	Inlet Gas/ Bed Temp. (F º)	Gas Composition	Gas Flow Rate (cc/min)	Gas Contact Time (hr)	Time with No Gas Flow (hr)
1	PAC	70	Air	500	4	4
2	PAC	340	Air	500	4	4
3	PAC	340	Simulated Flue Gas	500	4	4

The simulated flue gas used in the column tests contained similar major gases at close to the amounts found in the flue gas at Presque Isle. Table 4-20 lists the gases used.

Table 4-20. Simulated Flue Gas Composition.

Flue Gas	Amount
CO_2	13.5%
O_2	5.5%
Moisture	11%
SO_2	225 ppm

The first test using air at ambient conditions is shown in Figure 4-33 and showed a minimal temperature rise that corresponded to the ambient temperature increase. The second test using air at a temperature similar to the flue gas temperature going into the baghouse showed a temperature increase of about 120 ºF in the upper section of the PAC bed (Figure 4-34). This indicates some heat of oxidation, but in this particular test setup, not enough heat was provided to initiate ignition of the bed.

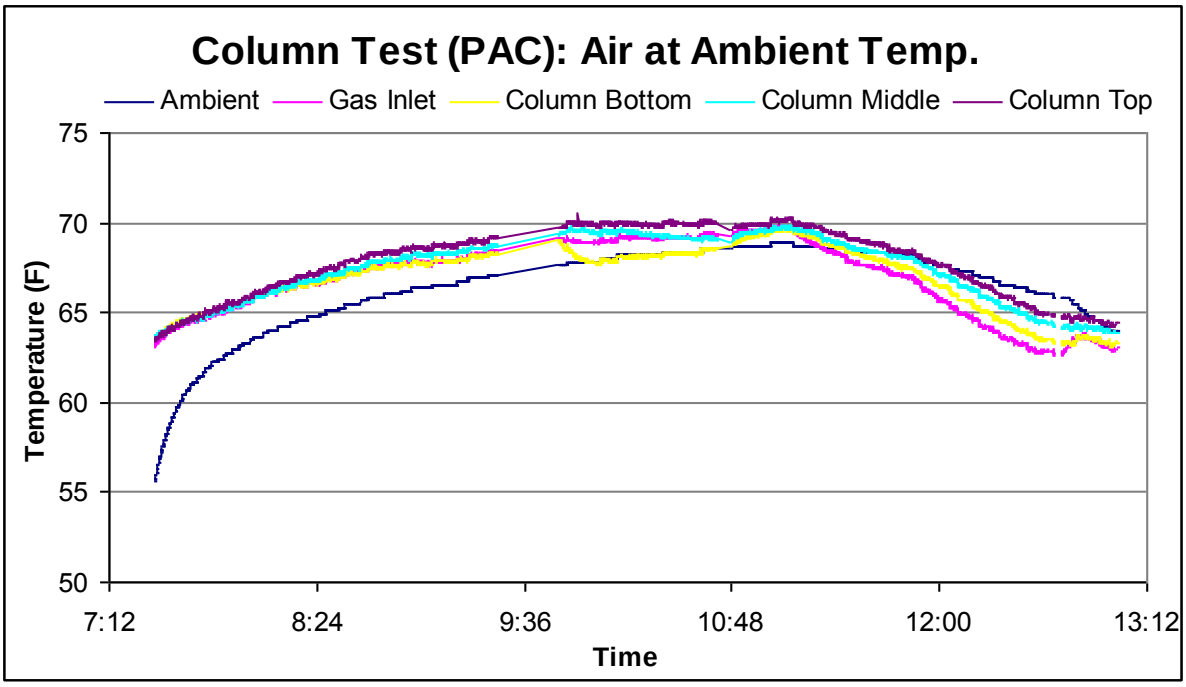


Figure 4-33. Column Test: PAC with Air at Ambient Temperature.

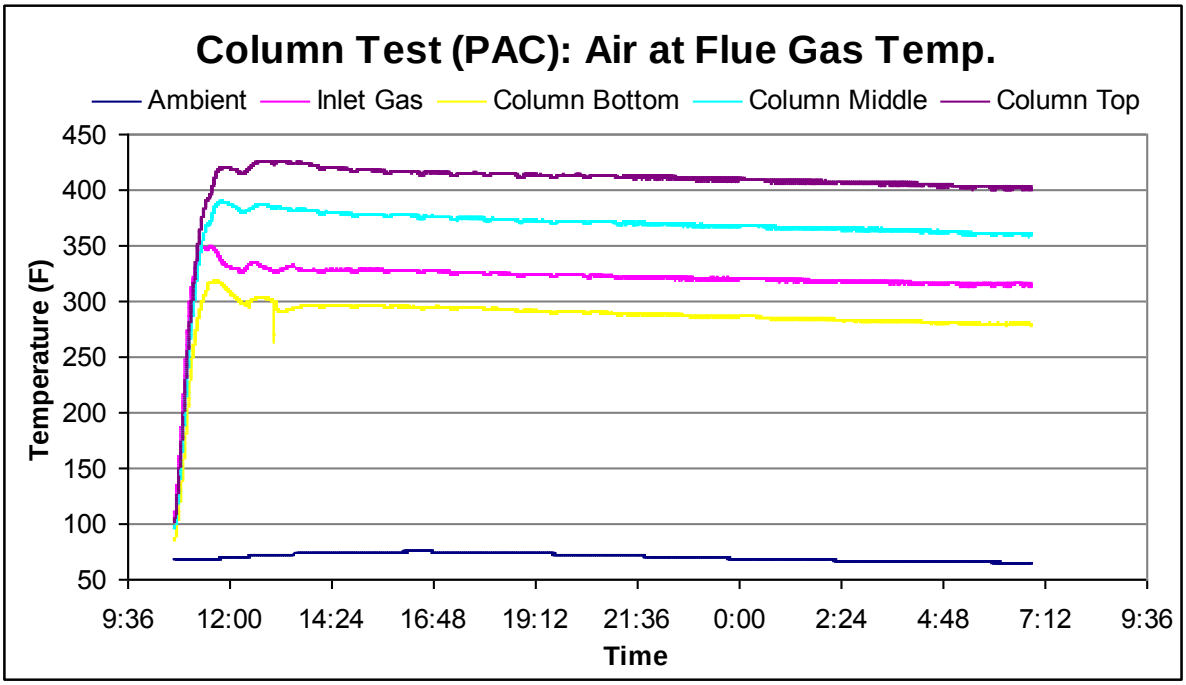


Figure 4-34. Column Test: PAC with Air at Flue Gas Temperature (340 ºF).

Figure 4-35 shows the results using the simulated flue gas stream at 340 ºF. As in the previous test, there was a temperature increase in the top of the bed, but not as high as with air. When the gas flow was terminated, the gas inlet temperature went down and the

temperature in the middle thermocouple went up. Since the other two column thermocouples did not respond, this slight shift may have been an anomaly. In general, the PAC exhibited a measurable heat of oxidation or adsorption at elevated temperatures using either air or a simulated flue gas.

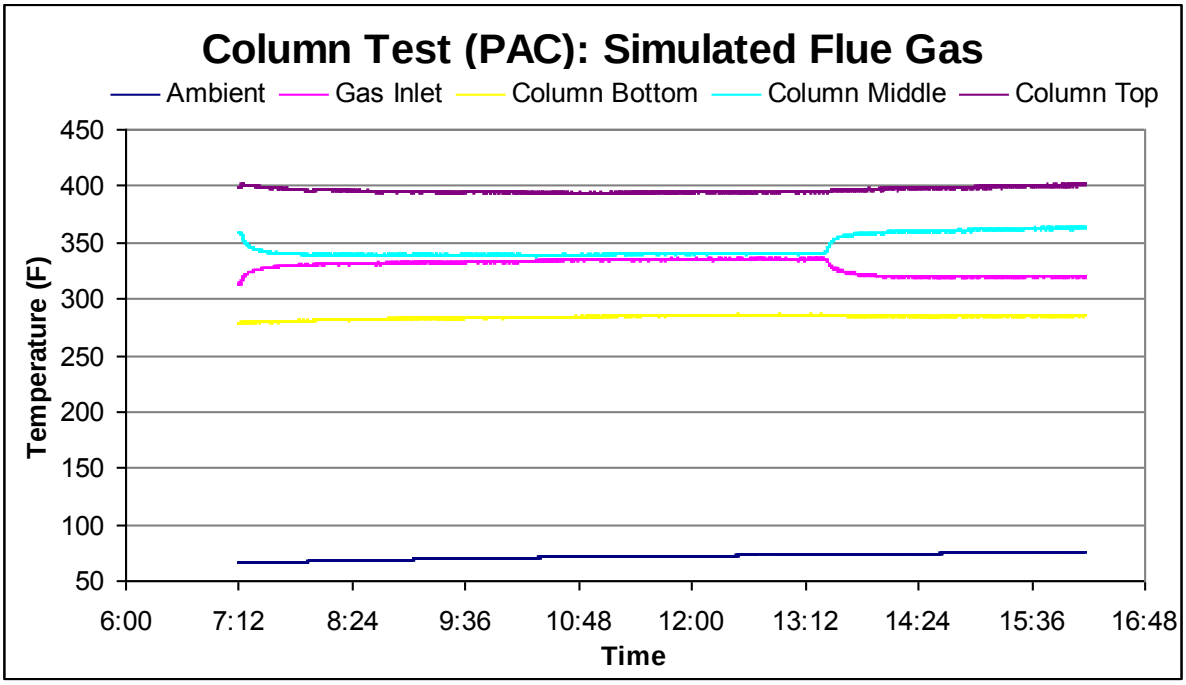


Figure 4-35. Column Test: PAC with Simulated Flue Gas (340 ºF).

4.15.6.4 TOXECON™ Configuration Discussion

Overheating of the PAC/ash mixture had not been seen at any power plant using PAC injection or the TOXECON™ process up to that point in the demonstration, although Alstom described the dangers of autoignition regarding their long-term experiences with PAC injection in their European operations. A yearlong TOXECON™ test was performed at Plant Gaston with no incident of overheating in the hoppers. Table 4-21 lists various parameters from each plant. The most notable difference between the two systems was the use of hopper heaters at Presque Isle, while none were used at Gaston.

Table 4-21. Comparison of Presque Isle and Gaston.

	Gaston	PIPP
Manufacturer	Hamon Research-Cottrell	Wheelabrator Air Pollution Control
Type	Low-pressure pulse-jet	Medium-pressure pulse-jet
Configuration	Hot-side ESP/COHPAC®	Hot-side ESP/TOXECON™
Coal	Low-sulfur, eastern bituminous	PRB
Design air-to-cloth (gross)	8.5	5.5
Cleaning	On-line	On-line
Max cleaning (p/b/h)	4.4 (1.75 typical)	
Bag length (feet)	23	26
Bag diameter (inches)	4.9 equivalent (oval bag)	5.0
Bag material (nominal weight)	18 ounce/yd^2 PPS	18 ounce/yd^2 PPS
Pulse pressure (psi)	12	60
Ash loading (gr/acf)	0.03–0.14	0.0048
Outlet PM emissions (lb/MMacf)	0.0045	0.034
Ash LOI (%)	11–25	< 0.5
PAC type	Norit DARCO® Hg	Norit DARCO® Hg
PAC loading (lb/MMacf)	0.5–2.0	0.5–2.0
PAC loading (gr/acf)	0.0016–0.0128	0.0032–0.0128
Time of operation with PAC	8 months	~ 5 weeks
Hopper heaters	None	Yes, Thermon resistance heaters (12.5 kW/hopper)
Hopper evacuation schedule	Every 2–3 hours per B. Corina at Gaston. (When requested, operators would shut off ash pulling system to build up ash for a sample.)	Every 12 hours
Fluidizing system	Vibrators	Vibrators
Ash system	Wet, hydroveyor system	Dry, pneumatic
Overheating of hopper PAC/ash	No	Yes, all hoppers
No. cage sections	2	2

4.15.6.5 Hopper Test

On March 30, 2006, We Energies performed a test in the Compartment 4 hopper. Four thermocouples were welded to each interior hopper wall. These were placed so that they would be 6.0 inches below the upper level of PAC within the hopper. One thermocouple was also sandwiched between one heater and the outside wall of the hopper. Four thermocouples were wired to metal rods, which were then placed in the PAC bed (Figure 4-36 and Figure 4-37). The ends of the thermocouples were located approximately 2.5 feet above the bottom of the rod.

A total of 360 pounds of PAC was then loaded into the hopper. This gave a depth of material of approximately 4 feet. The hopper heaters were turned on at 12:46 p.m. The temperature at the hopper walls reached a maximum of 400 ºF with the rate of increase then slowing (Figure 4-38), so the test was terminated at 3:52 p.m. The plan was to start the heaters again when there was flue gas going into the hopper. The maximum temperature reached in the PAC bed was 173 ºF (Figure 4-39). The hopper heater control was set to a maximum of 275 ºF, but the highest indication on the thermostat bulb was 210 ºF and the heater never cycled off during the test.

Figure 4-36. Installation of Thermocouples in the Hopper for PAC Test.

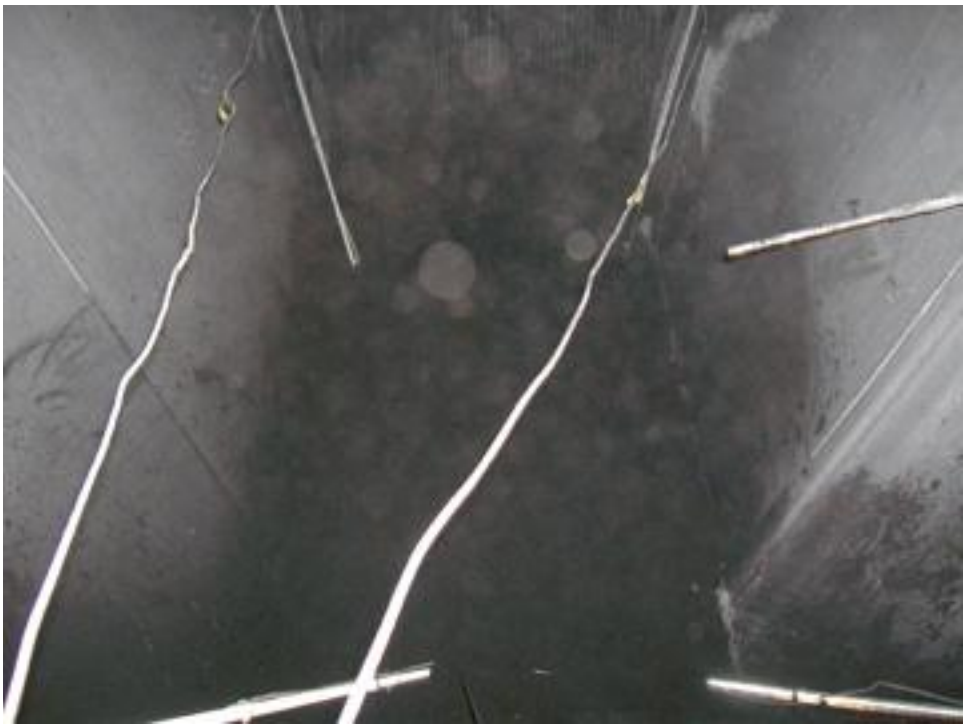


Figure 4-37. Installed Thermocouples in PAC Bed.

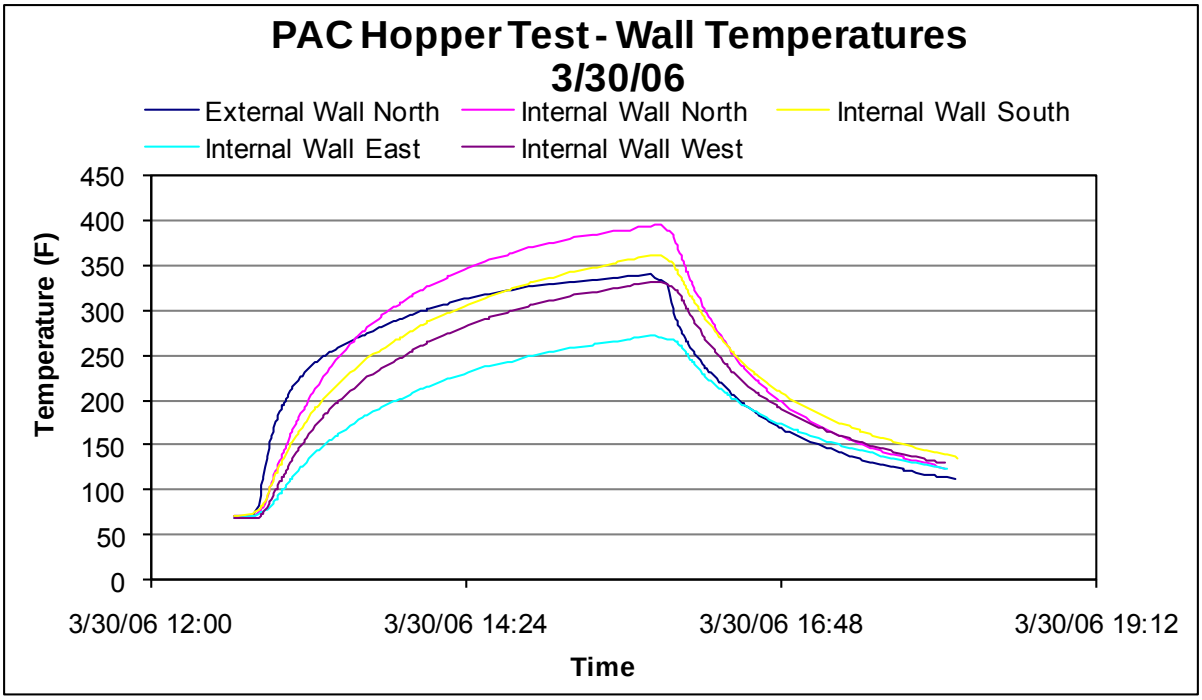


Figure 4-38. PAC Hopper Test: Inside Wall Temperatures.

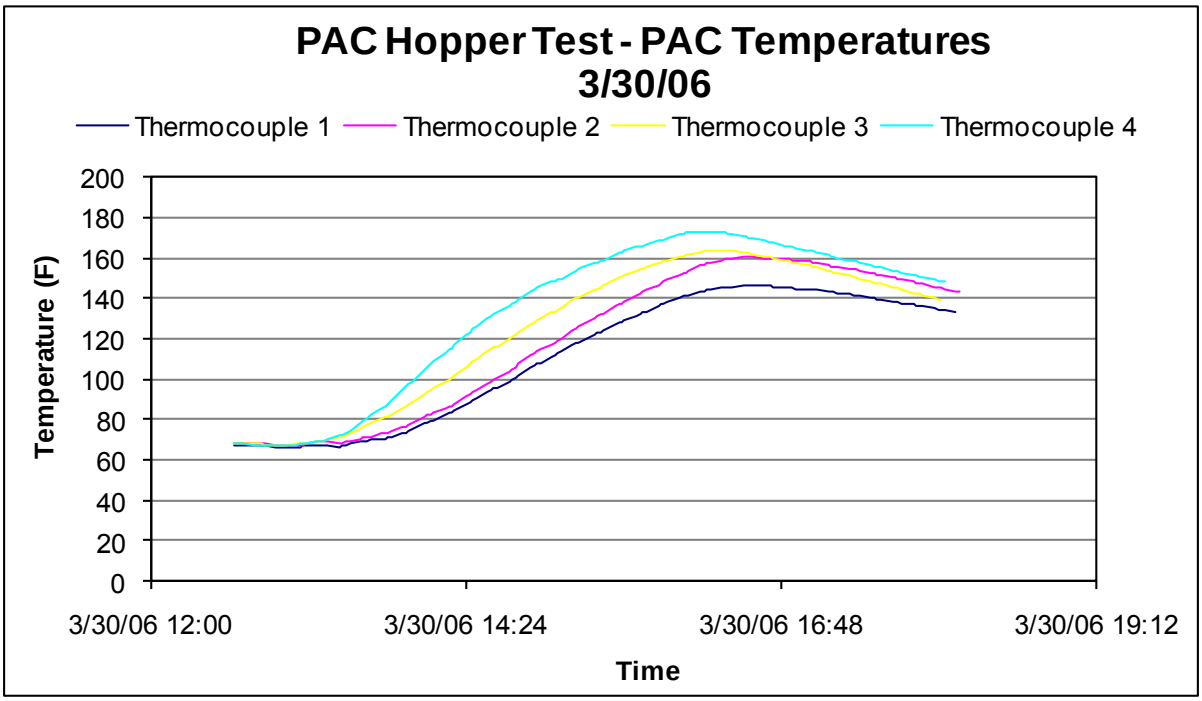


Figure 4-39. First PAC Hopper Test: PAC Bed Temperatures.

On May 24, 2006, We Energies performed a second test in Compartment 4 hopper. The first test, described earlier, occurred when the baghouse was not on-line, so no flue gas was present in the hopper. The second test was identical to the first test with the exception that

the baghouse was on-line receiving flue gas from Unit 7. A total of 360 pounds of PAC was again loaded into the hopper. The hopper heaters were turned on May 24 (Figure 4-40). The wall temperature in the hopper reached a maximum of 407 ºF. There was no indication of overheating of the PAC during this time. Cycling of the hopper heaters was evident during this test.

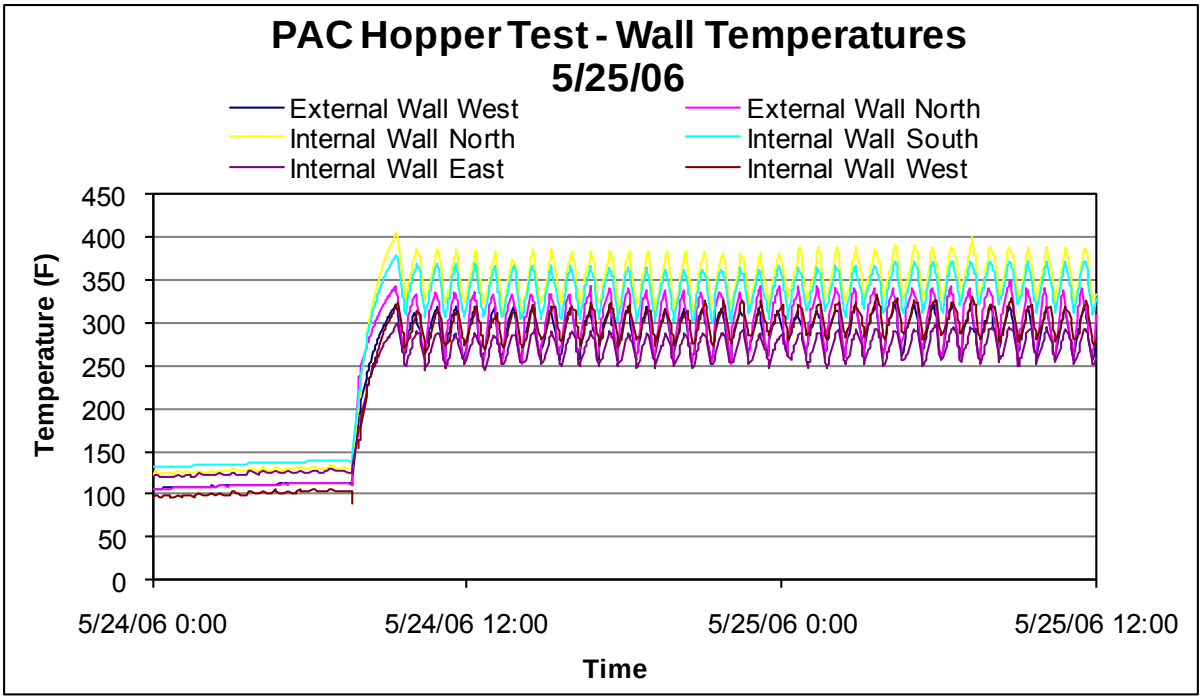


Figure 4-40. Second PAC Hopper Test: PAC Bed Temperatures.

4.15.6.6 Baghouse Restart

After the inspections and repairs were completed but prior to the second hopper tests, the baghouse was brought back online on May 12, 2006, receiving flue gas from Unit 7. The hopper heaters remained off during the startup and subsequent operation. There was an additional deviation from the normal startup procedure. After the initial two compartments were in service, four additional compartments were opened instantaneously. The correct procedure was to open one compartment, let the compartment come up to temperature, and then open the next one. This procedure was intended to minimize condensation in the baghouse. After pulling ash from the hoppers on May 15, water was seen in the bottom of eight hoppers. Flue gas was diverted from the compartments and an inspection performed. Figure 4-41 shows evidence of water flowing down the walls of the compartments.

After several inspections, it was determined that condensation from the cold startup of the baghouse was the likely cause of water in the hoppers. The hopper heaters were turned on and the baghouse taken off bypass and returned to normal operation with flue gas from Unit 7. Instructions were given to the operating staff on the importance of following the startup procedure to allow each compartment to come to operating temperature before adding additional compartments, thus building up the heat in a controllable fashion.

Figure 4-41. Water Marks in Baghouse Hoppers.

The baghouse compartments (except for Compartment 4) were brought back in service (taken off bypass) on May 22 and there was no evidence of free water in the hoppers. On May 25, the hopper heaters were turned off because of the concern they might be causing overheating of the PAC/ash. On May 26, operations found water in Hoppers 1, 2, and 3. The maximum set points for the hopper heaters were reduced by 25 ºF to 250 ºF on all compartments except for Compartment 4 (the test compartment) and all heaters were returned to service.

PAC injection began again on May 30, 2006. Ash was pulled every four hours to prevent buildup of material in the hoppers. The cleaning cycle was set to 2.3” w.c. for one unit to the baghouse (4.6” w.c. for two units, 6.5” w.c. for three units) with a default of 72 hours. The

cleaning logic was programmed to pulse six of the 36 pulse-pipes in successive compartments until the flange-to-flange pressure drop was lowered by 0.5” w.c.

4.15.6.7 Hopper Wall Temperatures

Prior to restarting the baghouse, thermocouples were placed on each compartment hopper (two each) to monitor temperatures and alert operators in the event of rising temperatures. The thermocouples were placed on the exterior between the hopper wall and a heater. Compartment 4 still had the four internal thermocouples that were installed in March 2006 for the hopper test.

The baghouse temperature data for the first two weeks during PAC injection (June 5 and 12, 2006, with one unit) were reviewed in detail to get a picture of the normal operating range. Table 4-22 presents a summary of typical values for each thermocouple location at the ten compartments over the two-week period. The data in Table 4-22 are typical of operation with one unit through the baghouse; this same assessment was repeated with all three units going to the baghouse. Typical data from periods when all three units were going to the baghouse can be seen in Figure 4-43 through Figure 4-46.

Over the course of a week, the temperatures at the thermocouple locations varied quite a bit, particularly at the Outer Wall North locations (noted as OWN in Table 4-22). Although there was a wide range between maximum and minimum temperatures, the data are consistent for the two-week period. The difference between the values at each thermocouple location for the weeks of June 5 and 12 indicate an average difference between the maximum and minimum temperatures of only 3.7 ºF.

Also calculated is the average temperature for each 24-hour period during the two weeks, and the range in this value is shown in Table 4-22 for each thermocouple location. The north wall thermocouples showed more variability in the daily averages as well. In order to get an idea of the overall variability in temperatures for each thermocouple location, the average plus or minus the standard deviation calculated using four-hour averages is presented in the last column.

Table 4-22. Summary of Temperature Data for Hopper Thermocouples.

Compartment and Location*	Maximum (ºF)	Minimum (ºF)	Average (ºF)	Range of 24-Hour Averages (ºF)	Overall Variability** (ave ± std dev, ºF)
1 OWW	280.9	229.8	250.8	242.4–257.9	250.5 ± 4.7
1 OWN	336.4	216.8	257.3	237.6–279.4	257.4 ± 11.0
2 OWW	276.7	234.7	250.8	242.2–257.0	249.5 ± 5.2
2 OWN	356.0	223.4	265.0	239.9–284.4	262.1 ± 16.6
3 OWW	287.9	230.3	252.5	237.3–259.9	252.5 ± 6.6
3 OWN	294.5	208.0	240.0	221.7–250.9	243.4 ± 10.8
4 OWW	319.7	240.5	273.4	253.3–281.1	270.9 ± 10.2
4 OWN	344.8	234.9	276.3	247.6–286.9	273.1 ± 14.1
4 IWN	380.8	272.2	310.4	285.5–321.7	306.8 ± 12.7
4 IWS	374.2	273.2	312.3	294.3–322.6	308.6 ± 11.4
4 IWE	326.2	251.0	287.4	278.4–300.6	289.3 ± 6.7
4 IWW	332.0	234.9	284.1	267.4–292.6	282.9 ± 7.8
5 OWW	309.1	263.1	289.1	282.5–292.7	288.8 ± 3.9
5 OWN	318.0	249.1	285.4	282.1–290.1	285.7 ± 4.6
6 OWW	296.3	244.4	268.0	253.4–273.3	267.1 ± 6.8
6 OWN	351.4	243.1	288.8	255.7–298.5	289.7 ± 13.6
7 OWW	278.4	229.9	249.6	239.1–255.2	251.0 ± 6.0
7 OWN	339.3	226.1	260.7	239.2–278.1	265.5 ± 14.3
8 OWW	294.3	231.6	256.2	245.2–263.8	254.9 ± 7.2
8 OWN	324.3	214.9	250.5	230.4–267.4	248.8 ± 13.3
9 OWW	294.2	234.2	256.0	243.9–262.9	256.1 ± 5.5
9 OWN	323.3	209.8	248.2	232.8–270.3	249.6 ± 12.8
10 OWW	293.7	230.7	263.7	246.0–271.3	263.5 ± 7.2
10 OWN	367.5	226.5	290.3	254.6–306.1	292.6 ± 15.5

*OWW = Outer Wall West IWN = Inner Wall North IWS = Inner Wall South
OWN = Outer Wall North IWE = Inner Wall East INW = Inner Wall West
**Based on four-hour averages; all others based on "raw" data.

On August 28, 2006, burning embers were found again, this time in Hopper 6. Figure 4-42 shows the wall temperatures for Compartment 6 during overheating in the hopper. The wall

temperature peaked at 403 °F on the south wall in Compartment 6. After Compartment 6 overheated, the hopper heaters were set at 175 °F as the low point and 200 °F as high point, down 50 °F from 250 °F. There have been no incidents of hopper overheating since that time.

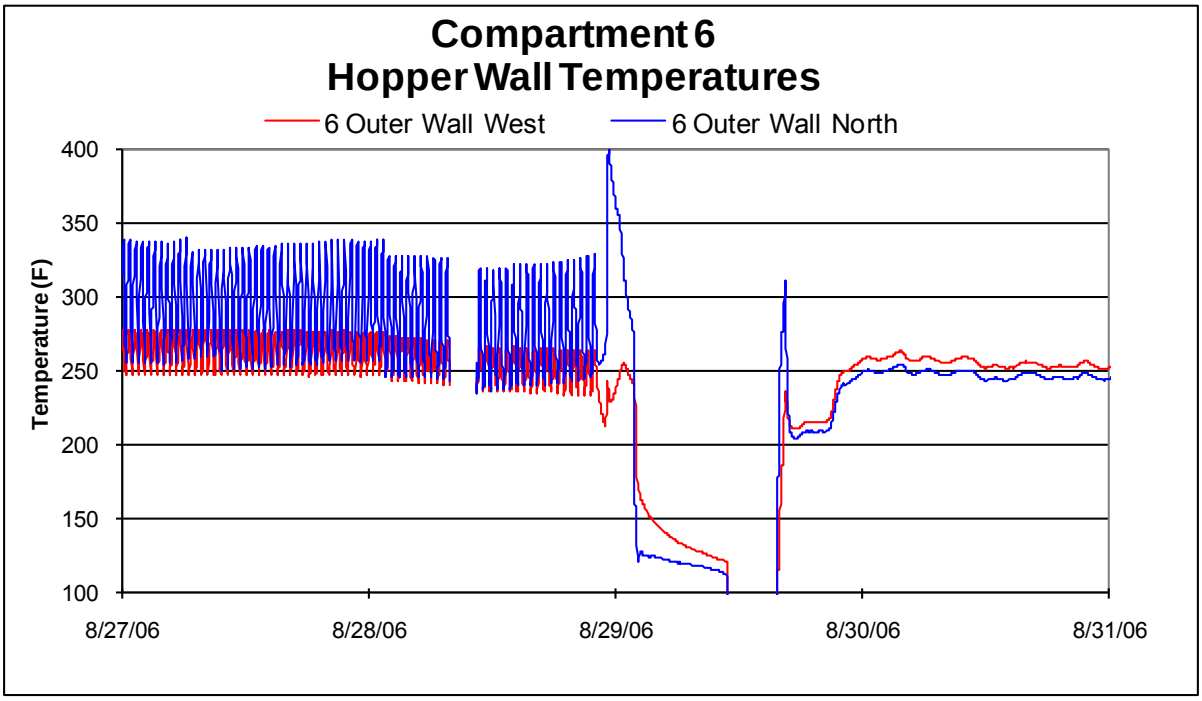


Figure 4-42. Compartment 6 Hopper Wall Temperatures.

Figure 4-43 through Figure 4-46 show detailed graphs of each compartment thermocouple for September 12–24, 2006. Compartment 4 still had the four internal thermocouples that were installed in March 2006. The set point change after overheating in Compartment 6 resulted in many of the hopper heaters not cycling. There was no indication of condensation with the hopper heaters at this setting.

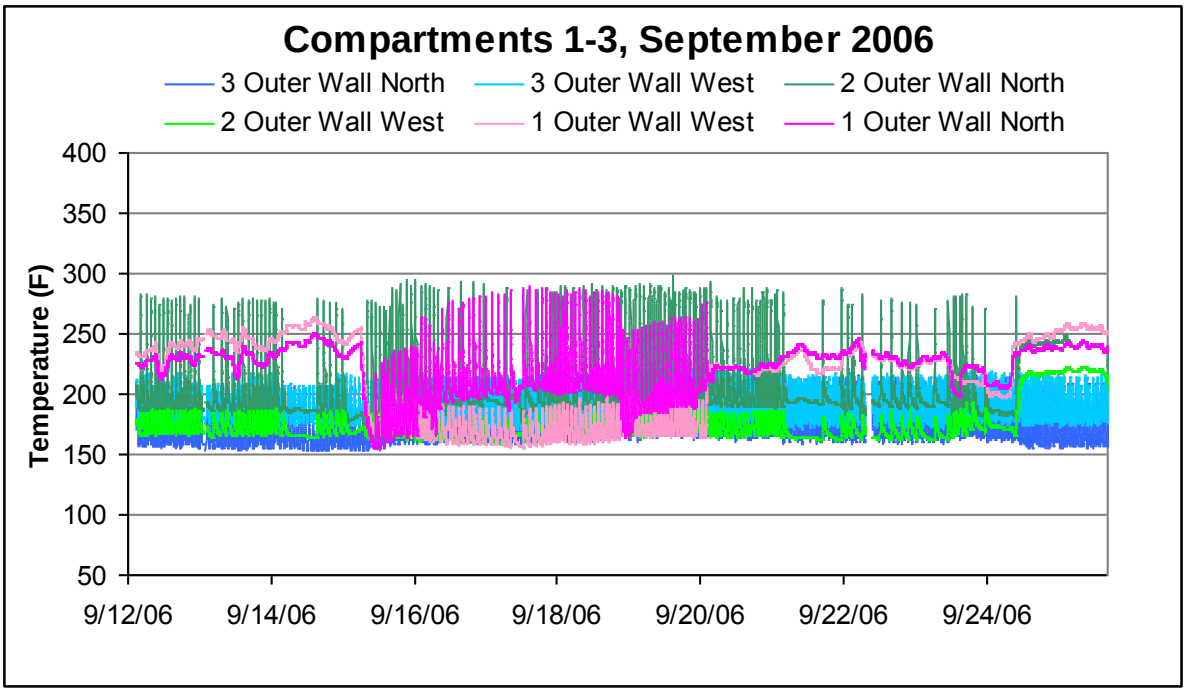


Figure 4-43. Compartments 1–3 Hopper Wall Temperatures.

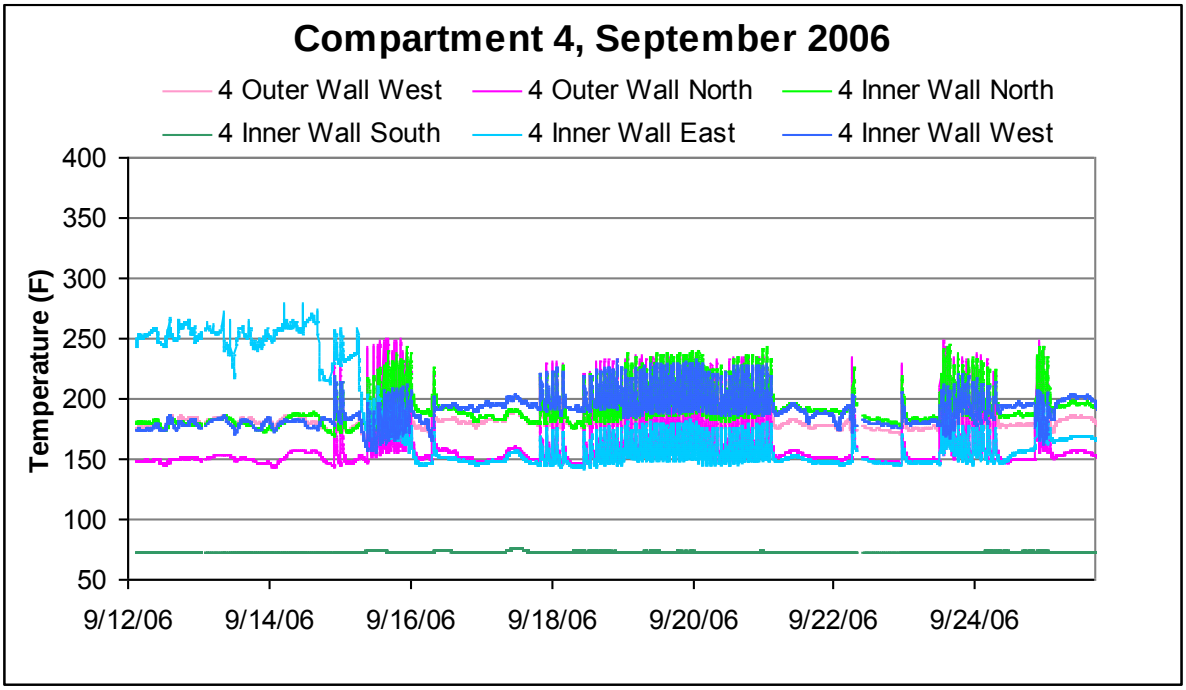


Figure 4-44. Compartment 4 Hopper Wall Temperatures.

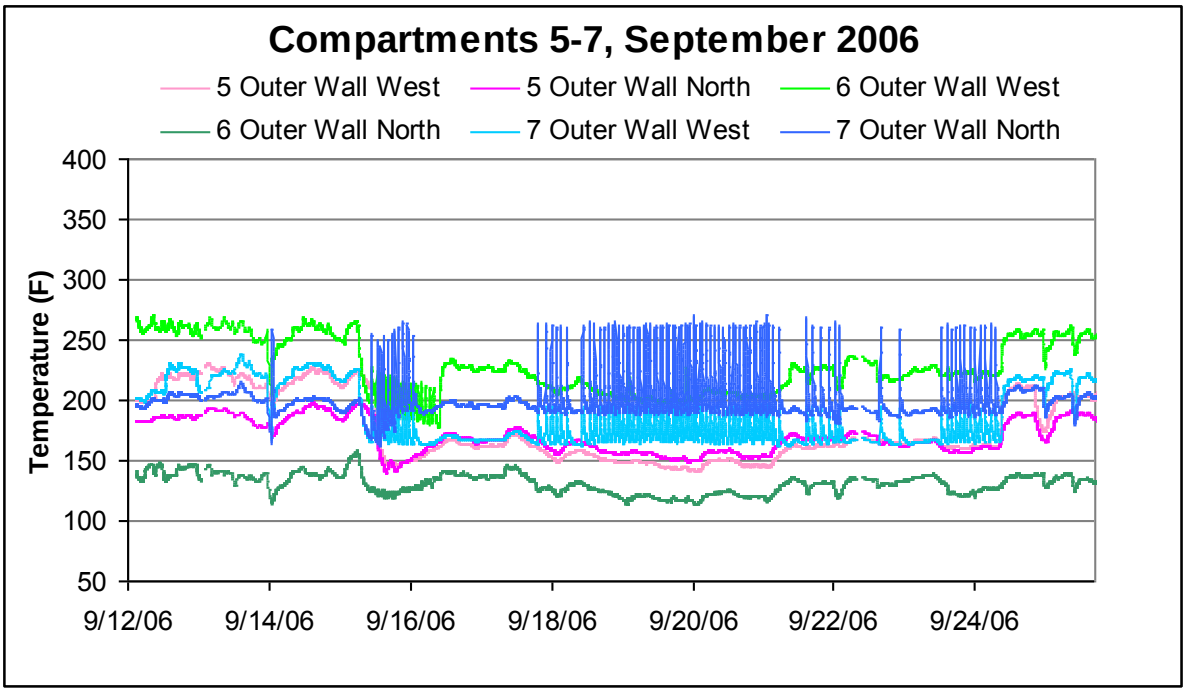


Figure 4-45. Compartments 5–7 Hopper Wall Temperatures.

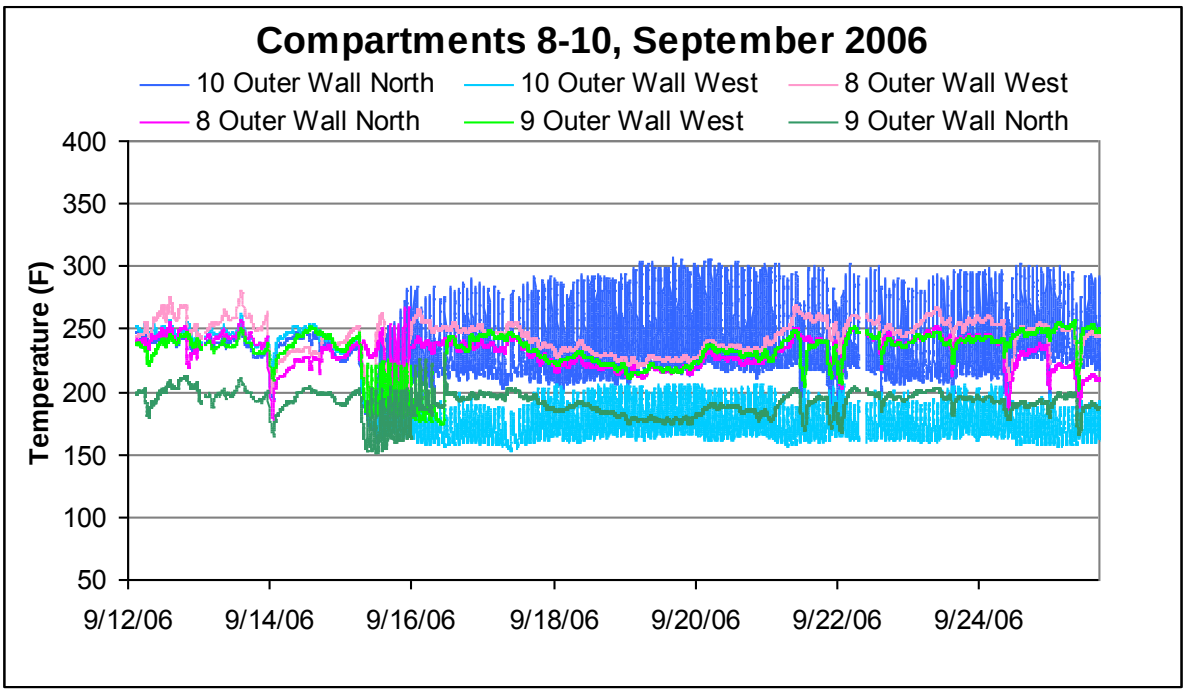


Figure 4-46. Compartments 8–10 Hopper Wall Temperatures.

4.15.6.8 Autoignition Laboratory Tests

Literature searches performed by ADA-ES revealed a model to predict autoignition of combustible materials called the Frank-Kamenetskii model. This model predicts that spontaneous combustion can result from internal heating of a combustible solid if the solid is sufficiently porous to allow oxygen to permeate it and if it produces heat faster than it can be liberated, which can happen with a highly insulating material. This phenomenon is normally associated with a relatively large mass of material (small surface to volume ratio). The model describes a relation between the radius of a specimen and the self-ignition temperature in a defined geometry.

It was suspected that hopper heaters caused localized high temperatures that increased the temperature of the accumulated PAC/ash mixture and, because of the insulating properties of the mixture, the heat supplied by the hopper heaters could not be dissipated. Observations on the burning material from the hoppers as well as tests in the lab at ADA-ES have shown that PAC alone and PAC/ash mixtures become "sticky" at temperatures above 250 ºF. Localized heating from hopper heaters may have prevented evacuation of the ash by increasing the "stickiness" of the PAC/ash.

4.15.6.8.1 Autoignition Test Setup

Laboratory tests were performed by ADA-ES to determine if PAC followed the Frank-Kamenetskii model and to determine the autoignition properties of PAC and PAC/ash mixtures. The tests were performed by filling various sized open-top carbon steel cubes with either as-received PAC or PAC/ash mixtures, then heating the cubes in a mechanical convection oven. Thermocouples were inserted into the center of the bed of material at different levels to track temperature profiles over time (Figure 4-47) (shown is an 8-inch cube). The goal was to determine the "critical temperature" of the different PAC and PAC/ash mixtures in different sized cubes. The critical temperature is the lowest oven or ambient temperature that allows the material to autoignite.

Figure 4-47. Laboratory Setup for Autoignition Tests.

For each test, a cube with PAC or PAC/ash was placed in the oven, which was set at a pre-determined temperature and left there until it was decided whether the material had autoignited. Figure 4-48 shows an example of a temperature profile for an 8-inch cube with pure DARCO® Hg PAC (LOI of 75%) that did not autoignite. The temperature of the material "over-heated," meaning its temperature reached levels greater than the oven temperature, but ignition did not occur.

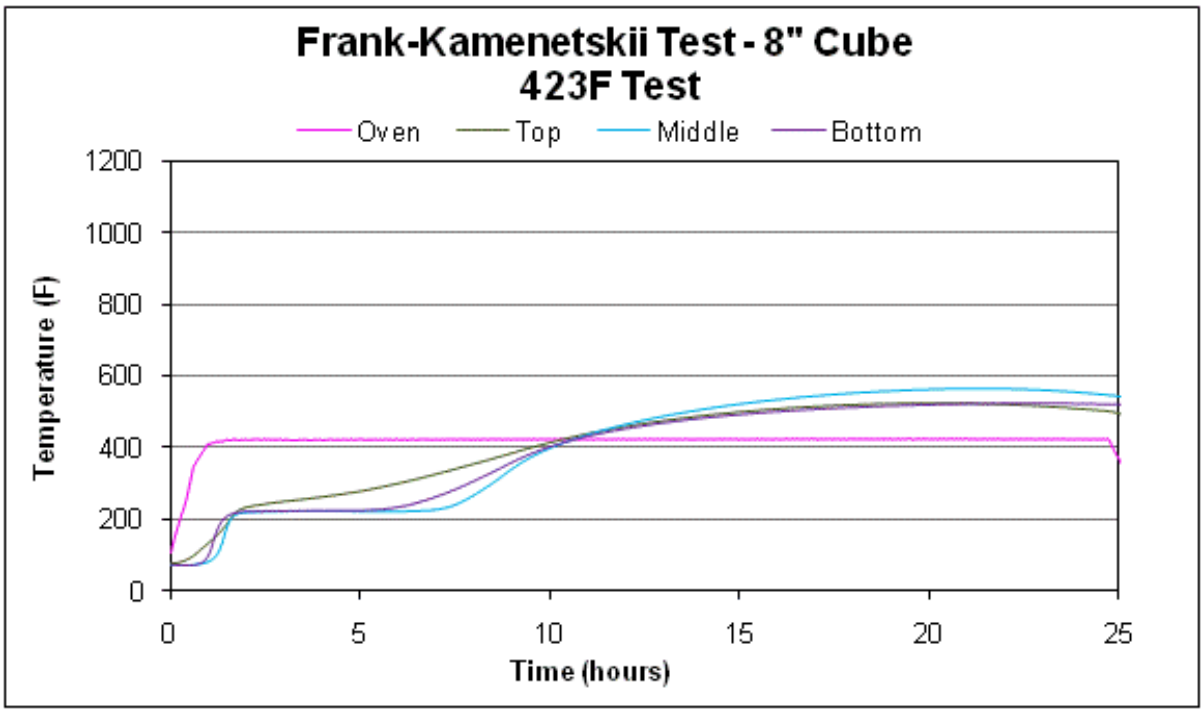


Figure 4-48. Autoignition Test on DARCO® Hg PAC (75% LOI) Showing Overheating but No Ignition.

Figure 4-49 shows an example of a test with the same material as shown in Figure 4-48, but that did autoignite. At 430 °F there was sufficient heat build-up in the center of the bed to eventually cause autoignition. Figure 4-50 shows a similar profile as Figure 4-49, but with PAC mixed with the PRB ash from the ESP hoppers at Presque Isle. This mix had an LOI of 37%.

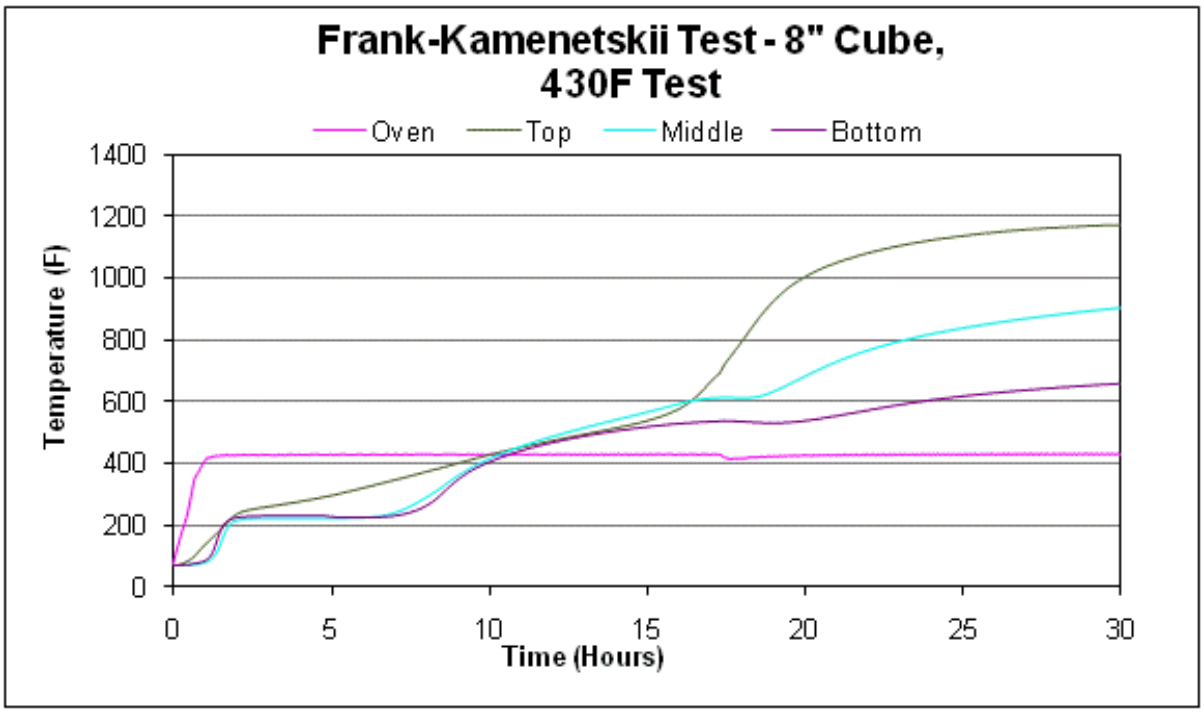


Figure 4-49. Autoignition Test on DARCO® Hg PAC (75% LOI) Showing Autoignition.

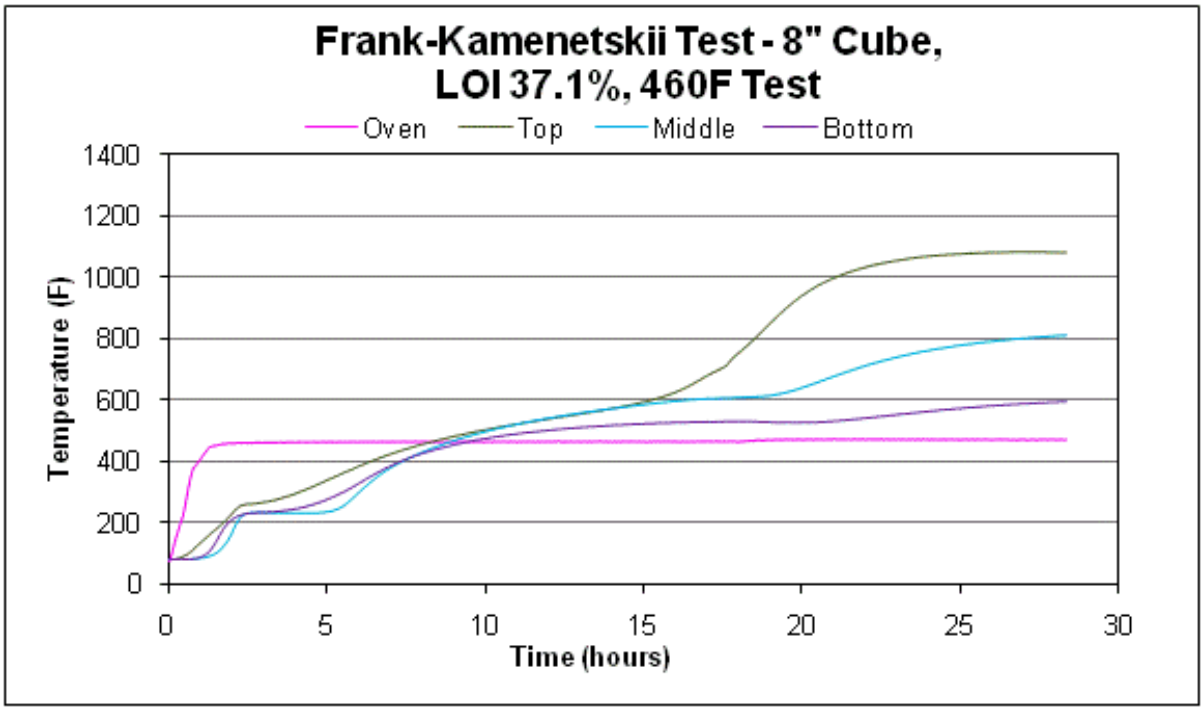


Figure 4-50. Autoignition Test on DARCO® Hg PAC and ESP Ash at 37% LOI.

An interesting observation of samples that did autoignite was that, as predicted in the model, the heat buildup was from the center. Figure 4-51 and Figure 4-52 show different levels in a test bed that autoignited and were then removed from the oven while still burning. Layers were carefully removed and photographed. In Figure 4-51, the light-colored ash in the center formed an inverted cone in the bed. This pattern was seen in numerous tests.

Also, the edge of the bed remained unburned regardless of placement in the bed. This is important for thermocouple placement for detection of overheating since the walls of the container were significantly cooler than the center of the bed.

Figure 4-51. Ash Pattern in an 8-Inch Bed of PAC after Autoignition.

Figure 4-52 shows the center of the bed of PAC still burning after removing 3.5 inches of material. Note the circular glowing area. This material was very "sticky," and when a metal scoop was used to pick up a small amount, the material would stick to the scoop until it cooled.

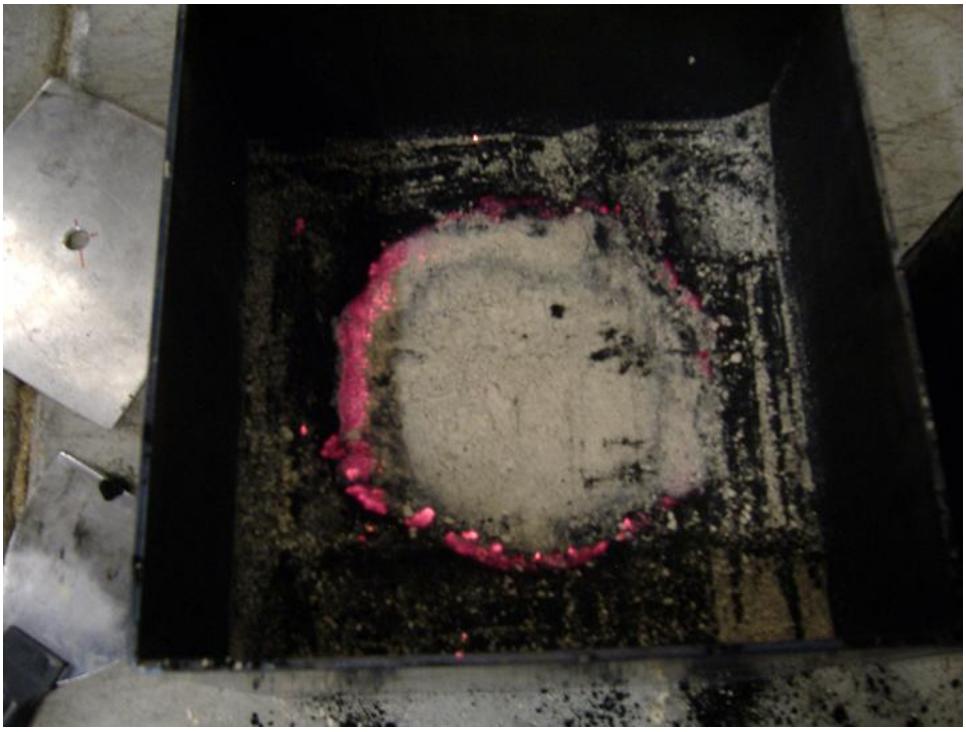


Figure 4-52. Ash Pattern and Glowing Embers in an 8-Inch Bed of PAC.

Another test was performed on a sample of ash from a site with a high-unburned carbon LOI in the ash. Approximately 35% of the LOI in the sample was unburned carbon and the remainder was PAC. The overall LOI of the sample was 41.6%, which should have resulted in autoignition, but the sample showed very little overheating and did not autoignite at the same conditions as the high-LOI ash at Presque Isle. This test indicates that LOI alone is not a predictor of autoignition risk.

Laboratory tests continued at the ADA-ES facility to determine the effect of bed size and LOI from PAC on autoignition risk. Tests were performed while varying the bed size and LOI to find the "critical temperature" of the various combinations. Figure 4-53 shows the results from the tests using DARCO® Hg PAC and a mixture of PAC and ash with LOIs of 9%, 21%, 26%, and 43%. Three correlations that can be made from the tests and data are:

- The lower the LOI of the PAC/ash mixture, the higher the critical temperature.
- The larger the bed size, the lower the critical temperature. This is because there is better insulation due to the large bed, and it takes longer for oxygen to diffuse into the

center where heating has begun. Because the critical temperature is lower, the time to ignition (induction period) is longer.

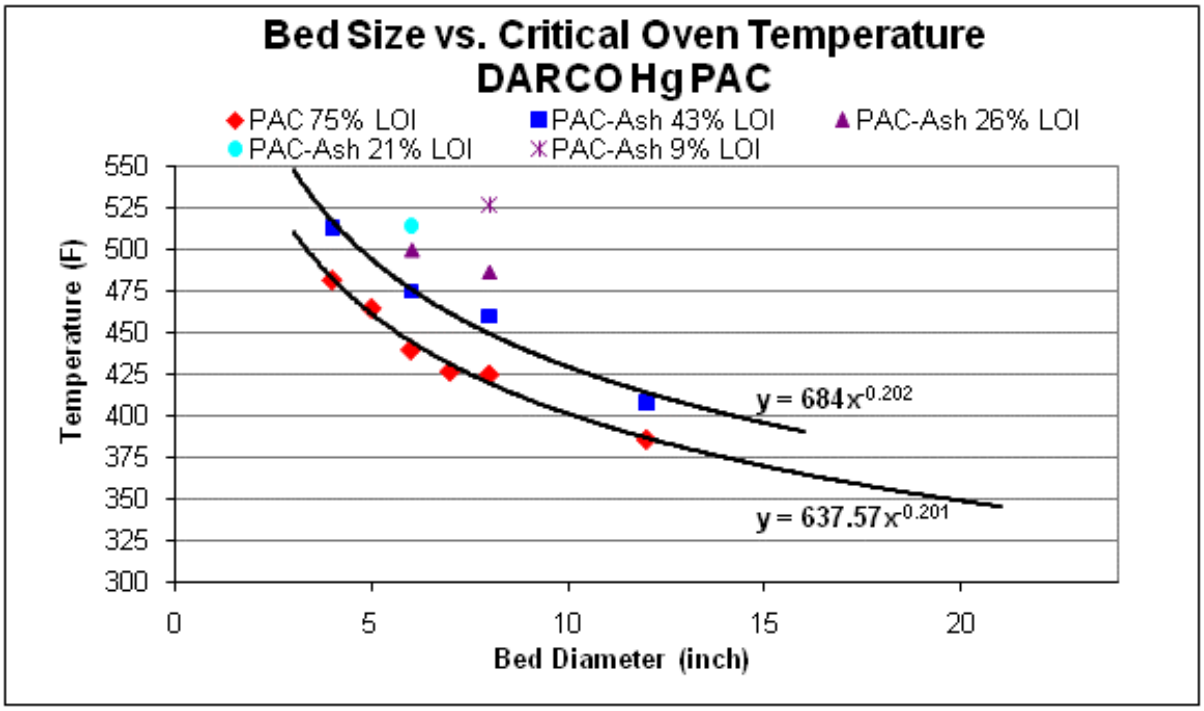


Figure 4-53. Autoignition Correlation using DARCO® Hg PAC.

Figure 4-54 displays another method to correlate the temperature effect. As the ratio of surface area of the bed to volume increases, the critical temperature increases. As the ratio of surface area to volume decreases to zero, the bed size goes to infinity. This shows that the larger the size of the bed, the lower the critical temperature.

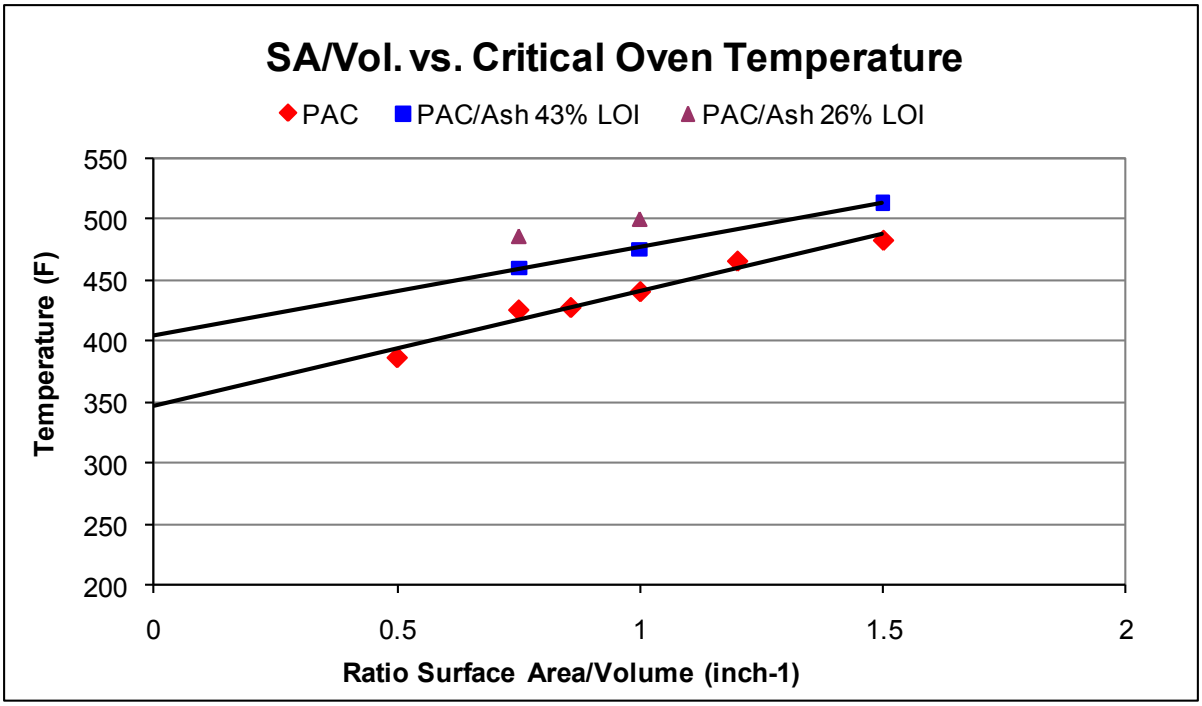


Figure 4-54. Autoignition Correlation of Surface Area to Volume Ratio versus Temperature.

When the critical temperature and bed dimensions are used in the Frank-Kamenetskii model calculations, the result should be a linear correlation. Figure 4-55 shows the results of the autoignition tests according to the Frank-Kamenetskii model equations. The Frank-Kamenetskii model equation provides a relationship between the following:

- $T_{a,cr}$ = critical ambient temperature for ignition (K)
- r_o = dimension of sample (m) (side of a cube = $2r_o$)
- δ_{cr} = critical parameter dictated by geometry of sample

The equations are as follows:

$$\ln(\delta_{cr}\, T_{a,cr}^2/r_o^2) = C_1 - C_2/T_{a,cr}$$

$$C_1 = \ln\{E\, H_c\, A_\rho/(k\, R)\}$$

$$C_2 = E/R$$

Rate of heat generation/volume = $H_c \rho A\exp(-E/R\ T_{a,cr})$

- E = activation energy
- H_c = heat of combustion (kJ/mole)
- R = gas constant
- T = absolute temperature (K)
- k = rate constant
- A = pre-exponential factor

(assumption)

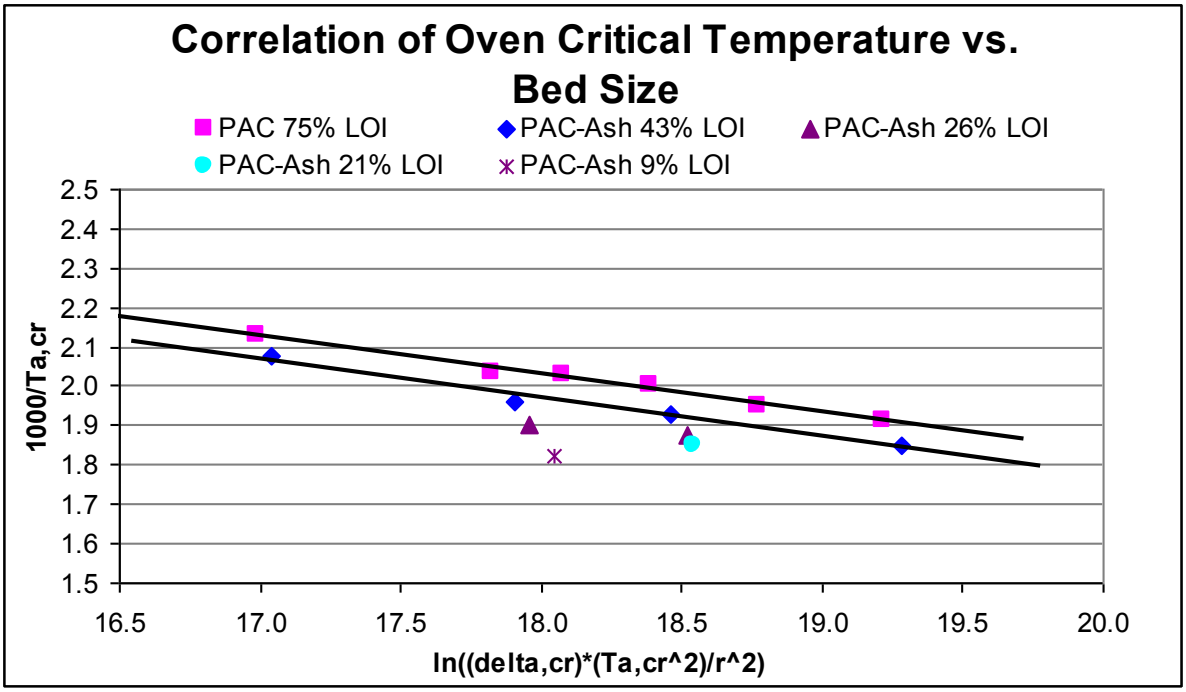


Figure 4-55. Correlation of Oven Critical Temperature versus Bed Size according to Frank-Kamenetskii Model Equations.

4.15.6.8.2 Carbon Monoxide Emission

A carbon monoxide (CO) monitor was used during several laboratory tests to determine whether enough carbon monoxide would evolve to effectively use this as a method of detecting impending combustion. During a test where the bed did not ignite, but overheated significantly, approximately 40 ppm of carbon monoxide was measured. Figure 4-56 shows

the carbon monoxide measured during autoignition following the overheating phase. The monitor was set at a maximum concentration of 400 ppm. This level was exceeded during this test and peaked at the onset of ignition.

The tests with a CO monitor show that the installation of a CO monitor in a hopper could show a small increase in CO levels before autoignition occurs, and large levels during ignition. However, CO monitors may not predict autoignition prior to the onset of detectible fire conditions. A CO monitoring system may provide time for properly trained operators to respond to elevated CO levels.

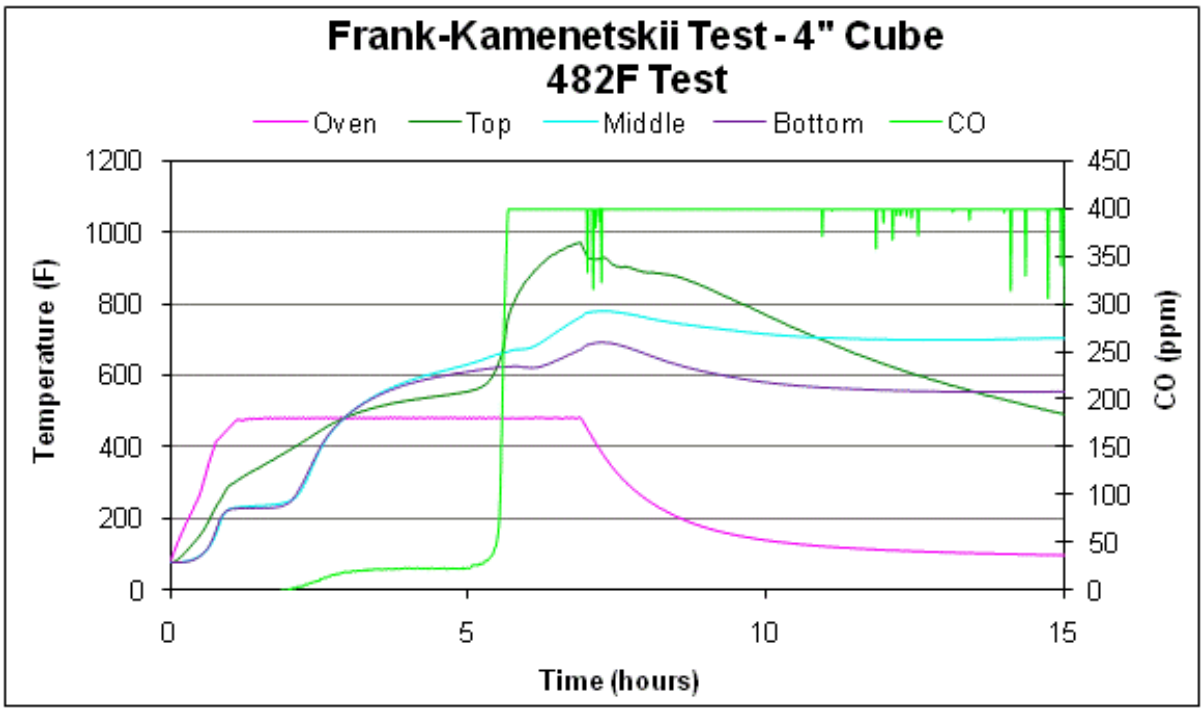


Figure 4-56. Carbon Monoxide Produced during Autoignition of PAC.

4.15.6.9 Hopper Modifications

One result of the hopper fires in 1Q06 was modifications to compartment Hopper #4. These changes were made to only one hopper as a test of possible modifications to improve operations and to minimize potential for hopper fires.

During 1Q07, the insulation was removed from the bottom portion of the hopper to expose the heaters and vibrator. The vibrator was moved to a lower position on the hopper wall. It

was felt that this would improve the effectiveness of the vibrator at ensuring the hopper was completely emptied when ash was pulled. One of the goals for preventing hopper fires was to minimize the time ash remained in the hopper. The level sensor was also moved down for the same reason.

Four new ports were cut into the hopper to accommodate carbon monoxide monitor probes. Laboratory testing performed by ADA-ES showed that carbon monoxide was liberated by smoldering PAC. Installing CO detection in the hopper was planned to determine if this would provide an early warning of overheating. Four ports were installed at different elevations to determine the optimum placement of the CO probe. Four probes were installed and connected to one CO analyzer.

During 2Q07 some minor electrical work associated with fixing and relocating unit hopper heaters were completed. These changes included moving the thermocouple to a location more representative of the hopper wall temperature.

4.15.6.10 CO Detector Installation

During 3Q07 We Energies began working with Forney Corporation to install a carbon monoxide detector on the Compartment #4 hopper. Since laboratory testing showed that carbon monoxide was produced at the onset of an overheating event, this was viewed as a potential method for early indication of a hopper fire.

During August 2007 testing with the system began but quickly showed signs of excessive condensation in the sample line. From 3Q07 to 2Q08 Forney was unsuccessful in resolving the condensation and other operational issues associated with sampling from the hopper. During 2Q08 Forney indicated they would discontinue their efforts. We Energies removed and shipped the CO measurement system back to Forney.

4.15.6.11 Operation at Presque Isle since the Initial Hopper Fires

After the initial hopper fires in March 2006, there were two more incidents with burning PAC in a hopper at Presque Isle. One incident was described earlier and occurred in August when the hopper heater settings were still too high. The other incident happened during an

outage when sample ports were installed in the hoppers to make it easier to take regular ash samples. The bags had been put through a manual clean and the ash pulled from the hoppers. A small amount (approximately 1 cubic foot) of residual PAC/ash from the bags accumulated in the throat of the hoppers during the outage. Approximately two days after cutting and welding the new ports, operators noticed that the throat of the hopper was hot to the touch. Burning embers were removed. The other nine hoppers were checked for overheating and were found to be cool. The next day another hopper had to have about 1 cubic foot of burning PAC/ash evacuated. This is a good indicator of the insulating properties of PAC, since the day before the wall was cool.

We Energies has never had an incident with overheating of the PAC/ash mixture in the ash silo, even during the initial incident when hot material had been pulled from the baghouse hoppers before the overheating was noticed. Since that time, as a precaution, the ash silo was emptied when overheating was noticed (two incidents noted above).

4.15.6.12 Suggestions for Baghouse Operation with High-Carbon Solids

Working with industry, the following preliminary design considerations and procedures were recommended to minimize the risk of overheating high-carbon ash in hoppers:

- Eliminate the use of hoppers heaters.
- If hopper heaters are necessary to control condensation, change the hopper heater control from an on-off mode to a more tightly constrained temperature band. This should result in a lower peak temperature output of the heater. Also, consider only using hopper heaters during startup and shutdown.
- Add or increase temperature monitoring in the hopper to include temperature sensors inside the hopper. This will help with early indication of unusual temperature increases. Thermocouple placement is important (e.g., within PAC/ash material bed).
- Consider hopper design to ensure proper flowability of the collected material, especially materials with a high PAC-to-ash ratio.

- Select a means of fluidization collected materials other than by use of vibrators that does not promote packing of the material. One option is the use of sonic horns. Fluidization with air is strongly discouraged because the introduction of oxygen could enhance the possibility of igniting PAC/ash mixtures. Further testing should be conducted to determine the effectiveness of vibrators for TOXECON™ systems.

- Employ a hopper evacuation schedule that frequently removes hopper materials from the hoppers, preventing material buildup.

- Install a hopper level detector system and ensure its reliable operation. The level detector should be at a low enough level to indicate inappropriate buildup of material within the hoppers.

- When working around PAC, any operations that produce heat (such as welding, cutting, etc.) should only occur after all PAC has been removed from the work area. Even a small piece of hot metal or other hot material dropped into PAC will eventually cause ignition of the material, even at ambient conditions and without another heat source.

4.15.7 Mercury Removal Performance

The field-testing at Presque Isle was divided into three periods: baseline, parametric, and long-term testing. During baseline testing, no sorbent was injected into the flue gas in order to establish the level of flue gas mercury leaving the air preheater (inlet to the baghouse) and to determine any native capture across the TOXECON™ baghouse. During parametric testing, the performance of two commercial mercury sorbents was evaluated for technical and economic feasibility. During long-term testing, which included optimization and reliability testing, performance of the TOXECON™ baghouse and PAC injection were evaluated while optimizing the various set points such as time between cleaning, baghouse pressure drop, air-to-cloth ratio, and compartment isolation. In addition to optimizing the PAC injection and baghouse set points during the long-term tests, alternative sorbents were tested using temporary injection equipment. Results from each test series are included in this section.

4.15.7.1 Baseline Test Results

On December 17, 2005, the TOXECON™ baghouse was put into service with flue gas from Unit 7. Unit 9 was added on January 5, 2006, and Unit 8 on January 27. Baseline tests officially began during the week of February 13 after check-out of the PAC system. Baseline tests were performed to determine the normal operating parameters and constituent levels without the effect of PAC injection. Efforts during this week included sampling of coal and ash, monitoring the CEMS and plant data, and performing mercury, halogen, and particulate testing on the flue gas into and out of the baghouse. No PAC was injected during the baseline tests, although there was residual PAC on the bags from the prior checkout of the activated carbon injection (ACI) equipment.

4.15.7.1.1 Baseline Flue Gas Testing Overview

During the baseline testing week, GE Energy was contracted by ADA-ES to measure flue gas constituents at the inlet and outlet of the baghouse. On February 14, 15, and 16, they conducted manual measurements that included:

- Ontario Hydro measurements for mercury at the common inlet and outlet duct
- Method 5 for particulate loading at the common inlet and outlet ducts
- Method 26A for halogens at the common outlet duct

The report from GE Energy is attached as Appendix G. The results of the baseline flue gas measurements are presented in the following section and are also summarized in the Emission Testing section of this report (4.15.10.1).

4.15.7.1.2 Mercury Measurements

Mercury concentrations at the inlet and outlet of the baghouse were measured using the Ontario Hydro Method (OH) and the Thermo CEMS. OH measurements were taken at a total of 24 test points using six ports at the baghouse common inlet and outlet test locations using speciated mercury sample trains that met all specifications required by the OH Method. Triplicate tests were performed at the inlet and the outlet. The inlet mercury concentration averaged 4.99 $\mu g/m^3$ when measured by the CEMS and 5.67 $\mu g/m^3$ when measured by the

OH method. The outlet mercury concentration averaged 4.96 μg/m³ when measured by the CEMS and 5.20 μg/m³ when measured by the OH method. Figure 4-57 shows how the OH measurements compare with the Thermo CEMS.

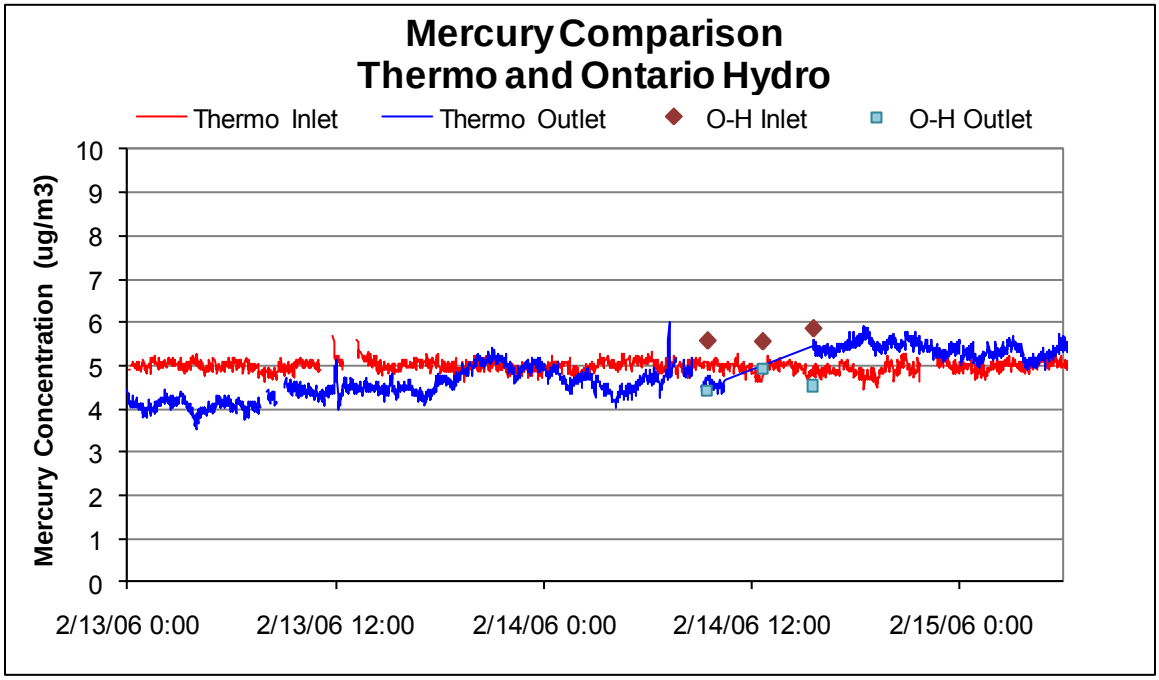


Figure 4-57. Thermo CEM and Ontario Hydro Measurements.

Table 4-23 shows the average inlet and outlet measurements using the CEMS and comparing with the OH Method. There was a 0.6% difference between inlet and outlet based on the CEMS, but 9% when using the OH method. The CEMS and the OH results differed by 12% and 4.6%, which is well within the 20% agreement required by EPA to pass the Relative Accuracy Test Audit (RATA) for mercury.

Table 4-23. Comparison of Thermo CEM and Ontario Hydro Data.

Measurement Method	Inlet Average (μg/m³)	Outlet Average (μg/m³)	Differential (%)
Thermo CEM	4.99	4.96	0.6%
Ontario Hydro	5.67	5.20	9.0%
Differential (CEM & OH)	12%	4.6%	

Based on the OH data, the elemental mercury at the inlet was 91% of the total and oxidized was the balance, with just a trace of the mercury particle-bound. At the outlet, the elemental portion was 88%, with the remainder in oxidized form.

4.15.7.1.3 Flue Gas Temperature Measurements

As part of the traverse process for the OH method, flue gas temperatures were taken at 24 points at both the inlet and outlet duct to the baghouse. Figure 4-58 displays a cross-sectional view of the inlet and outlet ducts with the temperatures at the 24 points throughout the duct.

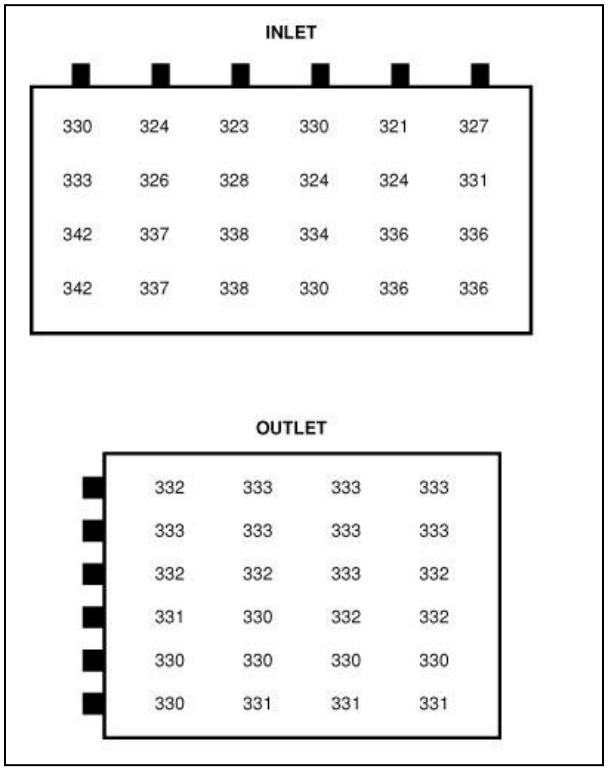


Figure 4-58. Baghouse Temperature Profile.

The results and comparison with the plant temperature data from the EDS are shown in Table 4-24. Load was steady during these tests. The two data sets are comparable and show good distribution across the duct with a variance of less than 20 ºF at the inlet and less than 10 ºF at the outlet.

Table 4-24. Flue Gas Temperature Comparison.

Temperature Profile in Ducts from 9:25 a.m. to 12:00 p on 2-14-06				
	Inlet Min. (°F)	**Inlet Max (°F).**	**Outlet Min. (°F)**	**Outlet Max. (°F)**
GE Energy	324	342	330	333
Plant EDS	332	339	326	334

4.15.7.1.4 Particulate Measurements

Particulate measurements were taken at a total of 24 test points using six ports at the baghouse common inlet and outlet test locations. The particulate sample trains met all specifications required by Method 5, 40CFR60. Triplicate sampling was performed at the inlet and outlet. The average inlet value was 110.166 lb/hr and the average outlet value was 1.701 lb/hr. Table 4-25 shows the results of this study. The average removal across the baghouse was 98.5%.

Table 4-25. Particulate Removal across the Baghouse.

Run #	Inlet (lb/hr)	Outlet (lb/hr)	Removal (%)
1	84.868	4.179	
2	104.438	0.368	
3	141.192	0.556	
Average	110.166	1.701	98.5

4.15.7.1.5 Hydrogen Halide and Halogen Measurements

Hydrogen chloride (HCl), hydrogen bromide (HBr), bromine (Br_2) and chlorine (Cl_2) concentrations were determined using Method 26A, 40CFR60. Three integrated twenty-four-point samples were extracted from the common outlet gas stream. The inlet was not measured during the baseline period. Table 4-26 lists the results of these measurements.

Table 4-26. Hydrogen Halide and Halogen Measurements.

Run #	HCl (ppm)	HBr (ppm)	Cl_2 (ppm)	Br_2 (ppm)
1	3.79	0.16	0.00	0.00
2	3.90	0.00	0.00	0.00
3	3.73	0.00	0.00	0.00
Average	3.81	0.05	0.00	0.00

4.15.7.1.6 Baghouse Performance Data

Data were downloaded from the Thermo CEMS and the plant's EDS for the week of baseline testing. Figure 4-59 shows inlet and outlet mercury concentrations, baghouse inlet temperature, total boiler load, flue gas volume, flange-to-flange pressure drop, Compartments 1–5 pressure drop, A/C ratio, PAC injection, and mercury removal percentage. The increased mercury removal on February 16 is an artifact of an issue with the outlet CEM calibration routine.

The baseline mercury concentrations as measured by the CEMS were about 5.0 μg/m³ at the inlet and between about 4.0 and 5.5 μg/m³ at the outlet. There was some drift on the outlet CEM because the calibration routine was not programmed properly. When this was corrected on February 16 and the instrument began undergoing daily calibrations, the mercury levels returned to the expected values. The baseline mercury removal was between 0–30%.

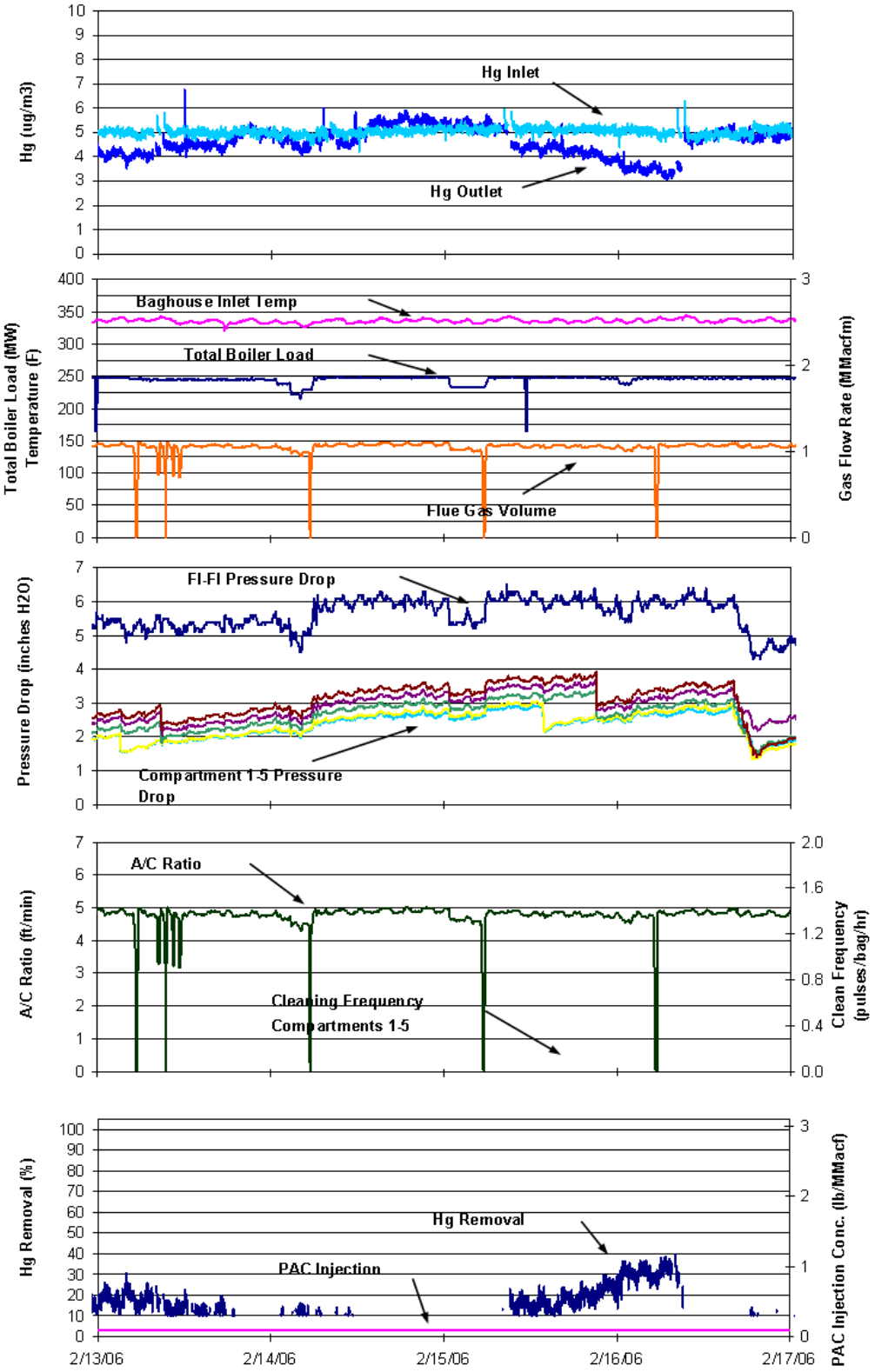


Figure 4-59. Baseline Mercury and Baghouse Data; February 13–17, 2006.

4.15.7.1.7 Baghouse Cleaning Cycle

Baghouse cleaning during baseline testing was set to initiate a clean at 6.5" w.c. or every 72 hours. On-line cleaning was used with one compartment of bags cleaned at a time. Each clean consisted of pulsing 6 of the 36 pulse pipes in a compartment and then sequencing to the next compartment. When the pressure drop decreased by 0.5" w.c. after any compartment had been cleaned, the cleaning was stopped. On the next cleaning cycle, the pulsing picked up where it left off. During any cleaning cycle all of the pipes in every compartment may or may not be pulsed.

4.15.7.1.8 Sample Collection and Analysis

During baseline testing, coal and ash samples were collected from the coal feeders on Units 7–9, the hot-side ESP ash hoppers, and the TOXECON™ baghouse hoppers. The goal for this sampling campaign was to collect sufficient samples to determine:

- Variations in coal mercury concentration between the three units and between the four feeders on each unit;
- Mercury concentration in the ash collected in the hot-side ESPs; and
- Mercury concentration in and variation between hoppers of the ash collected by the TOXECON™ baghouse.

Table 4-27 lists the samples collected.

Table 4-27. Coal and Ash Sampling Schedule – Baseline.

Sample	Location	Dates	# Samples
Coal	Feeders A1, A2, B1, B2 on Units 7–9	2/14–2/16/06 (12 samples per day)	36 total
ESP Ash	Unit 7 hoppers (A–L)	2/14/06	12
ESP Ash	Unit 8 hoppers (A–L)	2/15/06	12
ESP Ash	Unit 9 hoppers (A–L)	2/16/06	12
Baghouse Ash	Hoppers 1–10	2/14–2/16/06 (10 samples per day)	30 total

Samples were shipped to ADA-ES, where portions of the samples were analyzed. Depending on the analysis, samples were analyzed either by ADA-ES or sent to outside laboratories for the appropriate testing. Table 4-28 lists the analyses that were performed.

Table 4-28. Coal and Ash Analysis Schedule – Baseline.

Sample	Analysis
Coal	Ultimate, Proximate, Hg, Cl
ESP Ash	Loss on Ignition (LOI) and Hg
Baghouse Ash	LOI and Hg

Table 4-29 shows the ranges of the results from the baseline tests on the coal and ash. Details of the individual test results are shown in Appendix C, including results from the ultimate and proximate tests.

Table 4-29. Coal and Ash Results – Baseline.

Sample and Test	Results
Coal Hg	35–89 ng/g
Coal Cl	43–116 µg/g
ESP Ash Hg	< 10 ng/g
ESP Ash LOI	0.61–1.5%
Baghouse Ash Hg	1,790–14,100 ng/g
Baghouse Ash LOI	6–18% (after PAC startup testing)

Typical LOI values for the ESP ash were below 1%. The results from the baghouse ash were higher since there was residual PAC from the startup operations. The mercury level in the baghouse ash was also much higher due to the residual PAC from startup. There was no apparent difference in mercury or chlorine in the coal from coal feeders on the different units.

4.15.7.2 Parametric Test Results

The parametric test phase was performed to understand the effect of sorbent injection on mercury capture and fabric filter performance. Two sorbents were tested to assess both

technical and economic feasibility. Testing began with the first sorbent after the baseline period ended in February 2006 and ended with the second sorbent in January 2007.

The two sorbents injected for the parametric tests were Norit America's DARCO® Hg and DARCO® Hg-LH. DARCO® Hg, which was an industry benchmark sorbent for mercury capture, was injected during the first phase of parametric testing. DARCO® Hg-LH was a more expensive activated carbon compared to the DARCO® Hg because it was chemically enhanced with bromine. The DARCO® Hg-LH was tested because in many applications it provided better results at higher temperatures and lower injection rates. The DARCO® Hg-LH was injected during the second phase of parametric testing.

Coal and hopper ash samples were taken during each parametric test run. The coal samples were not analyzed as a matter of course since the primary mercury results were based on the mercury CEMS. The hopper ash samples were analyzed for each test run to evaluate the actual usage of the sorbent's capacity to adsorb mercury. The results of the coal and ash analysis can be found in Section 4.15.5, "Analysis of Feed Stock, Products, and Reagents."

4.15.7.2.1 DARCO® Hg – Parametric (Round 1)

The first round of parametric tests began in February 2006 with DARCO® Hg after startup and baseline tests were complete. Injection concentrations were planned from 0.5 lb/MMacf to 3.0 lb/MMacf increasing by 0.5 lb/MMacf increments for periods of 48 hours each.

To minimize variables, it was decided to operate the baghouse at a pressure drop of nominally 6" w.c. and use a cleaning logic that was similar to baseline testing. It was also agreed that a parametric test would be considered complete when the mercury removal varied less than ± 5% for 24 hours.

Table 4-30 lists the log of operational events for the first phase of parametric tests. Prior to parametric testing, the baghouse was put through one complete cleaning cycle to remove residual dust cake that was formed when the units were being brought on line. This was done by initiating a manual clean cycle six times to ensure every bag in every compartment was pulsed. The flange-flange (fl-fl) pressure drop decreased to nominally 4.5" w.c. To increase

the fl-fl pressure to the target of 6" w.c., PAC injection was started on February 17 at a concentration of 0.5 lb/MMacf but there were problems with the ash unloader so PAC injection was discontinued. On February 20, the injection was resumed at a relatively high concentration of 3.0 lb/MMacf and then lowered as the pressure drop increased. The effect of these injection rates can be seen in Figure 4-60.

Table 4-30. Operation Log during Parametric Tests.

Date	Time	PAC Inj. (lb/MMacf)	Operation Log
2/16/06	16:00	0	Initiate 6 clean cycles (1 full clean)
2/17/06	11:15	0.5	Cleaning completed, start PAC injection
2/17/06	15:23	0	Ash unloader broken, no PAC injection until fixed
2/19/06	23:08	0	One mill on Unit 9 offline
2/20/06	7:50	3	Increase carbon injection rate to build DP
2/20/06	16:35	0.5	Lower injection rate to begin parametric tests
2/21/06	00:12	0.5	Mill on Unit 9 came back on line
2/23/06	5:30	0.8	Control glitch caused increase in PAC rate
2/23/06	8:00	1.0	Increase to second parametric test condition
2/24/06	21:20	0.45	Control glitch caused decrease in PAC rate
2/25/06	4:18	0.5	Control glitch caused increase in PAC rate
2/25/06	6:45	1.5	Increase to third parametric test condition
2/27/06	8:30	2.0	Increase to fourth parametric test condition

On February 20, PAC injection was set at 0.5 lb/MMacf to begin parametric tests. By February 22, outlet mercury concentration leveled out. This long stabilization period was needed because mercury removal was higher than expected due to the residual PAC still on the bags from recent injection at 3.0 lb/MMacf. As the mercury capture capacity of the carbon was used up, the mercury concentrations increased from 0.5 to nominally 4 $\mu g/m^3$ and removal rate decreased until quasi-equilibrium was reached on February 22. At this condition average mercury removal was relatively stable, but outlet mercury cycled with what appeared to be a fairly consistent frequency. The amplitude of the cycle was at times as much as 1 $\mu g/m^3$, which caused a variation in mercury removal greater than 5%. This

cycling can be seen in the top graph in Figure 4-60. Several variables that could affect outlet mercury concentration, including temperature, flow, pressure drop, pulse cleaning, carbon feed, and hopper ash pulling, were analyzed and a strong correlation was found between outlet mercury concentration and inlet flue gas temperature. The criteria of operating for 24 hours at a removal efficiency (RE) variation of less than ± 5% was waived because of the significant and unexpected, but consistent variation in outlet mercury with temperature.

Parametric tests continued until March 1, 2006, when PAC injection was suspended because embers were found in the hoppers. Information about the hopper fires can be found in Section 4.15.6, "Startup Issues – Hopper Fires and Ash Overheating."

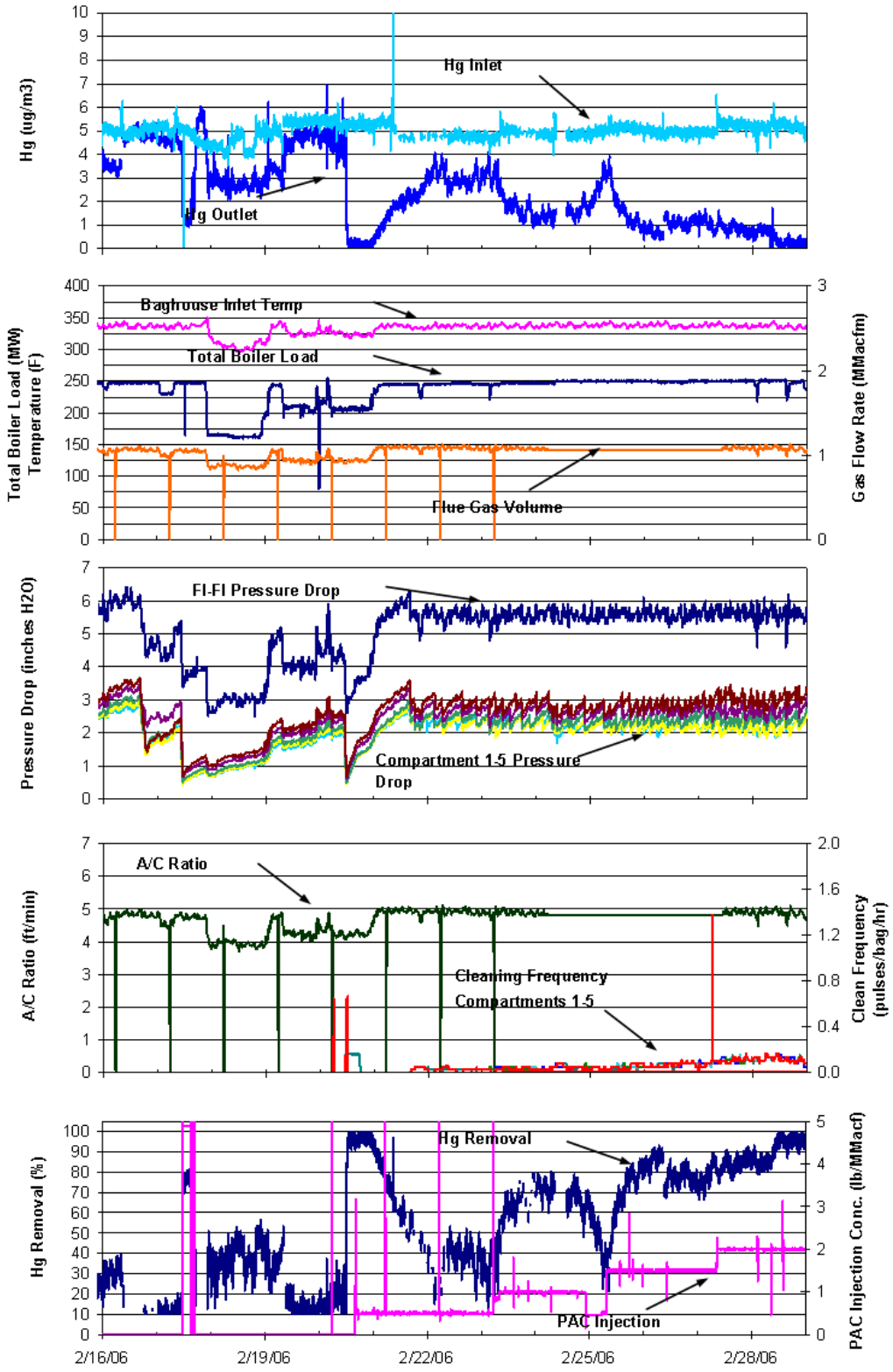


Figure 4-60. DARCO® Hg Parametric (Round 1) Mercury and Baghouse Data; February 16–28, 2006.

The relationship between mercury removal and inlet temperature during testing at 1.0 lb/MMacf can be seen in Figure 4-61. The effect on outlet mercury concentration from changes in the inlet temperature was nearly instantaneous and could vary up to 1.0 μg/m³ with as little as a 10 °F increase in temperature depending on the injection ratio. Bench-scale test have shown that DARCO® Hg begins to be less effective at removing mercury when temperature is increased, which is expected since physical adsorption reactions, including adsorption of mercury onto activated carbon, is temperature dependent. However, this relatively dramatic effect on mercury adsorption at temperatures as low as 333 ºF was unexpected.

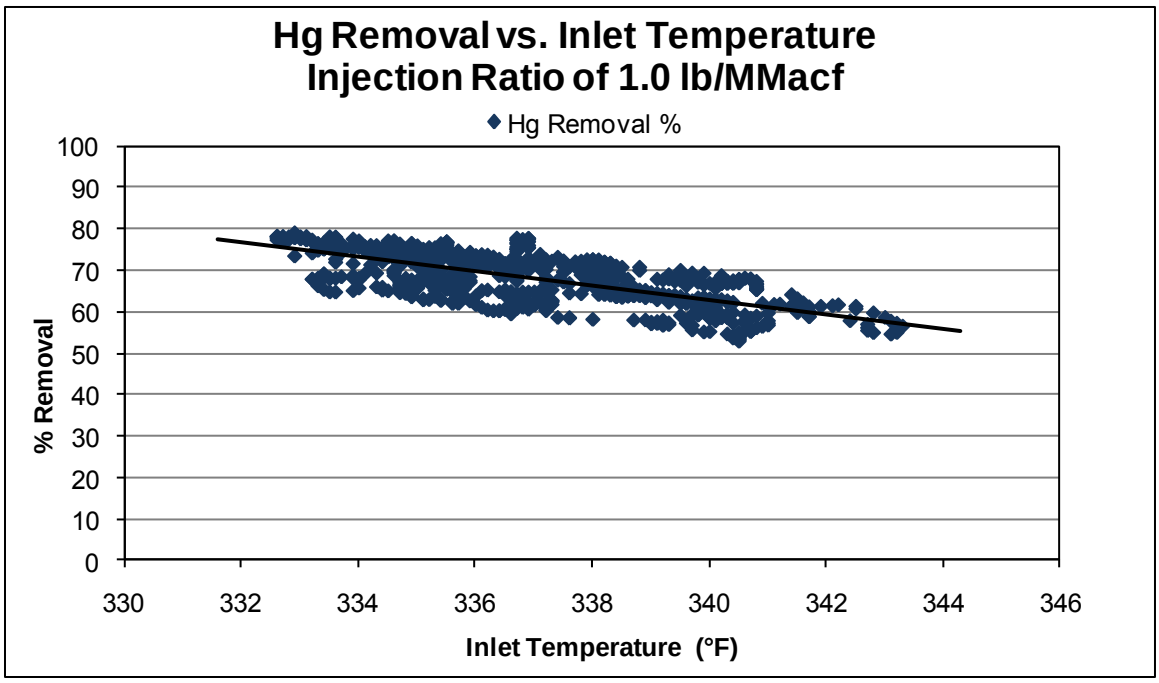


Figure 4-61. Relationship between Inlet Temperature and Mercury Removal at 1.0 lb/MMacf with DARCO® Hg.

4.15.7.2.2 DARCO® Hg Injection Continues

After the hopper fire incident, injection was discontinued pending investigation of the cause. Injection began again on May 30, 2006, with DARCO® Hg at 0.5 lb/MMacf, and then was increased to 1.0 lb/MMacf after about an hour. Units 8 and 9 were offline for scheduled outages during this time so this period of injection was not used for official parametric testing because the TOXECON™ system was not operating at full capacity. Figure 4-62

shows the baghouse data from May 25 through July 3. There was no mercury inlet reading since the inlet CEMS was tied into Unit 8. The mercury outlet reading responded quickly to the PAC injection, but the signal was very noisy compared to earlier parametric tests.

The injection concentration was increased to 1.5 lb/MMacf on June 6, as seen in the bottom graph of Figure 4-62. PAC injection was shut off from June 12 through June 16 to allow the plant to perform particulate tests. Injection was resumed at 2.0 lb/MMacf on June 16.

The PAC injection concentration was held at 2.0 lb/MMacf until June 29. At that time, plant personnel attempted to remove ash and PAC from the ash silo and encountered problems with excessive dusting. The new flow control valve to the dustless unloader was unable to provide the required steady flow of PAC/ash to the mixer. In addition, there appeared to be problems with adequate fluidizing airflow to the bottom of the ash silo. Unit 8 was tied into the baghouse on June 21, resuming inlet mercury readings. Unit 9 was tied into the baghouse on June 29.

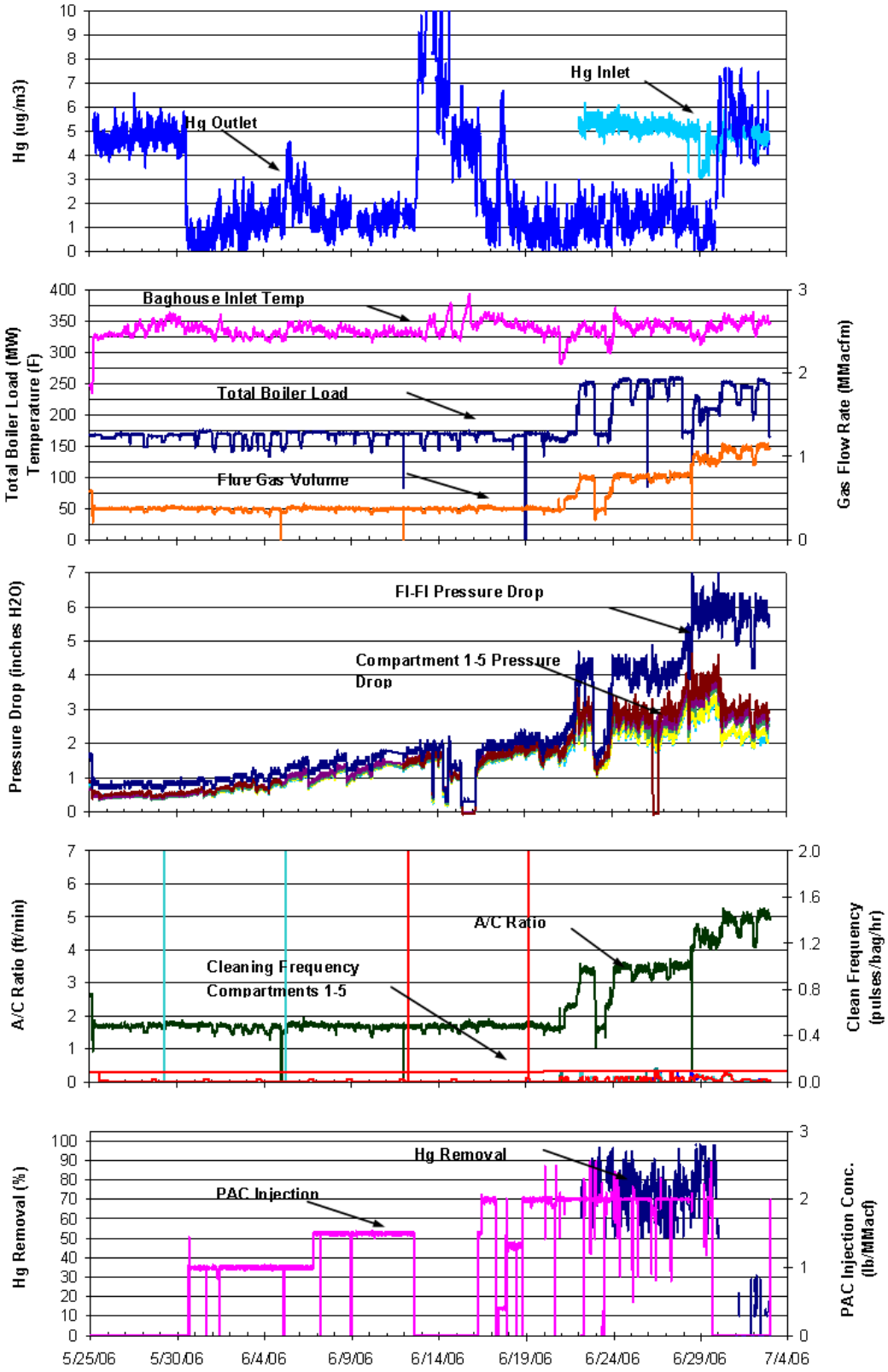


Figure 4-62. DARCO® Hg, Mercury, and Baghouse Data for May 25–July 3, 2006.

4.15.7.2.3 **DARCO® Hg – Parametric (Round 2)**

Parametric testing of PAC injection resumed on August 18, 2006, using DARCO® Hg carbon at an injection concentration of 0.5 lb/MMacf. The injection concentration was increased approximately every 72 hours in 0.5 lb increments up to 3.0 lb/MMacf. Figure 4-63 shows mercury and baghouse data from August 18 through September 12, including inlet and outlet mercury readings, PAC injection concentration, flue gas temperature, flange-to-flange pressure drop, tube sheet pressure drops, total boiler load for all three units, flue gas volume entering the baghouse, A/C ratio, cleaning frequency, and mercury removal. The inlet mercury was measured in both Unit 7 and Unit 8 during this time and showed similar mercury values.

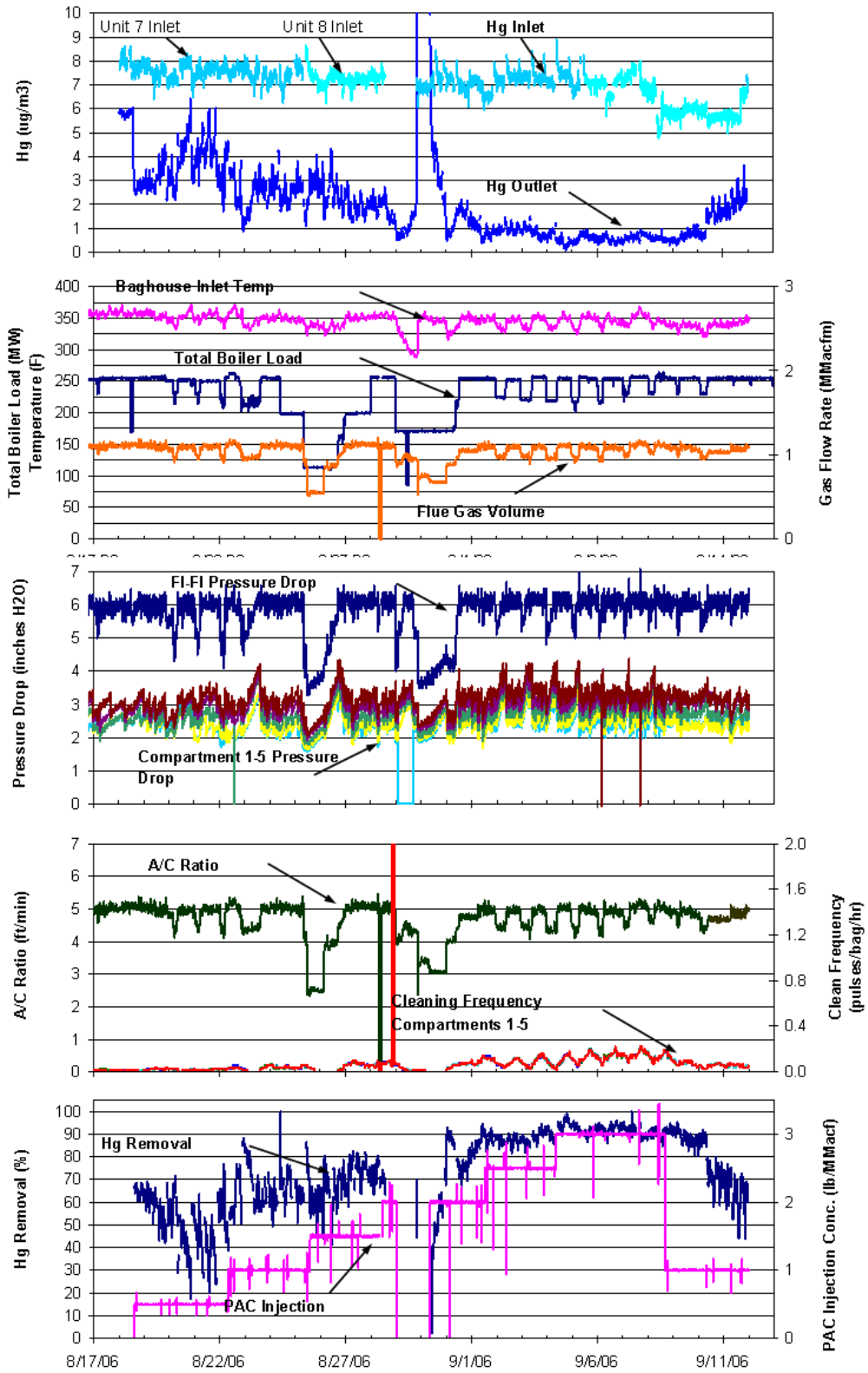


Figure 4-63. Mercury and Baghouse Data for August 17–September 12, 2006.

On August 28, 2006, PAC injection was suspended because burning embers were found in the Compartment 6 hopper. Operators had been pulling ash every four hours and thought that compartments were emptying, but could not quantify this while they were on line. Compartment 6 was isolated and the hopper material was cooled and removed without incident. Ash removal frequency was increased from every four hours to every two hours with a double pull done on each compartment. The compartment was put back on line and PAC injection resumed on August 30.

A comparison of the overall removal efficiencies from the first (February 2006) and second rounds (August 2006) of parametric tests using DARCO® Hg carbon can be seen in Table 4-31 and Figure 4-64. The mercury data from both rounds of testing were obtained from CEM measurements using data corrected with updated calibration factors. Mercury removal data from all temperatures was used in the average and median calculations.

Table 4-31. Comparison of Parametric Tests using DARCO® Hg.

Inj. Conc. (lb/MMacf)	Feed Rate (lb/hr)	Average Removal Efficiency 2/06 (% RE)	Median Removal Efficiency 2/06 (% RE)	Standard Deviation 2/06 (% RE)*	Average Removal Efficiency 8/06 (% RE)	Median Removal Efficiency 8/06 (% RE)	Standard Deviation 8/06 (% RE)*
0.5	30	37.4	38.7	+/- 7.6	49.1	48.0	+/- 12.6
1.0	60	69.8	70.2	+/- 4.9	67.3	66.6	+/- 7.1
1.5	90	77.5	77.4	+/- 4.4	73.7	74.4	+/- 4.3
2.0	120	93.7	93.5	+/- 3.6	79.4	80.0	+/- 5.5
2.5	150				89.7	89.9	+/- 2.0
3.0	180	95.4	95.9	+/- 3.5	89.9	89.7	+/- 1.6

*Example: At 2.5 lb/MMacf, the range of removal efficiency for 8/06 was 87.7–91.7%.

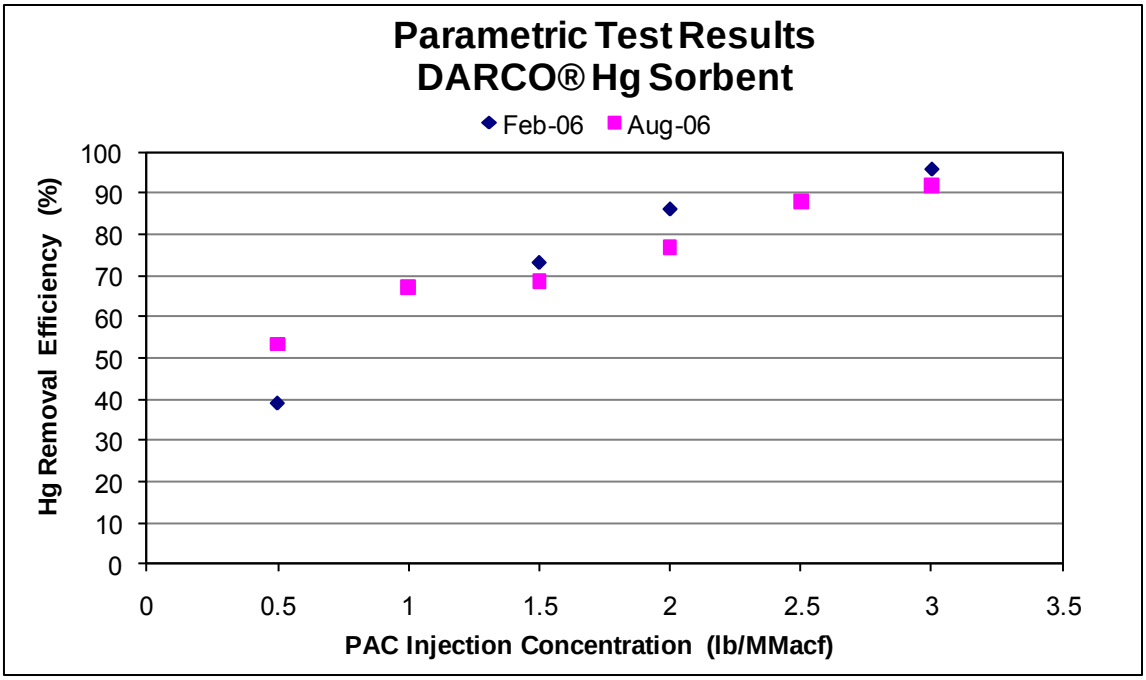


Figure 4-64. Average Mercury Removal using DARCO® Hg Sorbent.

In general, the mercury removal efficiency was higher in February than August, especially at injection concentrations of 2.0 and 3.0 lb/MMacf. This was likely due to the difference in the baghouse temperatures during winter and summer. Table 4-32 shows the baghouse inlet temperature ranges and averages for each injection concentration during February and August 2006. Figure 4-65 shows how removal correlates with temperature. Except for 0.5 lb/MMacf, increased temperature resulted in lower removal using DARCO® Hg sorbent. There is no known reason why the lowest injection rate should exhibit a different trend other than process control or baghouse stabilization issues.

Table 4-32. Baghouse Temperature during DARCO® Hg Parametric Tests.

Inj. Conc. (lb/MMacf)	Minimum Temp. 2/06 (°F)	Maximum Temp. 2/06 (°F)	Average Temp. 2/06 (°F)	Minimum Temp. 8/06 (°F)	Maximum Temp. 8/06 (°F)	Average Temp 8/06 (°F)
0.5	332	342	337	333	366	352
1.0	333	343	338	322	357	345
1.5	332	344	337	346	359	352
2.0	329	342	335	337	360	349
2.5				330	359	342
3.0	318	327	333	333	367	345

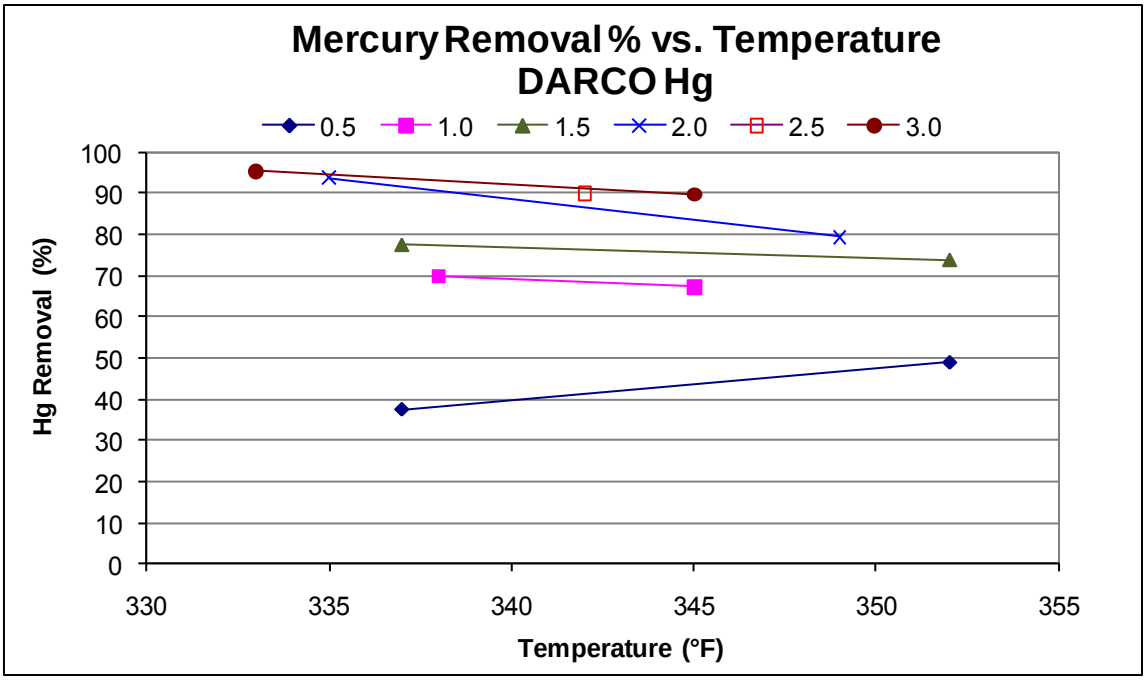


Figure 4-65. Effect of Temperature on Mercury Removal Using DARCO® Hg.

4.15.7.2.4 DARCO® Hg-LH – Parametric

On September 8, 2006, after the completion of the parametric testing using DARCO® Hg, a truckload of DARCO® Hg-LH was placed in the silo on top of 4.7 feet of DARCO® Hg. The PAC injection concentration was set at 1.0 lb/MMacf while the changeover to the DARCO® Hg-LH occurred. Figure 4-66 shows performance data for the period covering changeover and the beginning of parametric testing of the DARCO® Hg-LH. On September 15, the outlet mercury decreased and the variability decreased even though the flue gas temperature was increasing. This is the point at which the DARCO® Hg ran out and was replaced by the DARCO® Hg-LH. During this period of injection with DARCO® Hg-LH at 1.0 lb/MMacf the mercury removal was between 80 and 90%.

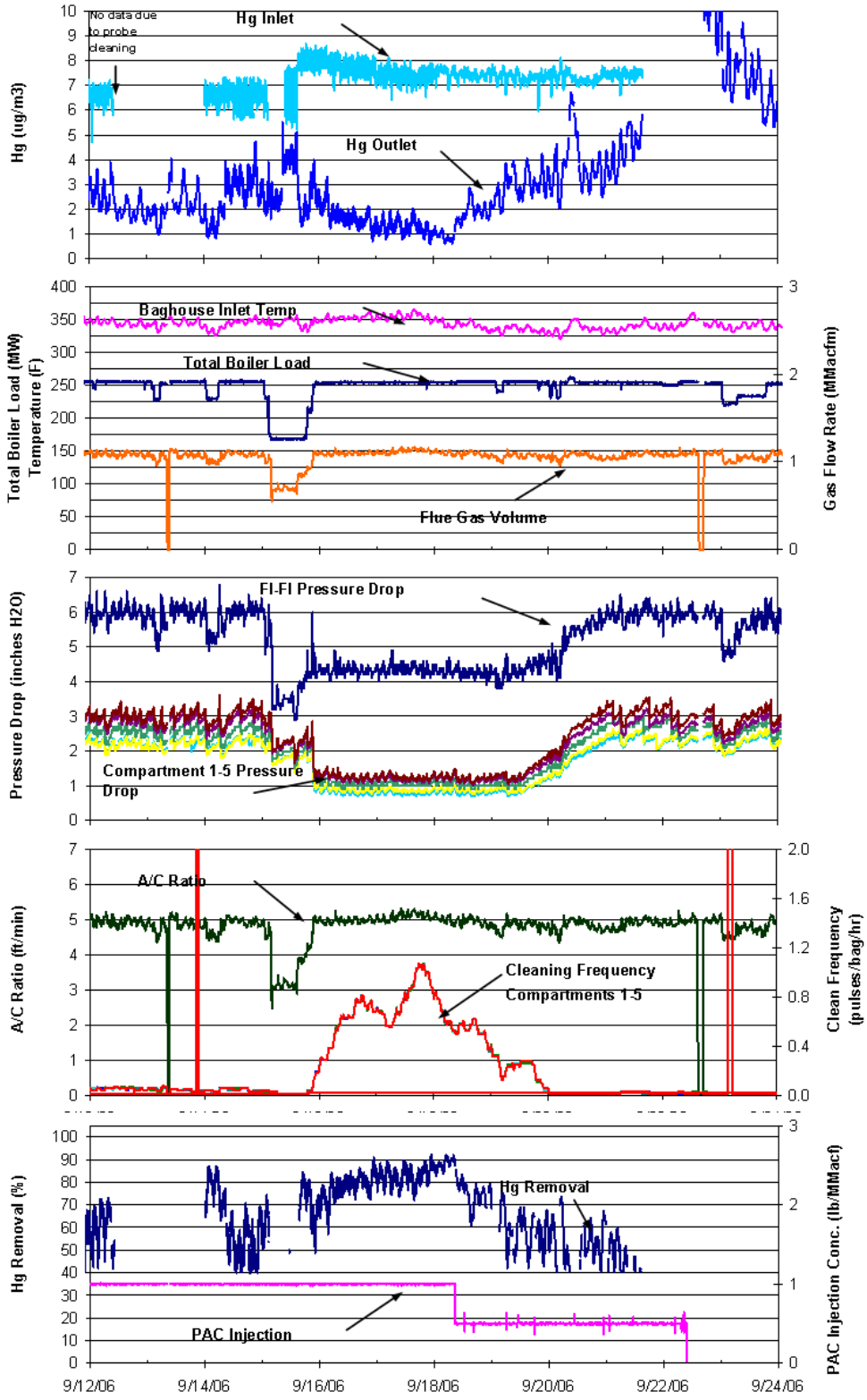


Figure 4-66. Mercury and Baghouse Data during Changeover from DARCO® Hg to DARCO® Hg-LH.

At the end of September 2006, PAC injection had been stopped due to issues with the ash unloader. PAC injection resumed on October 11, 2006 at a concentration of 0.5 lb/MMacf using DARCO® Hg LH carbon. The injection concentration was increased to 1.0 lb/MMacf on October 16, then back down to 0.5 lb/MMacf on October 19.

On October 24, the injection concentration was increased to 1.0 lb/MMacf then increased by 0.5 lb/MMacf increments approximately every 72 hours. On November 7, the injection concentration was dropped to 1.0 lb/MMacf. Figure 4-67 shows the baghouse data from October 20 through November 10, including inlet and outlet mercury readings, PAC injection concentration, flue gas temperature, flange-to-flange pressure drop, tube sheet pressure drops, total boiler load for all three units, flue gas volume entering the baghouse, A/C ratio, cleaning frequency, and mercury removal.

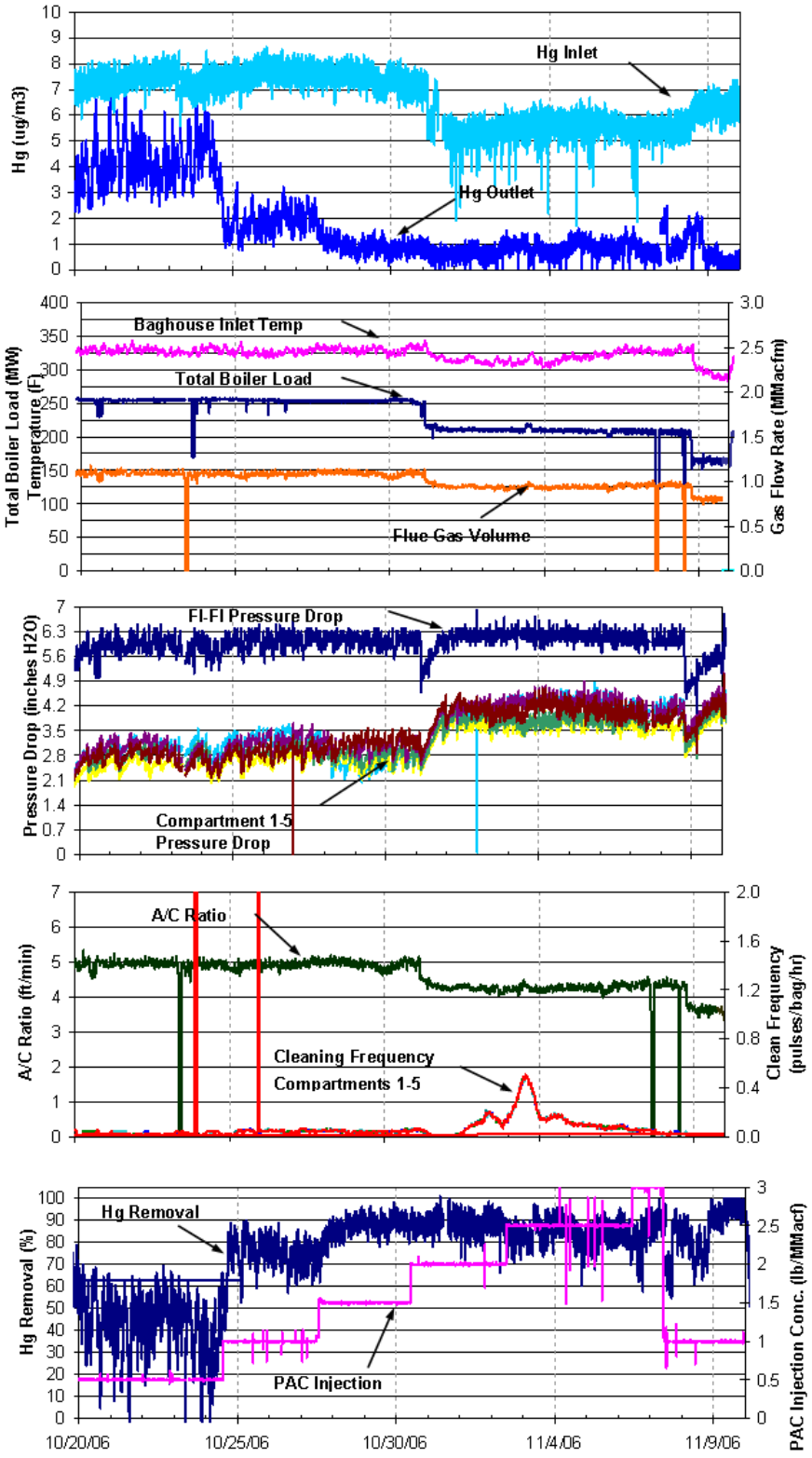


Figure 4-67. Mercury and Baghouse Data during DARCO® Hg-LH Parametric Testing; October 20–November 10, 2006.

4.15.7.2.5 Summary of Parametric Testing

The graph in Figure 4-68 summarizes the results of the parametric testing for the two sorbents, DARCO® Hg and DARCO® Hg-LH. For direct comparison, the data are limited to test results at flue gas inlet temperature of 330 °F and baghouse cleaning set point of 6.5" w.c.

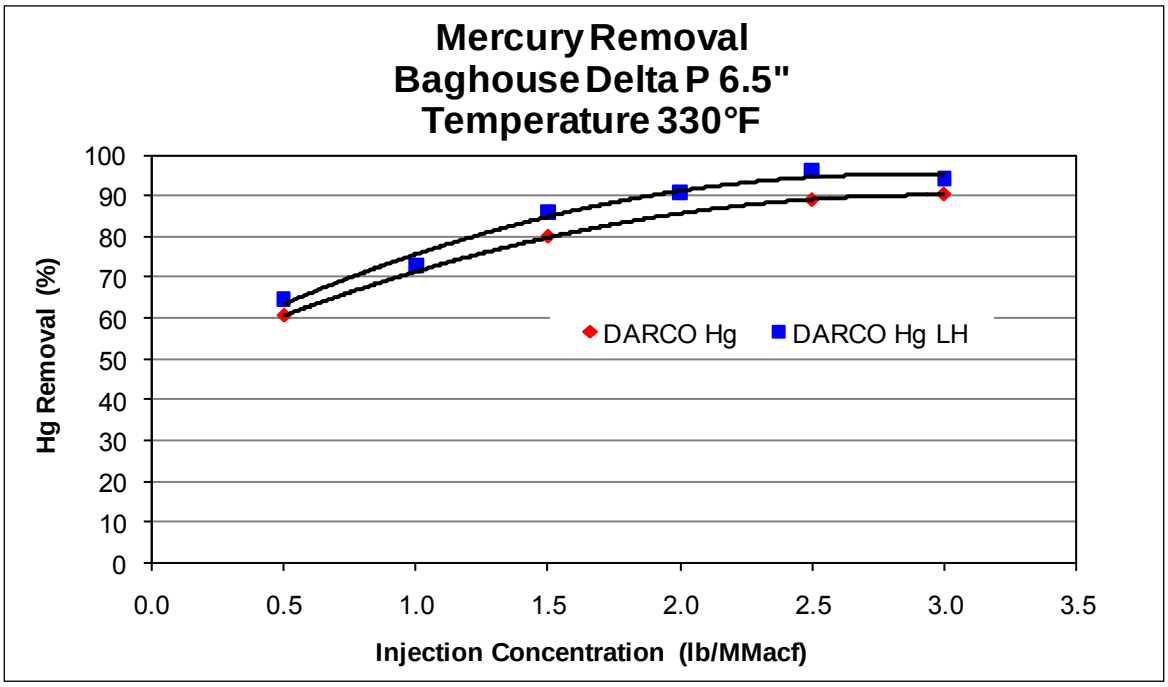


Figure 4-68. Parametric Test Results – 330 °F.

Figure 4-69 summarizes the results for all temperatures. This shows that DARCO® Hg at the lower injection concentrations was more affected by temperature than DARCO® Hg-LH.

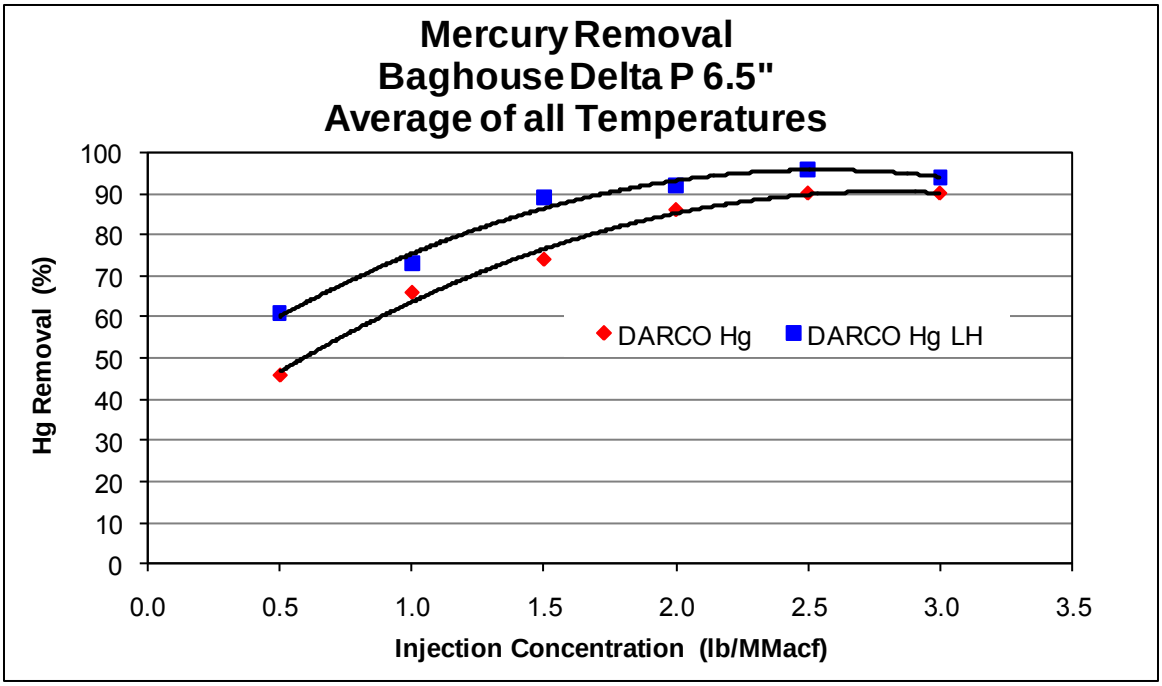


Figure 4-69. Parametric Test Results – All Temperatures.

The parametric test curves showed that a mercury removal efficiency of 90% in the TOXECON™ system could be achieved using PAC injection at concentrations between 1.5 lb/MMacf and 2.0 lb/MMacf for DARCO® Hg-LH and between 2.0 lb/MMacf and 2.5 lb/MMacf for DARCO® Hg.

4.15.7.3 Long-Term Mercury Removal

4.15.7.3.1 Baghouse Performance Graphs

Long-term mercury removal testing began in November 2006 after the completion of the parametric tests. Throughout the following 34 months, mercury and baghouse performance were reviewed weekly with data downloaded from the mercury CEMs and the plant EDS. Baghouse performance graphs for each month are in Appendix H. Figure 4-70 is an example of these graphs for July 2009. The top graph in the figure shows inlet and outlet mercury data. The second graph shows boiler load, flue gas temperature and flue gas flow rate. The third graph shows baghouse flange-to-flange (fl-fl) pressure drop and tube sheet pressure drop for 5 of the 10 compartments. The fourth graph shows air to cloth ratio A/C and cleaning frequency. The fifth graph shows mercury removal and PAC injection rate.

This graph and all others in Appendix H clearly show how boiler load affects pressure drop and temperature in the baghouse. The flue gas temperature also trends closely with outlet mercury. Mercury removal was, on a long-term average, above the 90% level targeted in this demonstration. These graphs also show the effect of various optimization tests throughout the demonstration.

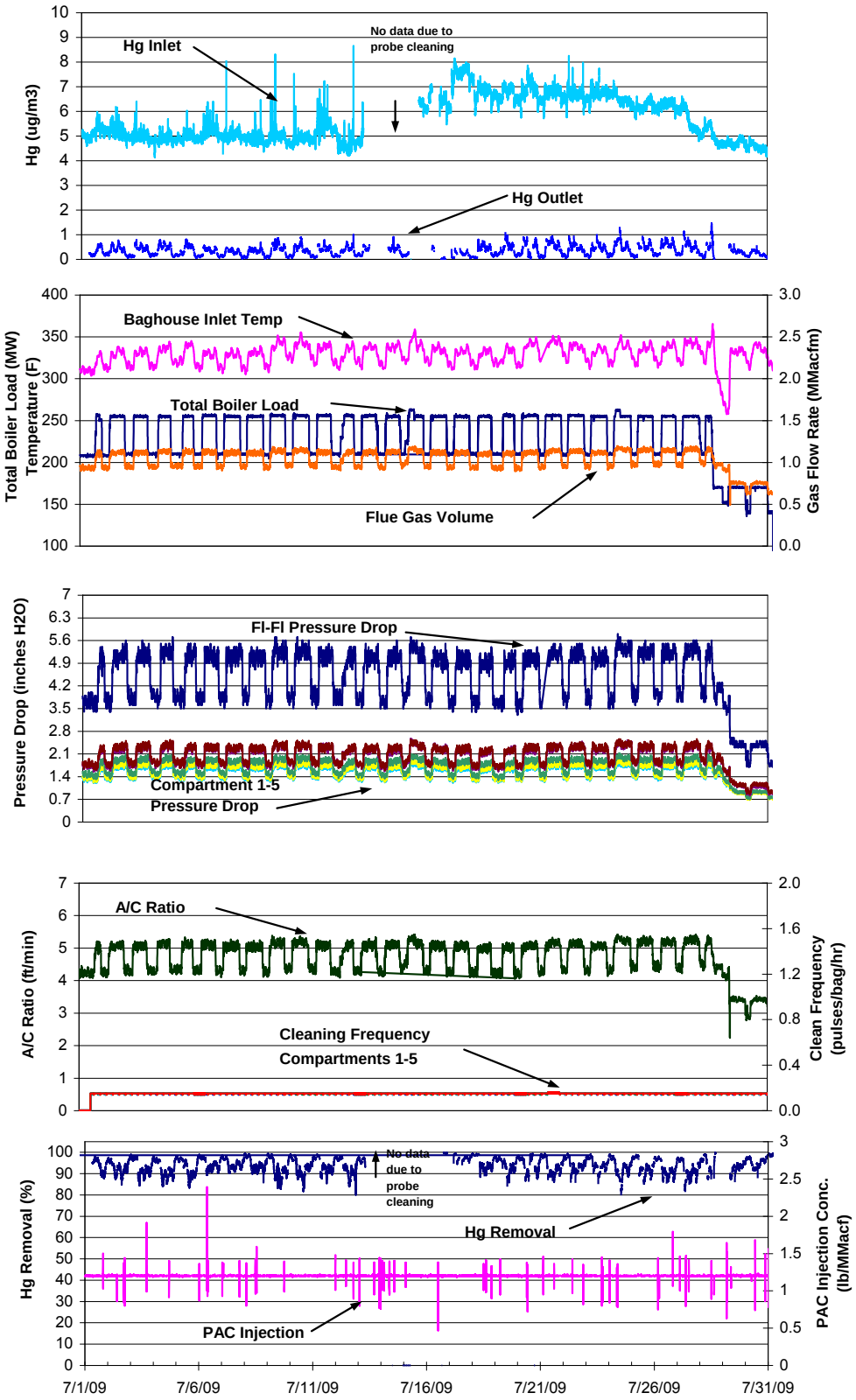


Figure 4-70. Baghouse Performance Graphs, July 2009.

4.15.7.3.2 Mercury Removal

One of the most important objectives of this project was to demonstrate the operation of the TOXECON™ multi-pollutant control system and achieve 90% mercury removal from flue gas through activated carbon injection (ACI). The following is a summary of the success in meeting this objective.

Mercury and PAC injection data are shown in a series of monthly graphs in Appendix I. Figure 4-71 is an example of these graphs showing data from December 2006. These graphs show ACI concentration, mercury removal, and mercury outlet values. This is the same data as in the more detailed baghouse performance graphs, but focused on mercury removal performance.

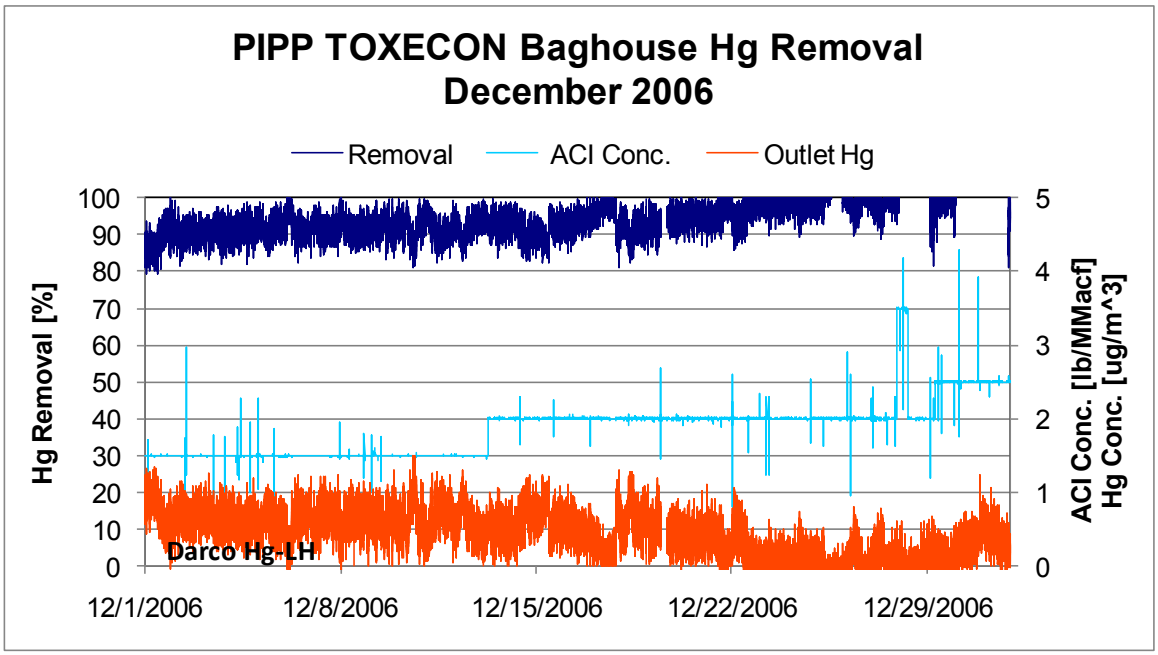


Figure 4-71. Mercury Removal Graph; December 2006.

4.15.7.3.2.1 2006 Mercury Removal

Average mercury removal data was compiled for all months during the demonstration project. The first series on these graphs (steady state removal) represents "normal operation" at a power plant and excludes periods when special testing was occurring. This first series includes periods when units were out of service, but not when the baghouse was out of service. If there was viable outlet CEM data but no inlet CEM data, then an inlet value of

6 µg/m3 was used to determine the removal value for that period. The confidence interval for each monthly data point represents two standard deviations in the data. The second series still excludes special testing, but includes baghouse outages and other equipment issues that impacted mercury removal.

Figure 4-72 shows the average mercury removal for the last part of 2006. December had an average mercury removal of 93.6 ± 7.8%.

All of the yearly graphs need to have the confidence intervals fixed so that the second series is not included.

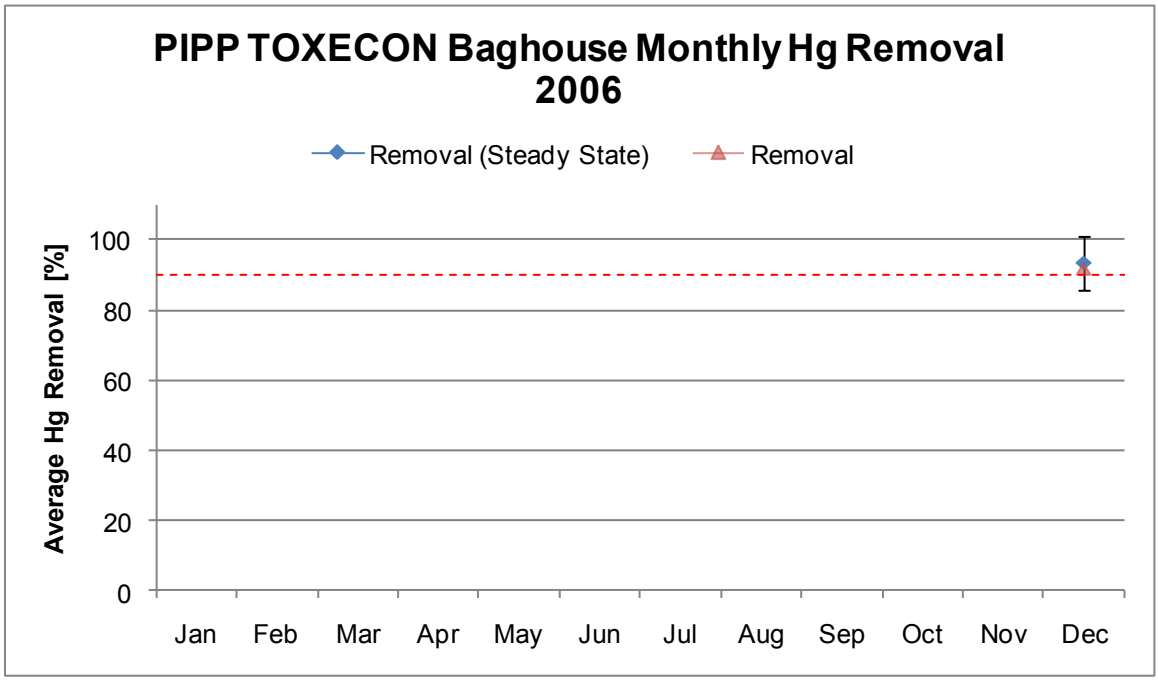


Figure 4-72. Average Mercury Removal – 2006.

4.15.7.3.2.2 2007 Mercury Removal

A significant milestone was met on January 19, 2007. The mercury removal was above 90% for 48 consecutive days, and We Energies determined that this was a sufficient time period to prove that the technology was capable of the targeted removal. During this time, both the DARCO® Hg and Hg-LH were being used, so both showed the capability of removing mercury at a high level. Figure 4-73 shows the average mercury removal for 2007 and is discussed below.

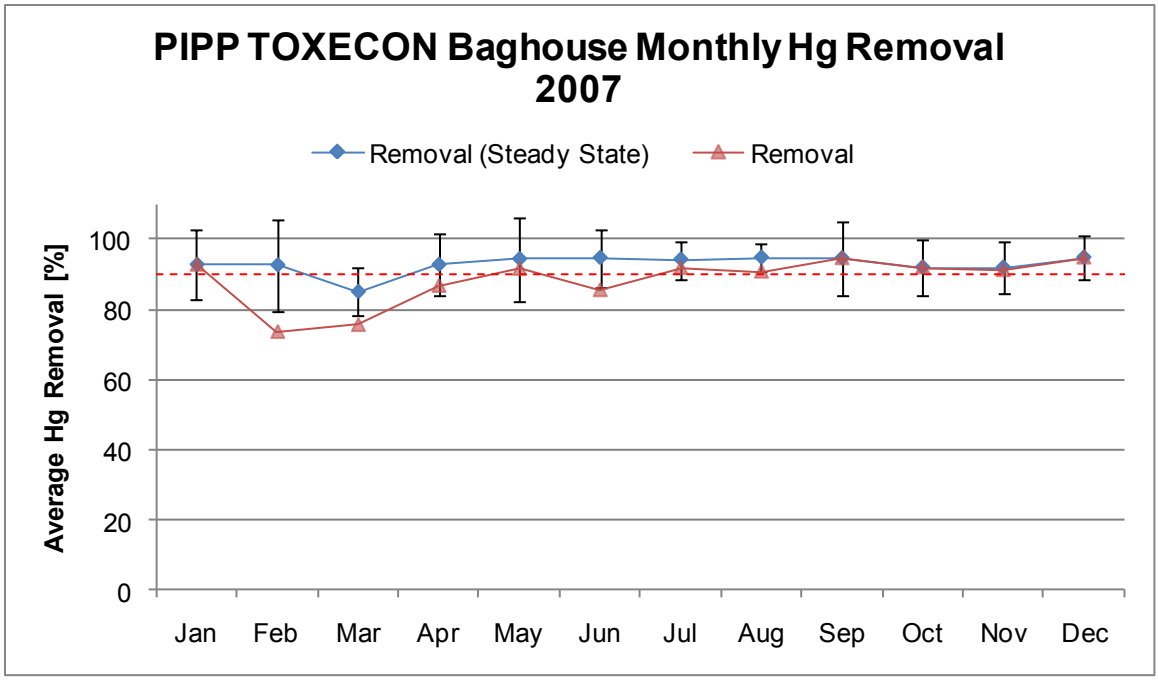


Figure 4-73. Average Mercury Removal – 2007.

Mercury removal was above 90% for eleven of the twelve months in 2007. The carbon type was switched from DARCO® Hg-LH to DARCO® Hg at the beginning of January 2007. Mercury removal in March was affected by upgrades and issues with the outlet CEM. The mercury oxidizer system was installed and was going through verification tests. Also the solar blind filter in the outlet CEM was removed, causing an increase in the outlet value. This was resolved in April, and although these tests affected the mercury removal values, they had no actual impact on the true mercury emissions. As the weather warmed, the carbon was switched back to DARCO® Hg-LH at the beginning of June 2007. During the first 10 days of August, trona injection testing was conducted, which affected mercury removal. Mercury removal on average was over 90% for the majority of August unless there were upset conditions present.

There were several days of unit outages during the middle of September. PAC was switched from DARCO® Hg-LH to Hg near the end of the month so PAC injection was increased accordingly. Mercury removal was over 90% for October and November. There was a brief outage of PAC injection on November 4 related to a failure of the ash system vent filters. Mercury removal was over 90% in December.

4.15.7.3.2.3 2008 Mercury Removal

Figure 4-74 shows the average mercury removal for 2008. Mercury removal was above 90% for ten of the twelve months in 2008 although there was no "steady state" data from February due to alternative sorbent testing.

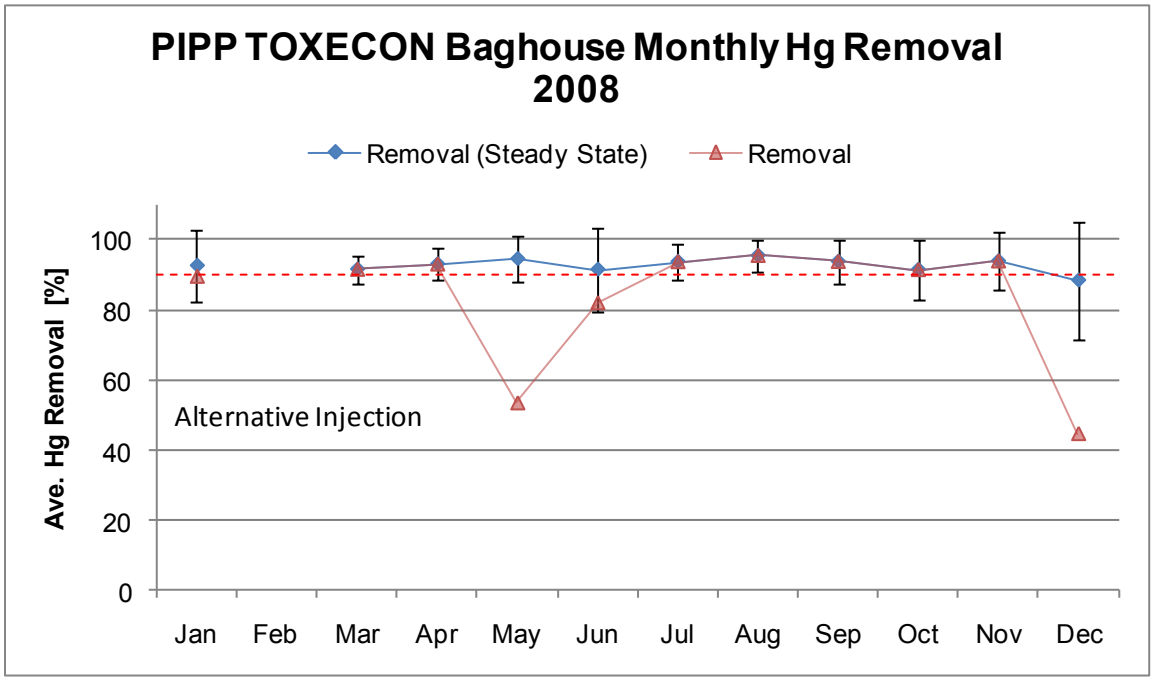


Figure 4-74. Average Mercury Removal – 2008.

DARCO® Hg-LH, a brominated carbon, was injected in January and continued throughout the year. Alternative sorbent tests were performed in February and March so there was no steady state data. Alternative carbon and ash testing ended the third week of March and PAC injection from the permanent silo began on March 25 at 1 lb/MMacf.

Mercury removal was over 90% during April–November 2008. The baghouse was off line in May and December for duct inspections and drag testing. Problems with the outlet monitor during the last half of the month in December resulted in lost removal data for most of this time period.

4.15.7.3.2.4 2009 Mercury Removal

Figure 4-75 shows the average mercury removal for 2009. Mercury removal was above 90% for eight of the nine months in 2009. DARCO® Hg-LH was used throughout this year. PAC

injection was turned off on February 10 to establish a baseline for the alternative PAC tests which continued until the end of the month. Ash re-burn testing was performed at the end of March. This testing was not part of the CCPI demonstration so it was included in the overall removal value as part of "normal operation" at a power plant.

The baghouse was in an outage for several days near the end of August. The mercury removal in September was below 90% because of an issue with the outlet CEM lamp. The lamp had been recently replaced and had shown low intensity, thereby affecting the outlet CEM value. A new lamp was ordered but was not received until October 2009.

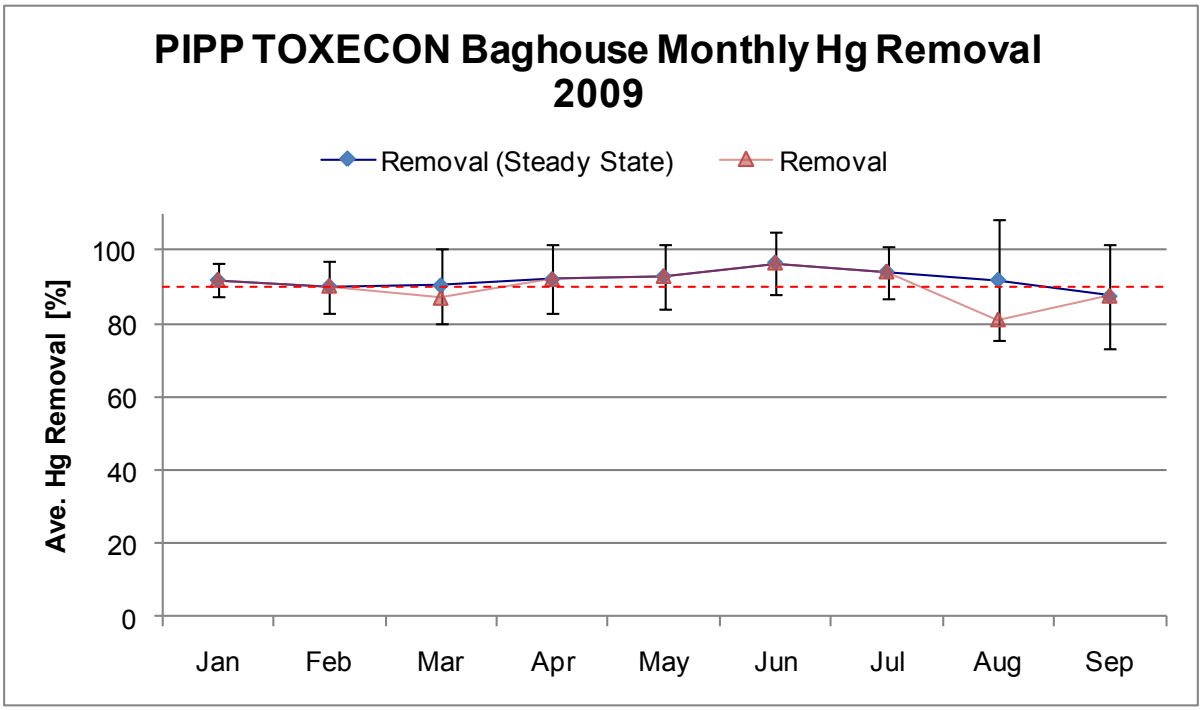


Figure 4-75. Average Mercury Removal – 2009.

4.15.7.4 Alternative Sorbent Tests

4.15.7.4.1 Sorbent Tests – 2008

4.15.7.4.1.1 Introduction

During 1Q08, several test series were performed at the plant using a temporary silo and injection system. The purpose behind using a temporary silo and injection system was to

allow testing of various sorbents at full scale without impacting the permanent silo or injection system. Specifically, the following test program objectives were pursued:

- Quantify the mercury removal curve for unprocessed high-LOI ash from Units 5 and 6 at full scale.
- Evaluate the effect of the ADA-ES sorbent milling treatment on high-LOI ash and DARCO® PAC.
- Quantify the mercury removal curve for ADA-ES imported carbon and Norit Americas imported carbon.
- Record baghouse performance over all of the test periods, showing how pressure drop, cleaning frequency, and mercury removal change.
- Evaluate the technical and economic performances of tested sorbents and processing.

The first objective involved co-injection of high LOI ash from the PIPP Units 5 and 6 ESP and baghouse. Units 5 and 6 burn bituminous coal and are equipped with low NO_x burners which can result in high carbon ash. Sorbent screening tests performed in December 2007 showed low (12–17%) mercury removal using this ash when tested upstream of the TOXECON™ baghouse. Full-scale re-injection of this ash upstream of the TOXECON™ baghouse was tested as a possible supplement to PAC injection. The effect of milling of the ash was also tested at the highest ash injection rate to see if this would improve performance.

The ADA-ES sorbent milling process was also performed on the DARCO® Hg-LH PAC. This process has been used on other test sites and has shown favorable results.

The third objective involved injection of two alternative sources of activated carbon. The first source of PAC originated from Asia and was then treated, prepared, and shipped from a U.S. facility. This material was provided by ADA-ES. The second source was provided by Norit Americas.

Baghouse performance and mercury removal was monitored and assessed for all test phases.

4.15.7.4.1.2 Alternative Sorbent Test Equipment

Placement of the injection equipment for this test program was near the Units 7–9 stack. This is the same staging area that was used in August 2007 for the trona injection testing.

The sorbent injection equipment consisted of a hopper bulk trailer holding approximately 20 tons of high-LOI ash and a silo for sorbent injection (Figure 4-76). The silo had a storage capacity of 650 ft^3 and a monorail system with a hoist on top to allow loading smaller quantities of test sorbents from super sacks. Load cells at the base continuously recorded the weight of the silo over time to accurately measure sorbent injection rate. A maximum injection rate of 1000 lb/hr of the ash was planned. PAC injection would be at more typical rates during parametric testing, such as 35–150 lb/hr.

Figure 4-76. Temporary Silo Installation.

4.15.7.4.1.3 High Carbon Ash Co-Injection

Parametric testing with high LOI ash from Units 5 and 6 silo was performed in early February 2008. PAC injection had been turned off the previous week to allow the baghouse to stabilize. Figure 4-77 shows the removal curve for the ash up to 13.3 lb/MMacf (919 lb/hr).

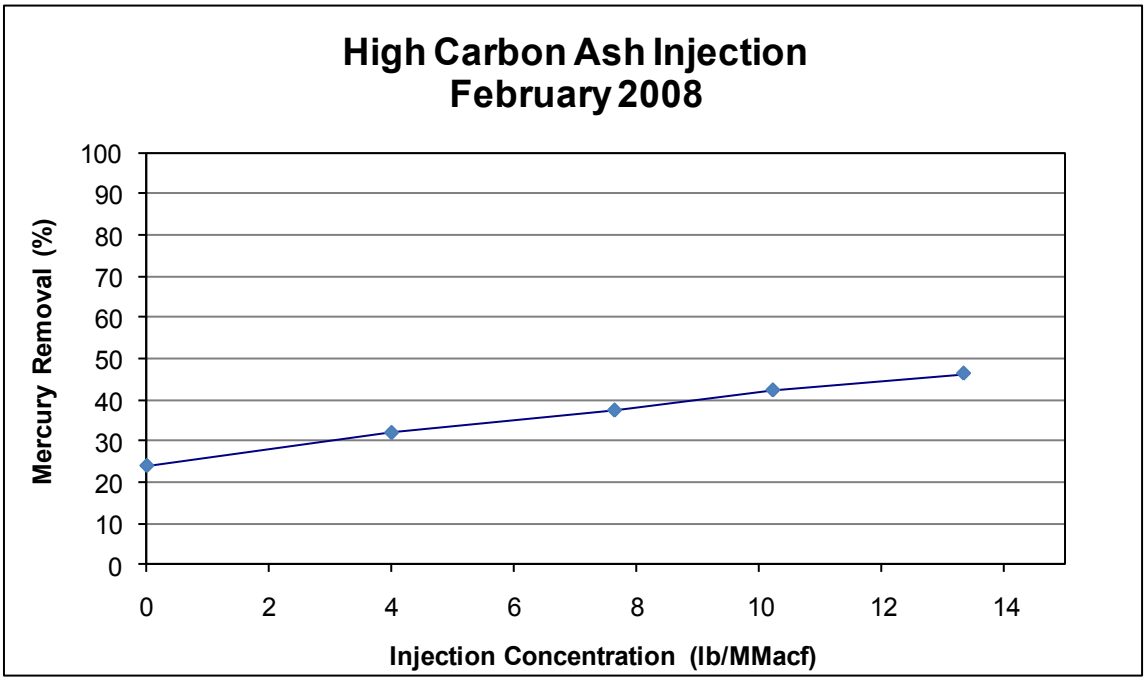


Figure 4-77. Mercury Removal using High-LOI Ash.

A second series of parametric tests was then performed by keeping the ash injection constant at the highest injection rate (919 lb/hr) while PAC injection was varied. The four targeted PAC injection rates were 0.25, 0.5, 0.75, and 1.0 lb/MMacf. The goal was to determine if ash could supplement PAC injection to achieve 90% mercury removal. Figure 4-78 shows the results of this series of tests and indicates that the ash did not contribute significantly at a mercury removal rate > 90%.

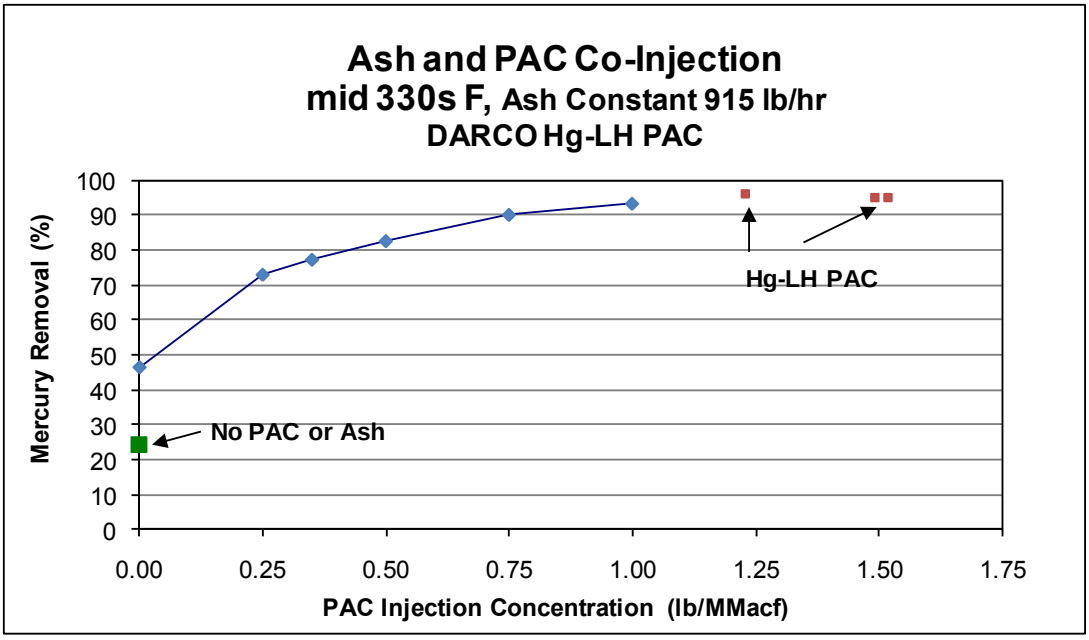


Figure 4-78. High LOI Ash and PAC Co-Injection Parametric Test Results.

In an effort to enhance the LOI carbon availability, the Unit 5 and 6 ash was treated with the ADA-ES milling process and injected upstream of the baghouse. The injection rate was close to the highest rate injected in earlier parametric tests. Figure 4-79 shows that the sorbent milling treatment did not increase mercury removal when injected upstream of the baghouse.

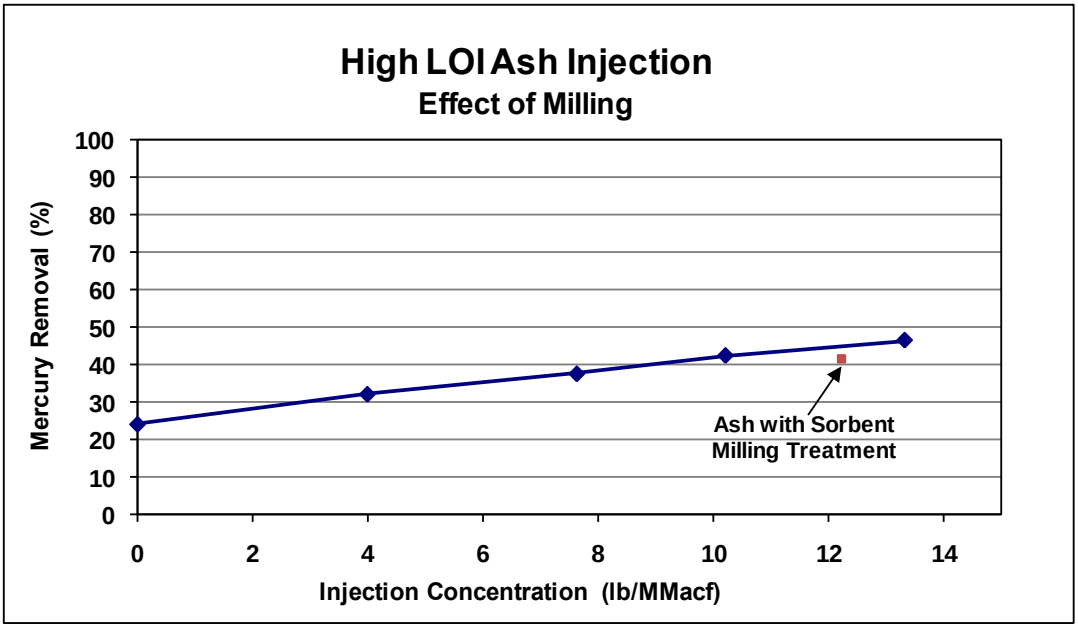


Figure 4-79. Effect of Milling on High LOI Ash.

4.15.7.4.1.4 Alternative PAC Injection

A series of tests were performed in February and March 2008 using two alternative carbons. ADA-ES provided a brominated carbon that was treated and prepared domestically. This material will provide the utility industry with an additional source for future carbon needs. Norit Americas also provided a brominated carbon from a different manufacturing source than their DARCO® Hg-LH. Both of these carbons were compared with the DARCO® Hg-LH. The LH carbon was loaded into the mini-silo and injected into the baghouse using the same injection equipment as the ash and the two alternative carbons. This setup also allowed for sorbent milling treatment of the Hg-LH to determine if this would have an impact on mercury removal and PAC usage.

Figure 4-80 summarizes the results from this series of tests with all data normalized to removal at 330 ºF. There were equipment issues due to cold weather and icing of the air lines during the Norit Americas and ADA-ES PAC injection. Due to this the data at the lower injection rates should be considered a minimum for these carbons. This series of tests also showed that milling treatment showed no major benefit in a TOXECON™ configuration.

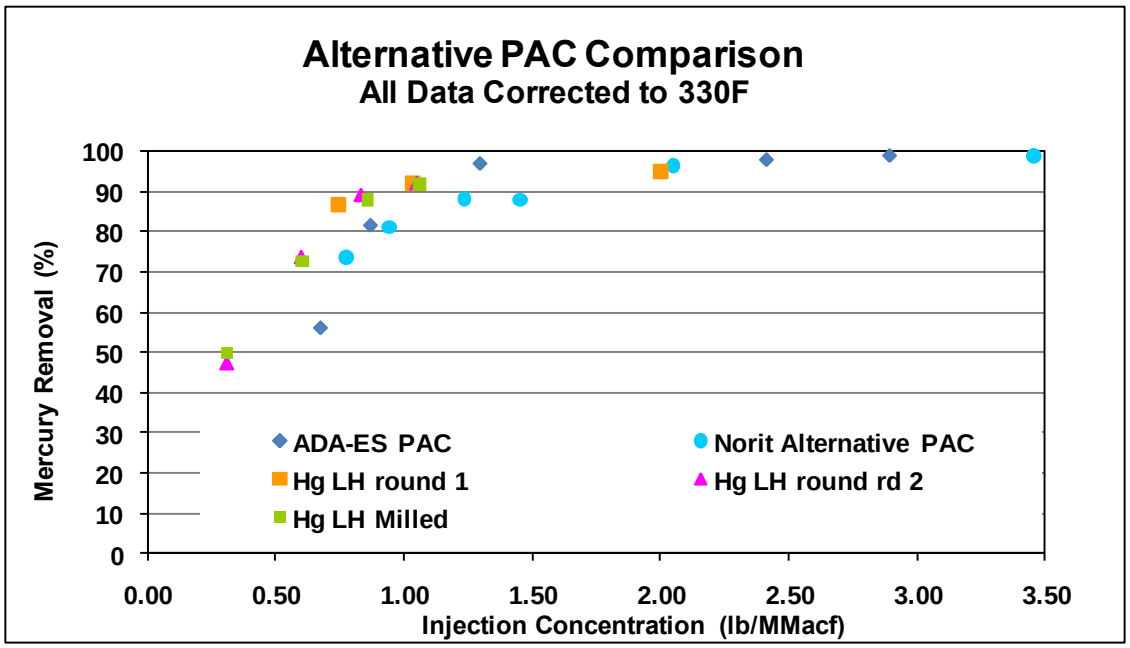


Figure 4-80. Alternative Carbon Test Results.

4.15.7.4.2 Sorbent Tests – 2009

4.15.7.4.2.1 Introduction

In February 2009 a second series of tests with alternative sorbents for mercury control was performed. Temporary injection equipment was installed specifically for these tests, and differed from the injection system used in 2008. The following test program objectives were pursued:

- quantify the mercury removal for alternative sorbents using temporary injection equipment
- compare the mercury removal of DARCO® Hg-LH with the alternative sorbents
- record baghouse performance over the test period, showing how pressure drop, cleaning frequency and mercury removal change

The alternative sorbent injection tests for mercury control were conducted in a parametric testing format over a period of two weeks in February 2009. Initially, ADA-ES planned to inject Norit Americas DARCO® Hg-LH using the temporary injection equipment along with the alternative carbons, but due to time constraints this was not possible. The purpose of injecting DARCO® Hg-LH was to have a direct comparison between a commercially available sorbent and the alternative sorbents while using the temporary injection system. Since a direct comparison was not available data from previous parametric testing with DARCO® Hg-LH was used for the comparison. A total of six alternative carbons provided by ADA-ES were tested.

4.15.7.4.2.2 Alternative Sorbent Injection Equipment

The temporary sorbent injection equipment consisted of a portable sorbent injection module capable of delivering a sufficient feed rate of activated carbon to develop performance curves for the different sorbents. The injection module was comprised of sorbent storage and handling, a metering and feed delivery system, transport hose, a sorbent distribution system, and three injection lances.

Figure 4-81 shows the portable injection equipment installed at PIPP. The unit was approximately 16 feet high (two 8-foot sections), with an 8’ x 8’ footprint and an empty weight of three (3) tons. The loading capacity of the injection equipment was one super sack of sorbent (~ 1,000 lbs). Placement of the temporary injection equipment for this test program was inside the boiler house on the ground floor between Units 8 and 9.

The sorbent was metered by a variable speed screw feeder into a pneumatic eductor that provided the motive force to transport the sorbent to the injection points. A blower provided the conveying air. During the parametric injection testing ADA-ES personnel manually adjusted the feed rate in proportion to the varying unit load.

For parametric injection testing, sorbent was delivered to the site in 1,000-pound super sacks. The super sacks were off-loaded from the delivery truck by plant personnel to the lay down area near the injection equipment. ADA-ES personnel loaded the super sacks into the portable injection silo as needed throughout the test.

Figure 4-81. Portable Injection Equipment – 2009 Tests.

The sorbent was conveyed to three injection lances which were located downstream of the ID fan discharges, but upstream of the point where the ducts combine. Each lance discharged sorbent into the center of its duct, where turbulent flow provided gas/sorbent mixing. The lances were located underneath the permanent PAC injection lances. This location was also downstream of the NO_x analyzer probe used for boiler feedback. These are the same ports used during previous alternative carbon tests.

4.15.7.4.2.3 Baseline Testing

Baseline measurements were taken over a six-day period during the week prior to injection testing. PAC injection from the permanent ACI system was stopped on Tuesday, February 10 and alternative sorbent injection testing started on Monday, February 16. Unit 8 had an unscheduled outage from February 13–16. This period was used to determine the native mercury removal without injection as well as ensure that the baghouse had enough time to clear out as much PAC as possible from the previously on-going injection. Mercury was continuously measured at the inlet and outlet locations. The inlet measurement was made using the Unit 8 probe. Figure 4-82 shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the baseline period.

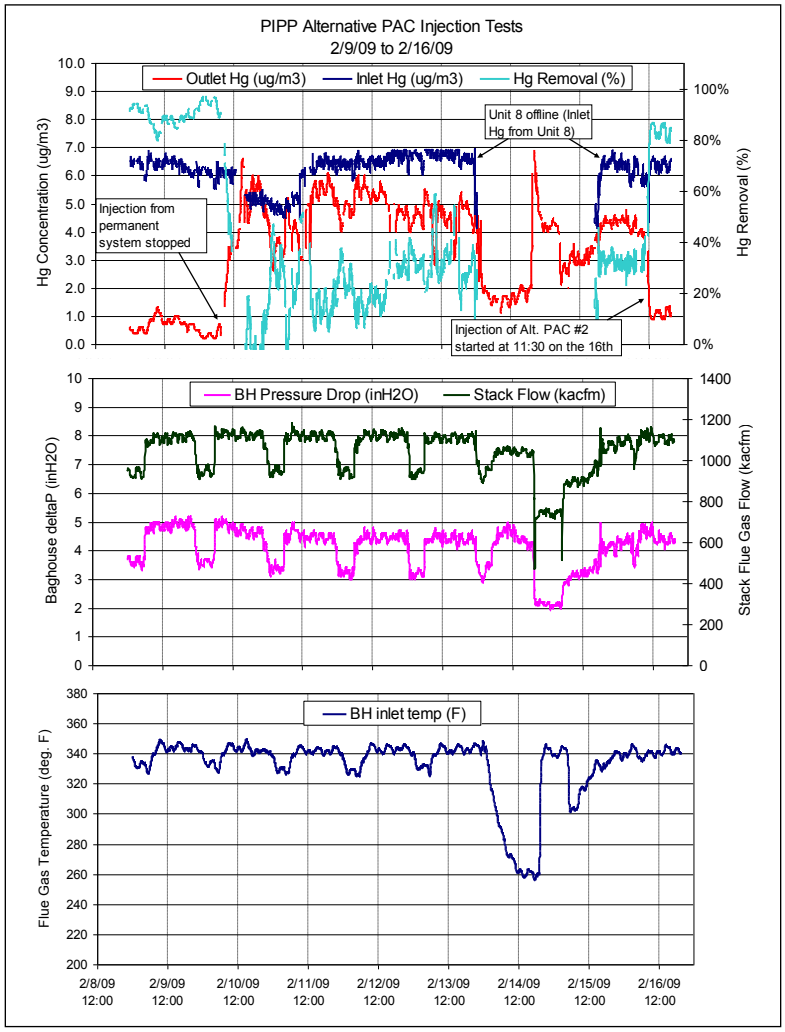


Figure 4-82. Baseline Mercury and Plant Data.

4.15.7.4.2.4 Parametric Testing

Parametric tests were performed with six alternative PACs over a two week period from February 16–28. Each alternative PAC was injected using the temporary injection equipment at nominal concentrations ranging from 0.5 lb/MMacf to 1.5 lb/MMacf. Each parametric test was run for 6 to 12 hours depending on the amount of PAC available and operating conditions; with the intent to capture enough stable mercury and baghouse data to produce an average mercury control value. The series of parametric tests were used to develop sorbent performance curves relating the injection concentration to mercury removal efficiency for each alternative PAC.

The alternative PAC injection tests were performed 24 hours a day throughout the entire test period. This made it possible to get the six alternative PACs tested; however, there was not enough time to inject the DARCO® Hg-LH as planned. It was requested that the plant hold full, steady load for the duration of the test, but this was not possible due to power demand. Each night between about midnight and 6:00 a.m., the load on all three units was reduced. The last alternative, PAC #4, was tested with only two units online because of Unit 8's early outage. Since load and flue gas flow varied during testing the injection rates (lb/hr) were manually adjusted to maintain consistent injection concentrations (lb/MMacf).

All baghouse operational set points were unchanged during the two week period of testing except when a full clean of the baghouse was initiated when switching to a different carbon to remove residual PAC from the bags. This was performed by manually pulsing all the bags twice.

Table 4-33 summarizes the nominal sorbent feed rates for the injection concentrations evaluated during this demonstration. The flue gas volumetric flow rates were taken from the plant's EDS system which measures the flow rates at the stack of each unit. The total flow rate was then calculated by adding together each online unit's flow. The injection rates were adjusted according to the varying flow rates to keep consistent injection concentrations.

Table 4-33. Sorbent Injection Rates and Concentrations at Varying Boiler Loads.

	Units 7-9 TOXECON Alternative PAC Injection Rates		
Injection Concentration (lb/MMacf)	**3 Units full-load (lb/hr)**	**3 Units mid-load (lb/hr)**	**2 Units full-load (lb/hr)**
0.25	16.5	14.25	11.0
0.50	33.0	28.5	22.0
0.75	49.5	42.75	33.0
1.00	66.0	57.0	44.0
1.25	82.5	71.25	55.0
1.50	99.0	85.5	66.0

Alternative PAC #2 was the first sorbent tested. The initial injection plan was to test target injection concentrations of 0.5, 1.0 and 1.5 lb/MMacf. However, at the injection concentration of 1.0 lb/MMacf the mercury removal percentages were between 95% – 100%. Since the mid-range injection concentration was able to produce such high mercury removal it was decided to test lower injection concentrations. The lower injection concentrations tested were 0.5 and 0.75 lb/MMacf. The injection concentration of 0.5 lb/MMacf was tested for the second time to determine if the results were repeatable and 0.75 lb/MMacf was tested to fill out the sorbent performance curve. As expected, baghouse pressure drop varied with flue gas flow rate and was minimally affected by PAC injection rate. The data used for the performance curves was taken from periods when it was determined that the conditions had stabilized.

Figure 4-83 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested. The correlations are linear; as the baghouse temperature increases the mercury removal percentage decreases. A removal percentage at a given temperature can be determined by inserting the given temperature into the linear regression formula. Figure 4-83 also shows the two periods of an injection concentration of 0.5 lb/MMacf (shown by pink triangles and blue squares) which confirms that the mercury removal for PAC #2 at this injection concentration was repeatable.

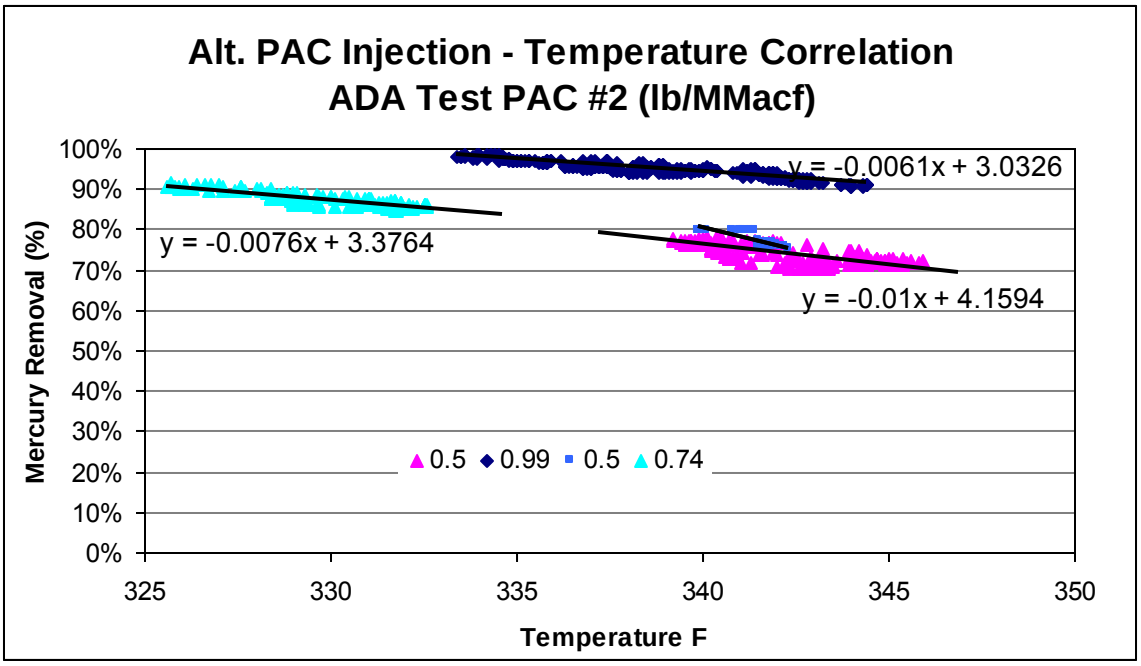


Figure 4-83. PAC #2 Mercury Removal versus Temperature Correlations.

Alternative PAC #1 was the second sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. After testing the four injection concentrations, the injection rate was increased to the equipment's highest feed rate to run out the remainder of the sorbent. Figure 4-84 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested.

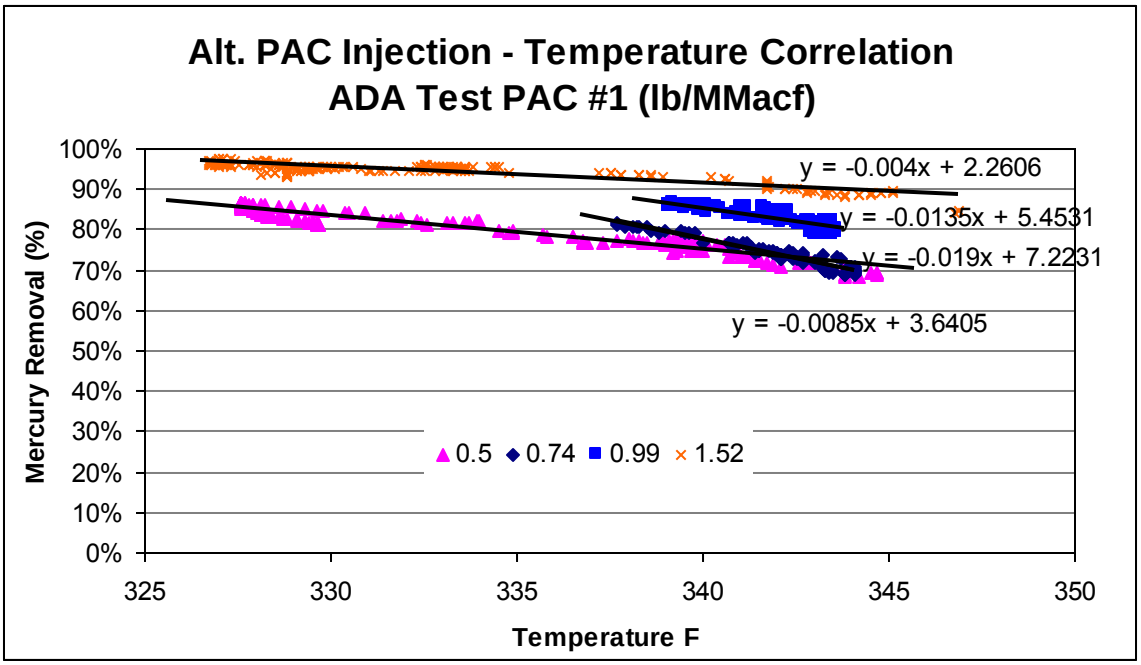


Figure 4-84. PAC #1 Mercury Removal versus Temperature Correlations.

Alternative PAC #3 was the third sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. Figure 4-85 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested.

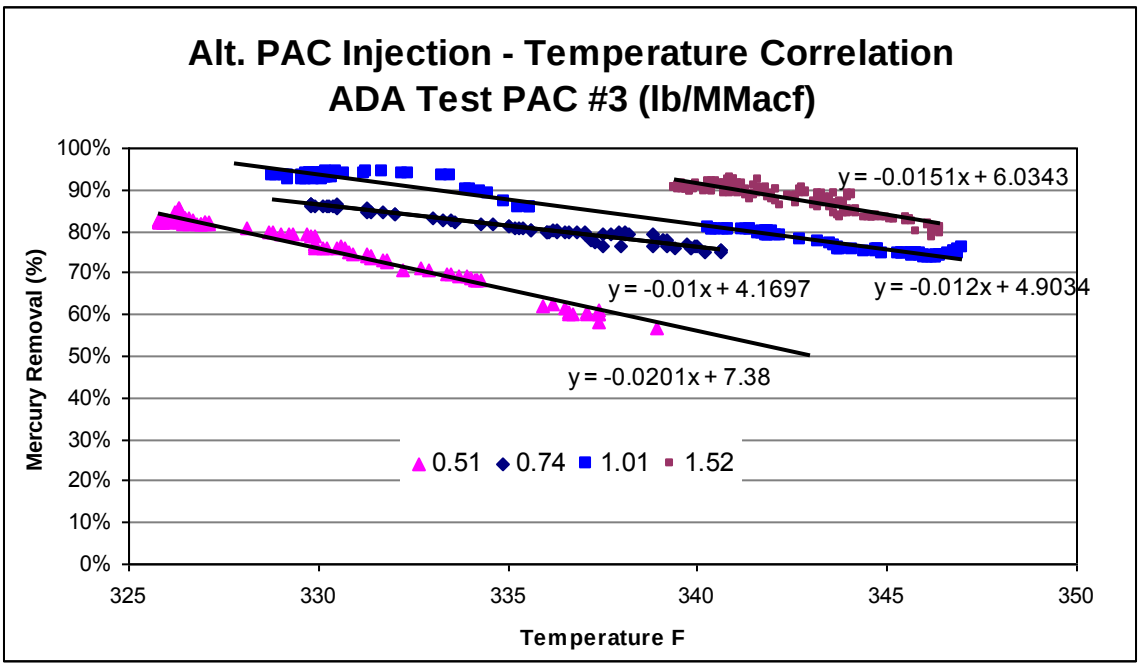


Figure 4-85. PAC #3 Mercury Removal versus Temperature Correlations.

Alternative PAC #6 was the fourth sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. Figure 4-86 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested.

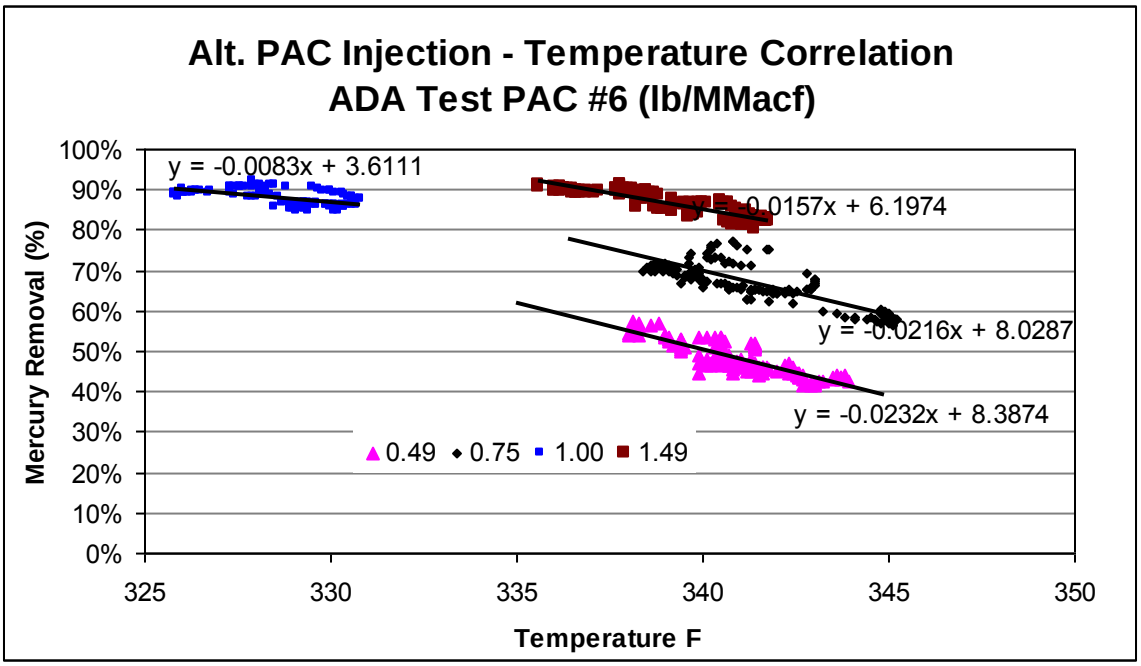


Figure 4-86. PAC #6 Mercury Removal versus Temperature Correlations.

Alternative PAC #5 was the fifth sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. Figure 4-87 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested.

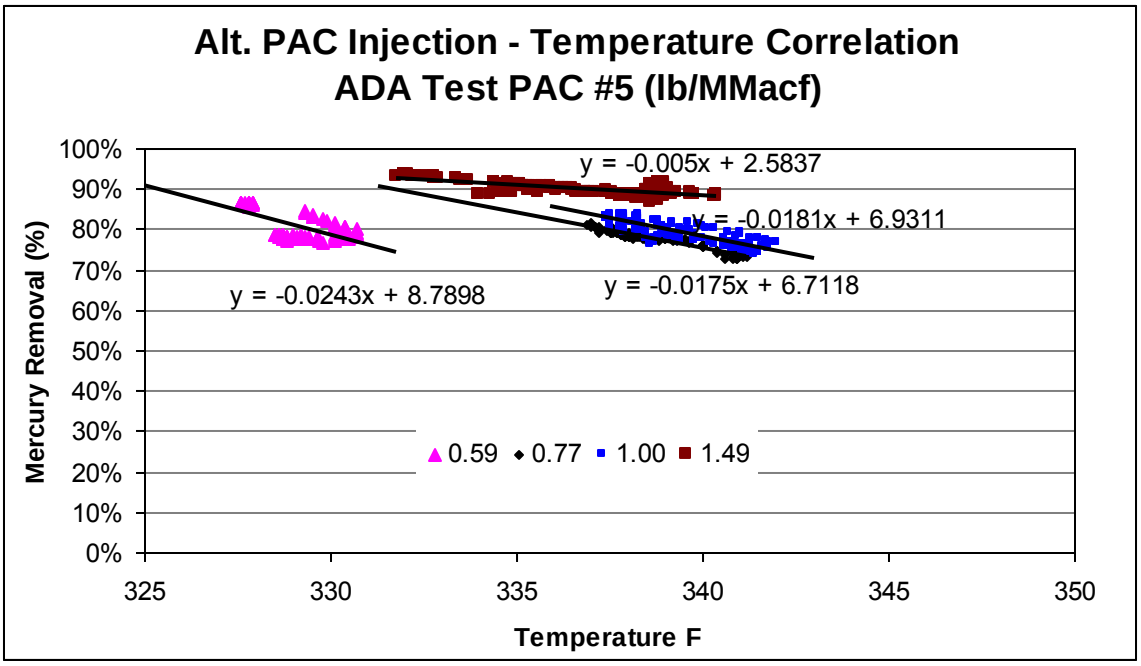


Figure 4-87. PAC #5 Mercury Removal versus Temperature Correlations.

Alternative PAC #4 was the last sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. Prior to starting injection of PAC #4 Unit 8 went into its scheduled outage. The injection to the Unit 8 duct was secured and the injection rate to the other two ducts was adjusted to account for the reduced flue gas flow rate. Figure 4-88 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested.

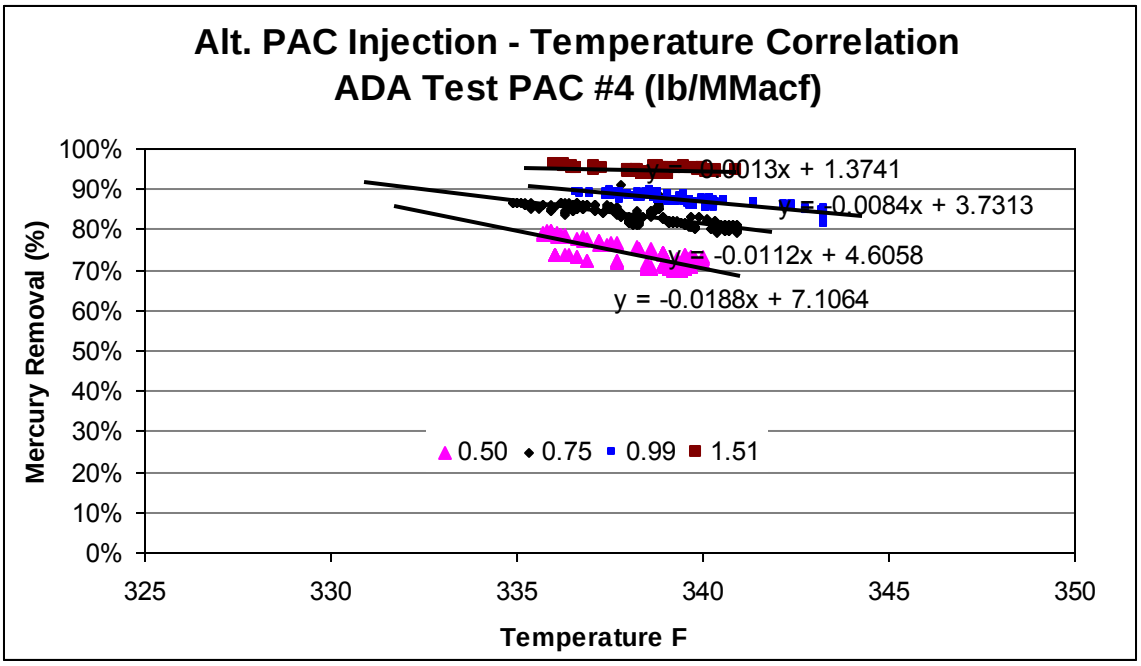


Figure 4-88. PAC #4 Mercury Removal versus Temperature Correlations.

The mercury removal at baghouse temperatures of 330 ºF and 340 ºF are shown in Figure 4-89 and Figure 4-90, respectively. Each removal point was calculated using the linear regression equations produced by the Hg removal versus baghouse temperature correlations. Note: There is an inherent variability in this method of extrapolation. Even though removal has been shown to have a linear relationship with baghouse temperature, any error in this method can be exaggerated by data collected over a limited temperature range and variable plant operating conditions. Long-term injection over a wide temperature range would be preferable to characterize each sorbent's performance at a specific temperature. These figures also display removal data from DARCO® Hg-LH injection tests performed in 1Q08 injection tests. The removals were determined by the same linear regression method as the alternative PACs.

Taking into account the variability of determining mercury removals at specific temperatures, the alternative PACs performed as well or perhaps better than the DARCO® Hg-LH did in the previous tests. PACs #1 and #2 seemed to perform slightly better than the others, while PACs #3, #6 were on the lower end of the removals.

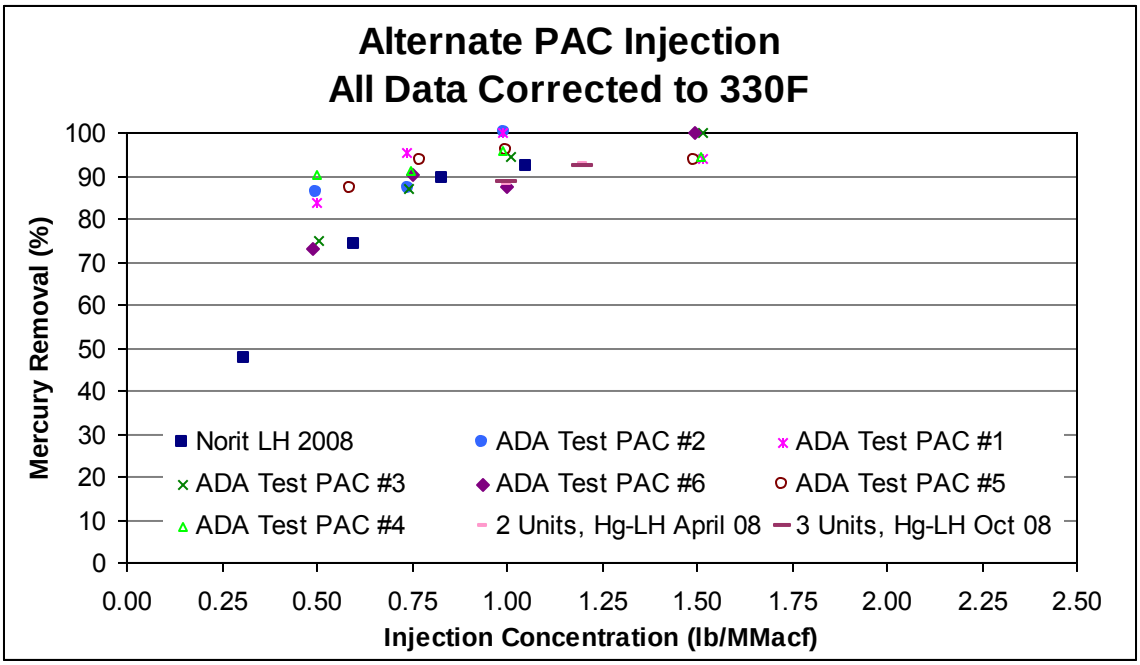


Figure 4-89. Sorbent Performance Curves, Normalized to 330 ºF.

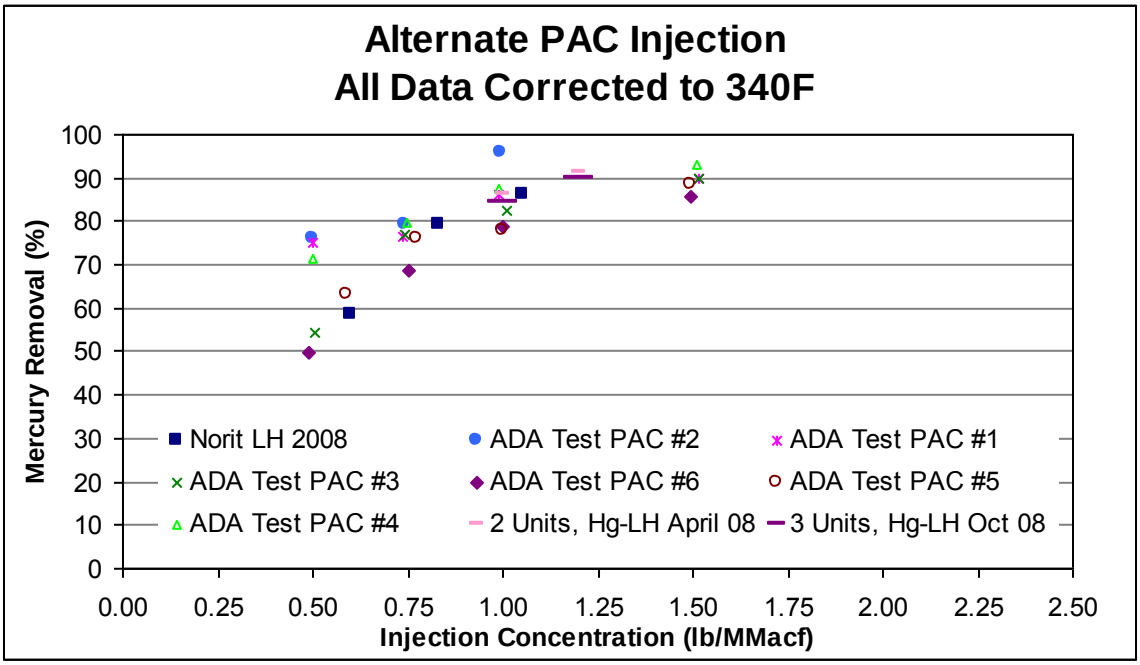


Figure 4-90. Sorbent Performance Curves, Normalized to 340 ºF.

PAC #4 performed well at the lower injection concentrations and even though this PAC was tested with only 2 out of 3 Units online it is possible to make a performance comparison with the other tests. Historically, PAC injection with the Presque Isle TOXECON™ system

produces similar mercury control at the same injection concentration if there are 2 or 3 Units are online. Evidence of the similarity can be seen in Figure 4-91 and Figure 4-92 which display DARCO® Hg-LH performance curves from periods with two Units online, three Units online, and from the 2008 tests using temporary injection equipment.

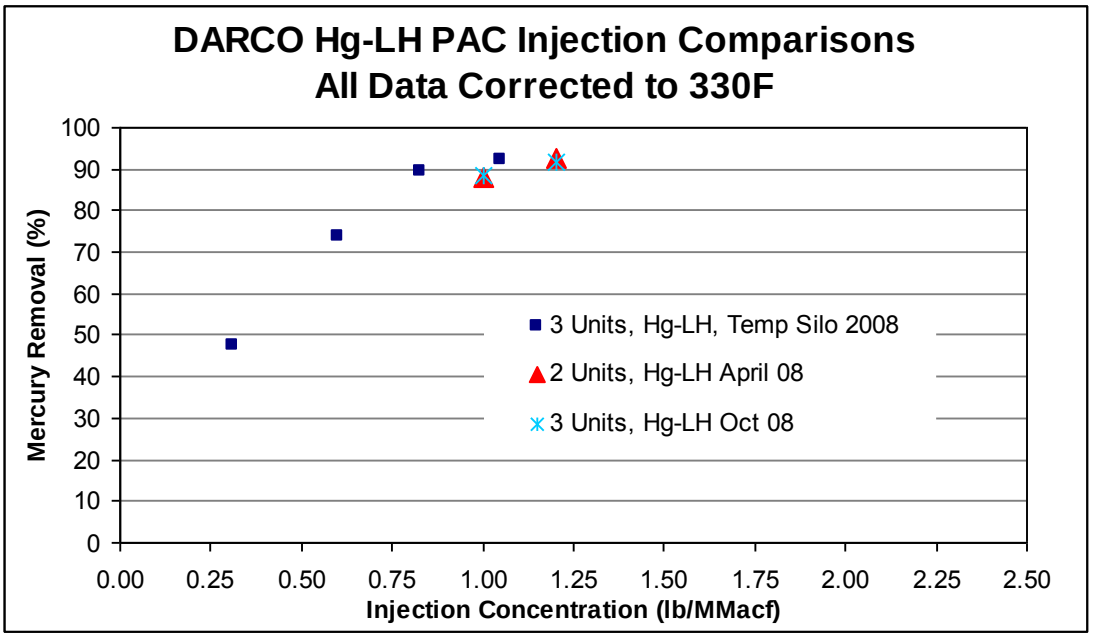


Figure 4-91. DARCO® Hg-LH Performance Curves, Normalized to 330 ºF.

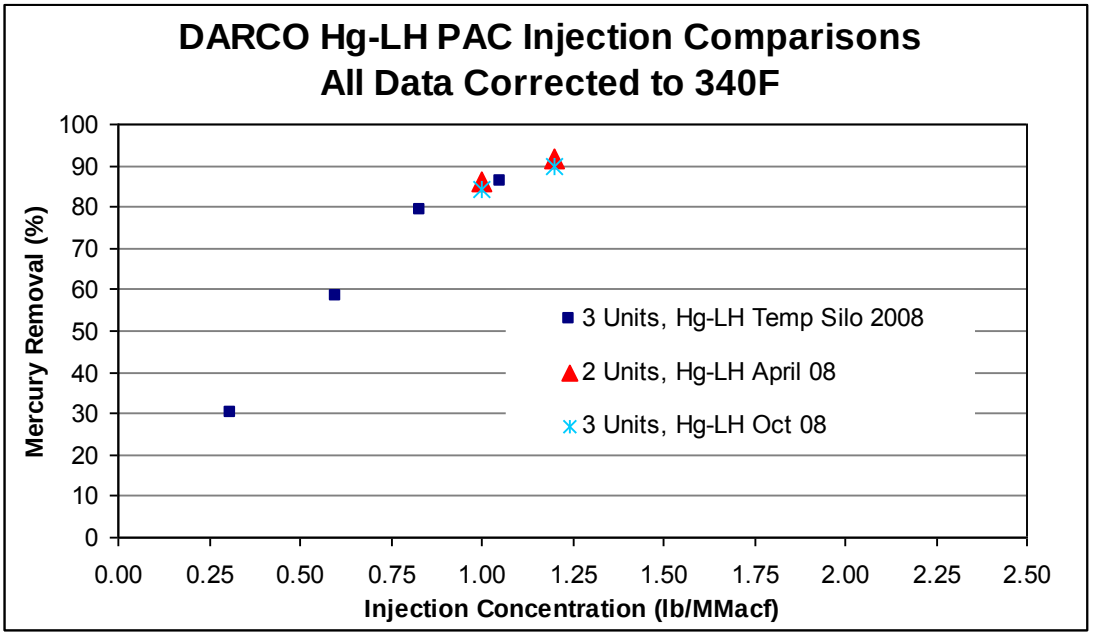


Figure 4-92. DARCO® Hg-LH Performance Curves, Normalized to 340 ºF.

The conclusions from this series of tests are as follows:

- All six ADA-ES alternative sorbents performed as well as the commercially available sorbent DARCO® Hg-LH in the TOXECON™ baghouse at Presque Isle.
- Mercury removal varied linearly with baghouse temperature. As temperature increased mercury removal decreased. This is a well-documented correlation in the TOXECON™ baghouse.
- PAC injection using these six alternative carbons showed minimal effect on baghouse pressure drop or other performance parameters. Cleaning frequency was unchanged during these tests.

Additional detail on baghouse performance and PAC injection data can be seen in the Topical Report covering this series of tests in Appendix J.

4.15.8 Optimization of TOXECON™ System for Hg Control

4.15.8.1 Effect of Air-to-Cloth Ratio on Mercury Removal

Previous TOXECON™ testing was conducted at an air-to-cloth ratio (A/C) of approximately 8.0 ft/min. Operating at this aggressive ratio combined with high inlet loading proved unsustainable because the cleaning system could not keep up to maintain an acceptable pressure drop. The Presque Isle TOXECON™ fabric filter has been designed with a gross A/C ratio of 5.5 ft/min, which was expected to permit easily sustained operation. Because of the economic benefit of installing a higher A/C ratio design, this test series evaluated the performance of the fabric filter with isolated compartments, effectively increasing the A/C ratio.

Figure 4-93 shows how the A/C ratio affects mercury removal. Two time periods were chosen having constant PAC injection rate, flue gas temperature, flue gas flow rate, boiler load, and baghouse pressure drop. The only variable was the A/C ratio. This figure clearly shows that the mercury removal was not noticeably affected by the A/C ratio at these conditions.

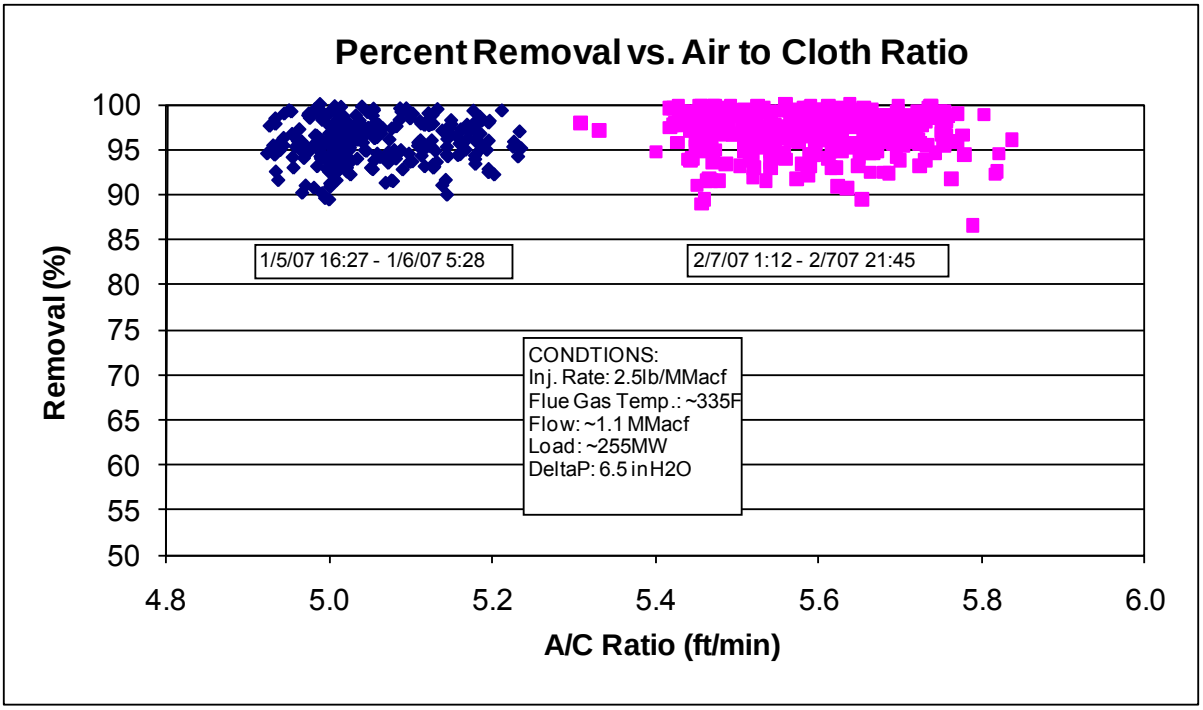


Figure 4-93. Effect of A/C Ratio on Mercury Removal.

4.15.8.2 Effect of Pressure Drop

The following describes the results of testing the effects of reducing baghouse cleaning set point differential pressure (ΔP) on mercury removal efficiency. All of the initial mercury removal testing had been with a set point of 6.5 inches w.c. When flange-to-flange ΔP reached 6.5 inches, cleaning of the baghouse would commence until the ΔP was reduced to 6.0 inches. For this testing, the set point was reduced by increments of 0.5 inches down to 5.0 inches. At each set point, data was taken for 2 days. The schedule for the testing is shown in Table 4-34.

Table 4-34. Schedule for Testing Baghouse Pressure Drop.

Set Point (″ w.c.)	Start Time	End Time
6.5	11/14/06 0730	11/16/06 0730
6.0	11/20/06 0730	11/22/06 0730
5.5	11/22/06 0803	11/24/06 0800
5.0	11/24/06 0811	11/26/06 0800

After reviewing the data, it appeared that at lower flue gas temperatures (< 320 ºF) there was little difference in mercury removal between the four set points. The temperature effect on

mercury removal became less with each decrement in set point. In Figure 4-94 the effect of flue gas temperature on mercury removal efficiency is shown. At the higher temperatures, more frequent pulsing of the bags resulted in improved mercury performance.

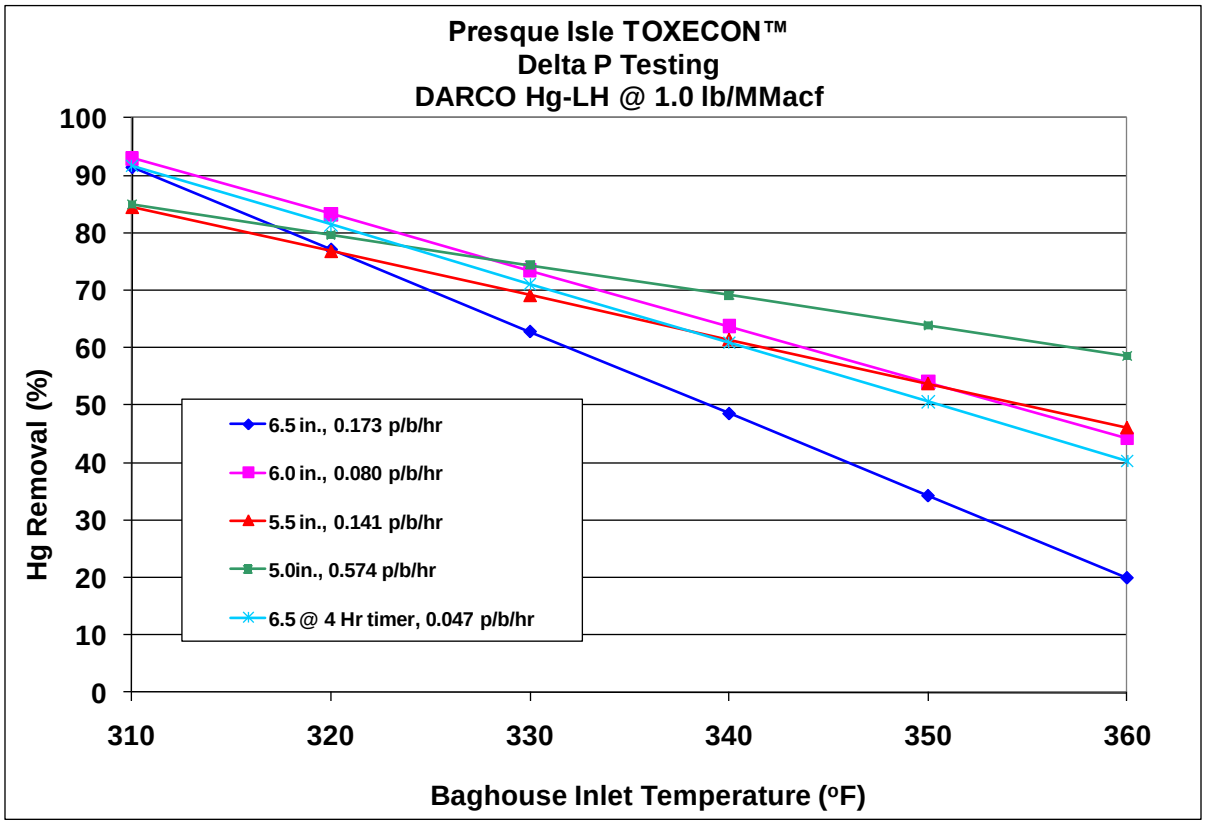


Figure 4-94. Effect of Baghouse Pressure Drop on Mercury Removal for 1.0 lb/MMacf DARCO® Hg LH.

Looking at cleaning rate (pulses/bag/hour), there was little difference from 6.5 down to 5.5. However, at 5.0 this parameter had a significant increase. Figure 4-95 shows a summary of this data. In general, cleaning rates below 1.0 pulse/bag/hr were well within expected operating parameters.

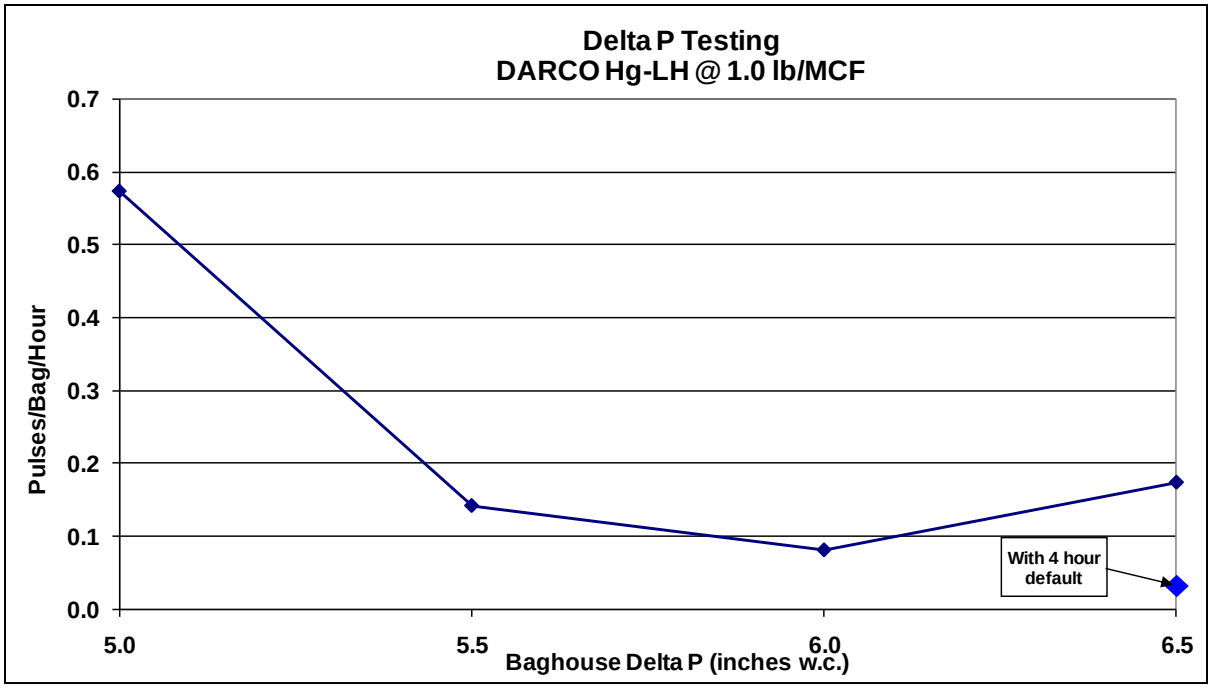


Figure 4-95. Effect of Baghouse Pressure Drop on Bag Cleaning.

There was an obvious savings in fan power when running at a reduced pressure drop across the baghouse. To estimate the magnitude of this savings, a regression analysis using a third order polynomial was done. The independent variables were baghouse ΔP, baghouse outlet temperature, and total flue gas flow. The dependent variable was booster fan amps. Table 4-35 estimates the annual power savings with reduced baghouse set point.

Table 4-35. Cost Savings for Baghouse Pressure Drop Reduction.

Set Point (″ W.C.)	Annual Savings
6.0	$21,300
5.5	$31,600
5.0	$35,000

The preliminary results of these tests indicated there was an advantage of running with reduced baghouse cleaning set point. Mercury removal was improved at higher inlet temperatures and fan power requirements were reduced. A significant increase in cleaning frequency did not become evident until the set point was reduced below 5.5 inches.

4.15.8.3 Effect of Temperature on Mercury Removal

The effect of temperature was correlated using first quarter 2007 data from testing using DARCO® Hg and fourth quarter 2006 data using DARCO® Hg LH carbon. Figure 4-96 shows the effect of temperature at varying injection concentrations for DARCO® Hg. Figure 4-97 shows the same effect using DARCO® Hg LH. For both types of carbon, higher injection rates resulted in a smaller effect of temperature.

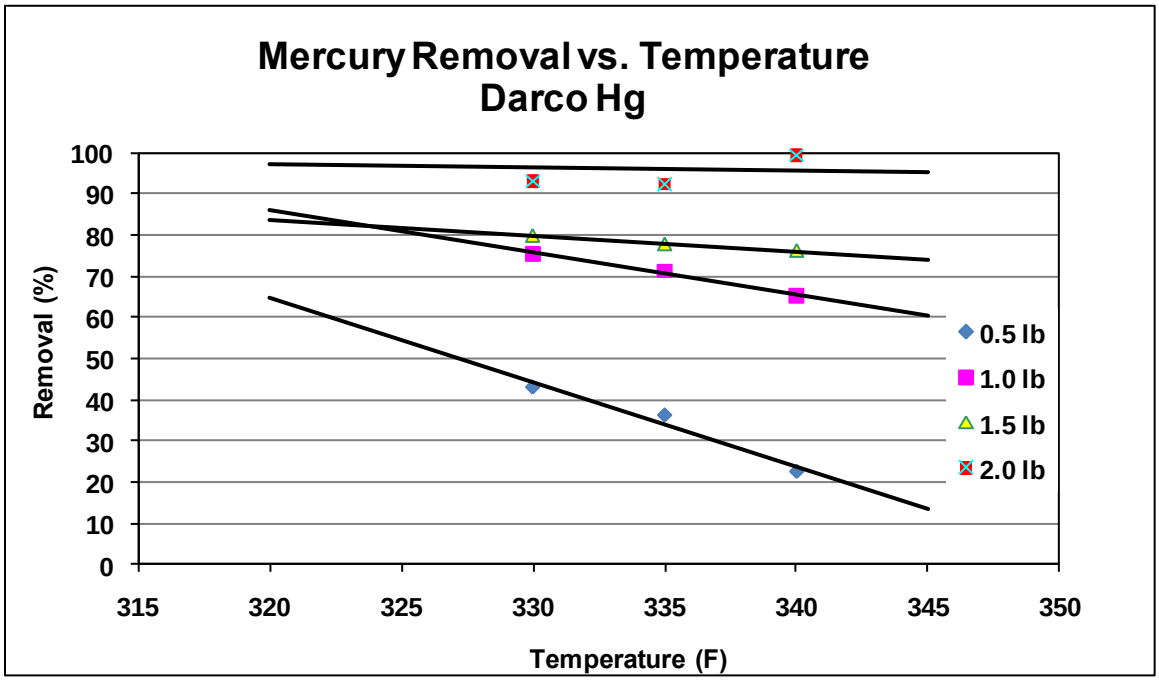


Figure 4-96. Effect of Temperature on Removal using DARCO® Hg.

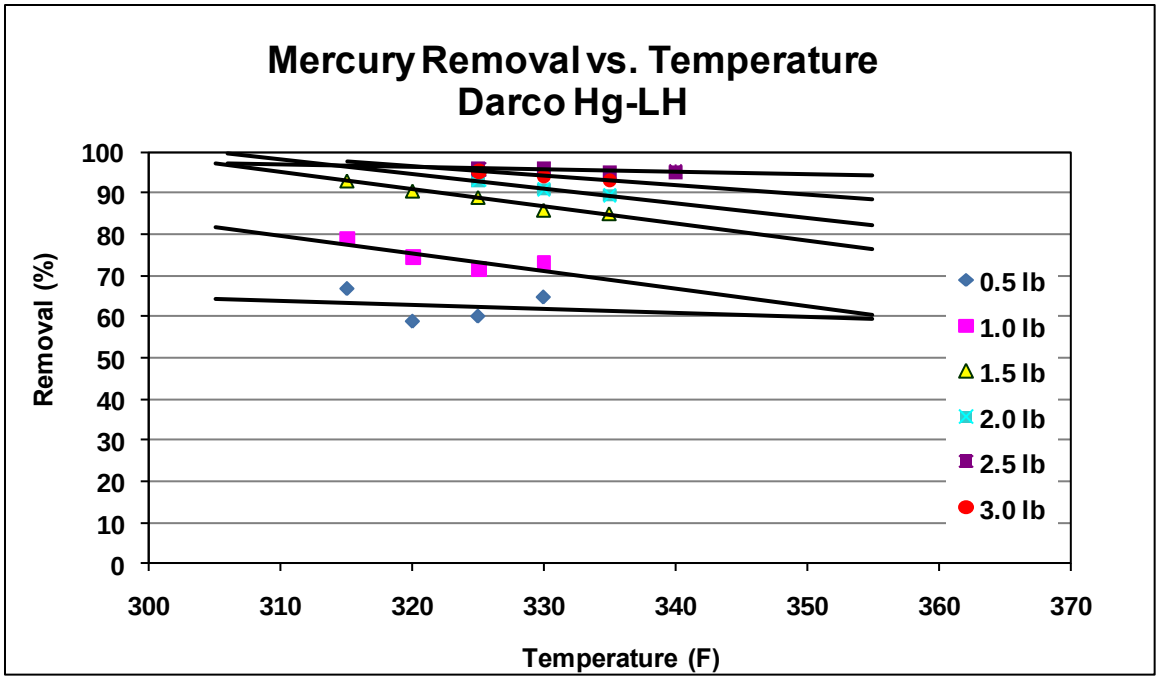


Figure 4-97. Effect of Temperature on Mercury Removal using DARCO® Hg LH.

4.15.8.4 ESP Detuning Tests

4.15.8.4.1 Background

The testing of the TOXECON™ process had shown a correlation between mercury removal and the amount and age of PAC on the filter bags. One of the problems with optimizing these factors was the complication of maintaining a proper filter cake on the bags.

The fabric of the filter bags was primarily used to collect dust particles upon its surface. The combination of the felted fabric and the dust cake filtered particulate out of the flue gas. The dust cake built up with time, and at some point it was necessary to clean the filter bags and remove part, but not all of the dust cake. The filter bags, with some residual dust on them continued to remove particulate matter more efficiently than if they were completely cleaned of the dust cake.

The baghouse cleaning strategy would normally be based on maintaining the ideal thickness of dust cake on the bags. First, it needed to be thick enough to be an efficient filter and protect the fabric on the filter bags. Second, it should not be too thick as to cause excessive draft loss which must be overcome with the booster fans. The thickness of the dust cake was

indirectly measured by the differential pressure from the inlet to the outlet of the baghouse. One of the lessons learned was that there was a conflicting need to clean the baghouse so the PAC does not become too "old." As a result, for much of the operation of the baghouse cleaning was based on time and not differential pressure. The problem this caused was that at times the amount of filter cake on the bags was not optimal. This may have led to higher emissions because, in a well-maintained baghouse, the majority of the emissions occur when the bags are cleaned. It could also lead to shortened bag life from more frequent pulsing.

Another problem which was ongoing involved operation of the ash unloader. There was a high ratio of carbon to ash in the material collected in the baghouse. The ash unloader system had not been successful dealing with this mixture when the carbon to ash ratio was greater than 1 to 1. If this ratio could be reduced to 0.5 to 1, the ash unloader may have been able to provide dustless unloading under most conditions.

An additional concern was the susceptibility of high concentrations of PAC to auto-ignition. Lowering the overall LOI of the PAC/ash mixture by adding more ash should reduce this risk.

The goal of this series of tests was to determine how the ash loading to the baghouse could be increased above base levels to:

- Improve collection efficiency of mercury
- Improve collection efficiency of particulate matter
- Protect the fabric of the filter bags and ensure normal life
- Eliminate dusting problems with the ash unloader operation.
- Reduce potential for auto-ignition in the baghouse hoppers.

Figure 4-98 shows the layout of the ESPs for Units 7–9.

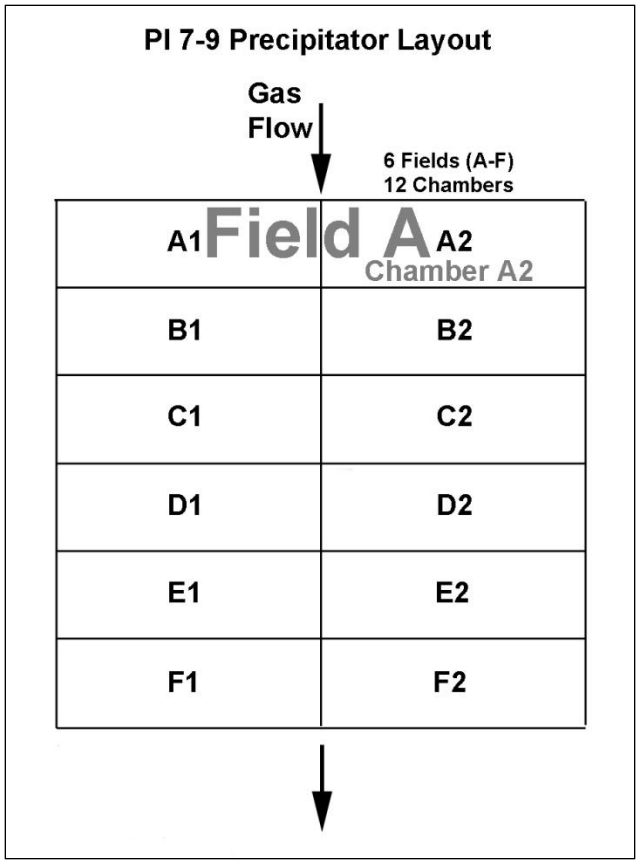


Figure 4-98. ESP Layout.

4.15.8.4.2 ESP Detuning Test Results

Stack opacity was monitored throughout the course of this project. Figure 4-99 below shows opacity data during the detuning tests. There was no noticeable change in opacity while the chambers were out of service. The Unit 9 CEM baseline was re-established on October 11.

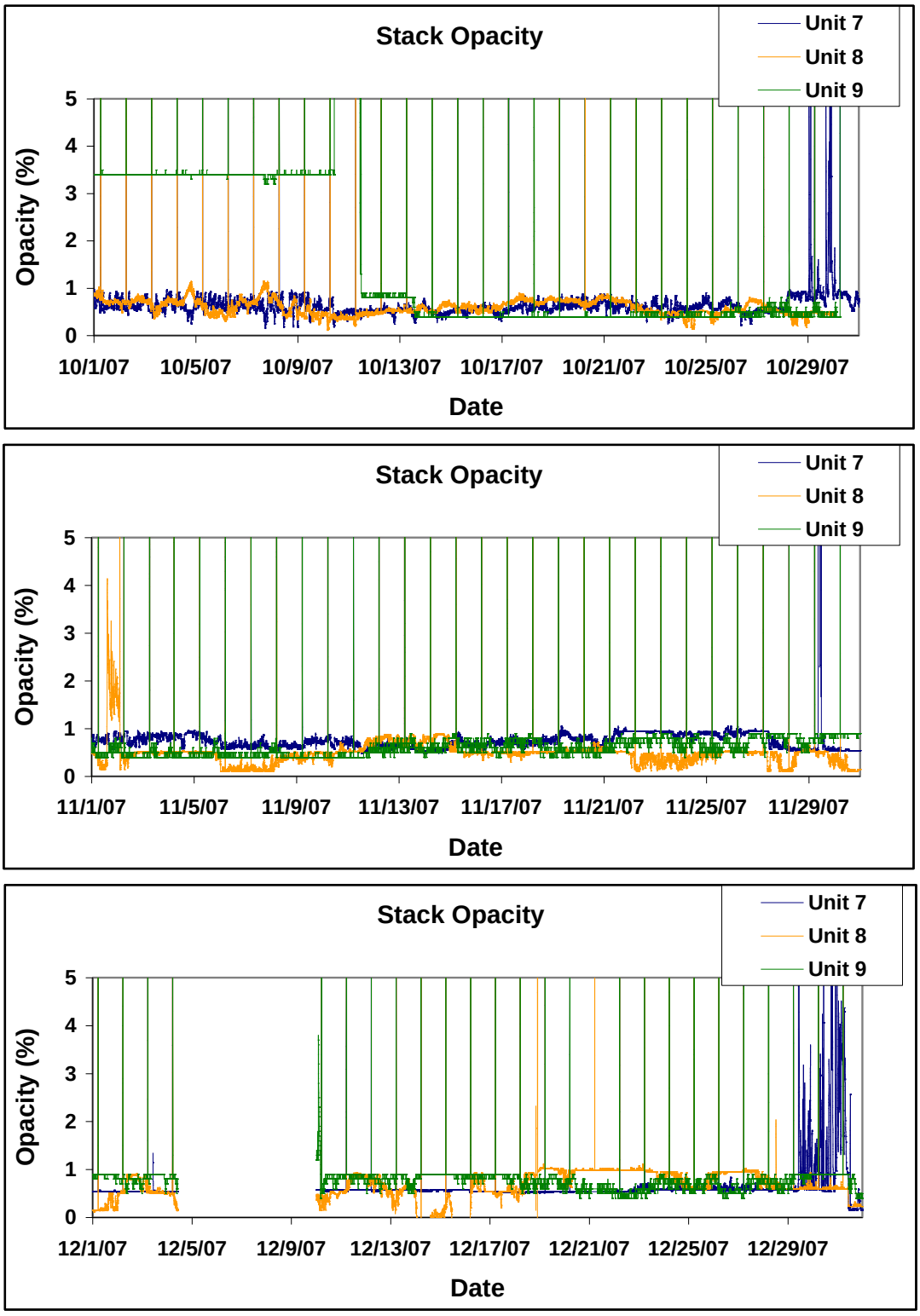


Figure 4-99. Stack Opacity during ESP Detuning Tests.

Figure 4-100 shows the LOI data for the test period. The LOI did not significantly drop until one of the front fields (7A1) was taken out of service in December, then the LOI dropped from 40-50% to around 30%. The lowest LOI was around 20%, and this was achieved with fields 7D, 7E, and 7F out of service. Unit 8 was out of service during this time, so the overall loading was much less than previous with all three units online.

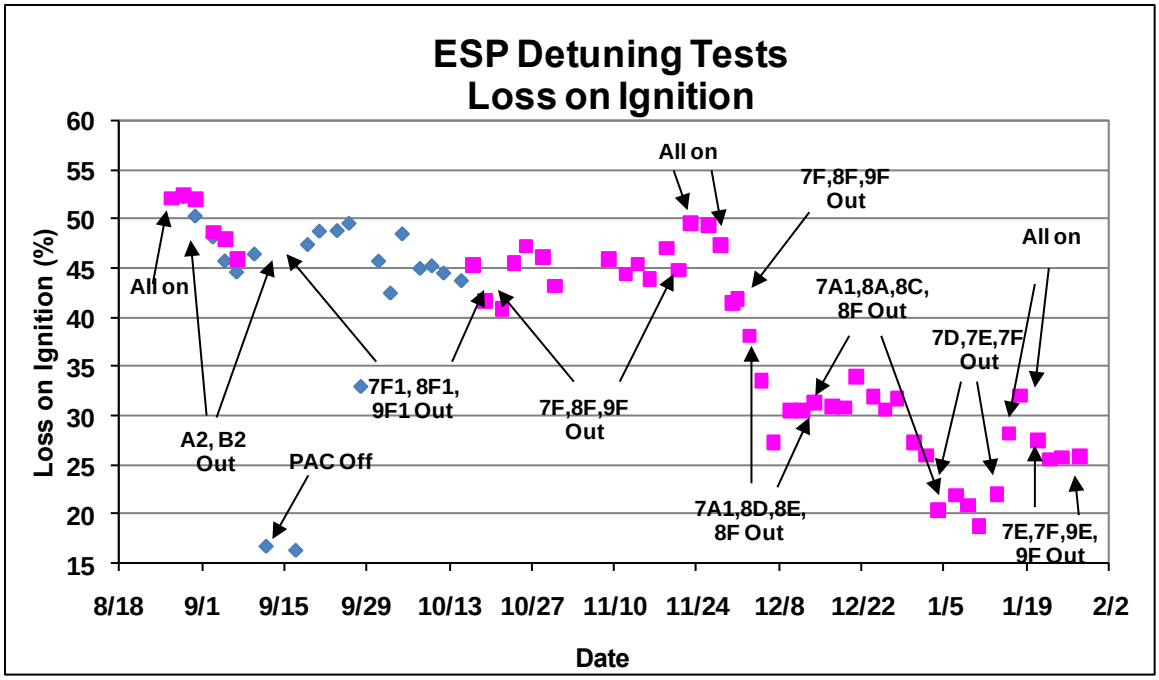


Figure 4-100. LOI during ESP Detuning Tests.

As shown in the average mercury removal graph (Figure 4-101), mercury removal did not noticeably improve with the additional ash going to the baghouse. There were still problems with dust during ash unloading, so the additional ESP ash was not beneficial. These tests were discontinued at the end of January 2008.

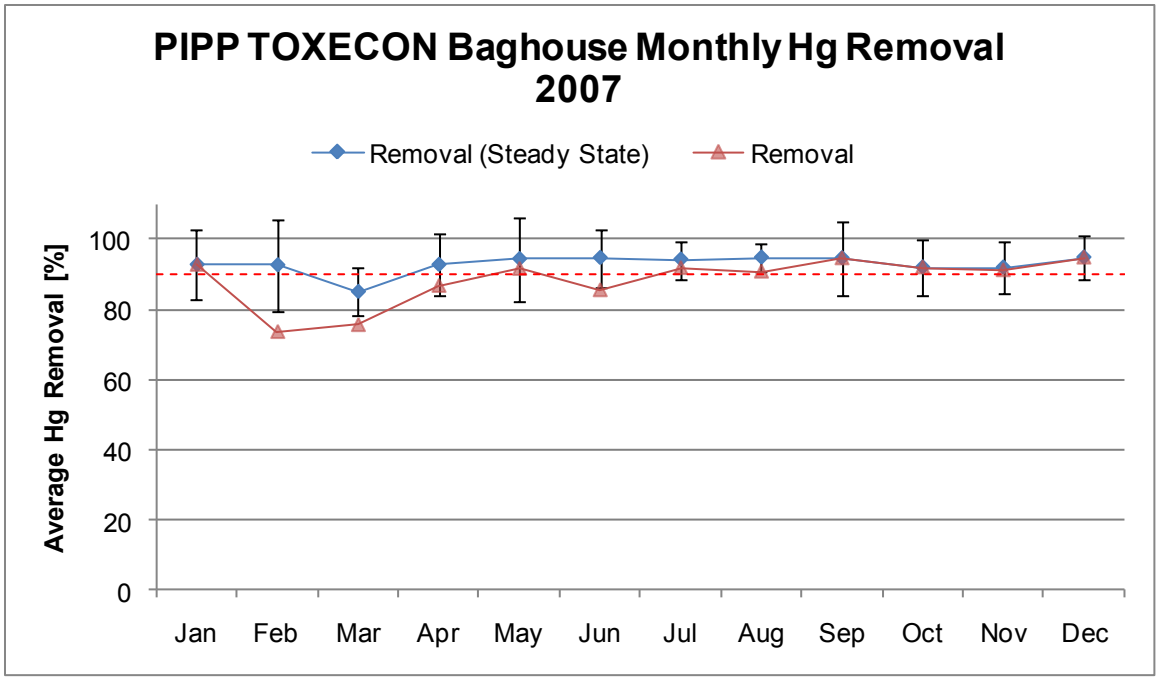


Figure 4-101. Average Mercury Removal – 2007.

4.15.9 Mercury Continuous Emissions Monitoring Systems

Thermo supplied two production-grade iSeries Mercury Freedom Systems to Presque Isle in December 2005. The Mercury Freedom System comprises a Model 80i Mercury Analyzer, Model 81i Mercury Calibrator, Model 82i Mercury Probe Controller, Model 83i Mercury Extraction Probe, and a mercury umbilical to transport the flue gas sample from the probe to the analyzer. The procurement and installation of the two Mercury Freedom Systems was described earlier in 4.7.8.2.

4.15.9.1 Units 7–9 Baghouse Inlet Mercury CEMS

The Thermo iSeries Mercury CEMS was installed at the baghouse inlet location on December 12, 2005. The mercury analyzer, calibrator, probe control box, pump, and zero air supply were installed into the CEMS Shelter #4, Rack 5 next to the Unit 8 FD fan inside the plant. The in-stack mercury probe was installed in a 4-inch duct port located downstream of the Unit 8 baghouse inlet. The 130-foot heated sample line connecting the analyzer to the probe was temporarily routed from the CEMS Shelter to the probe location. The installation of two additional mercury probes at the Unit 7 and Unit 9 baghouse inlet locations was scheduled for June 2006.

A desktop computer was also installed into the contractor trailer to connect to the baghouse inlet mercury system via serial cable and the iPort computer program. The iPort software was developed by Thermo and designed to communicate with all of the iSeries instruments to enable full control of the instruments by a remote device. This computer located in the trailer was set up to allow remote connection to the system through the Presque Isle Remote Access Portal.

There are several appendices in this report related to the performance of the baghouse inlet mercury CEMS. Appendix K is a record of the daily average mercury concentration as measured by the mercury CEMS. Appendix L contains the complete calibration record from December 2005 to September 2009. Appendix M lists the monthly maintenance records and availability calculations from January 2008 to September 2009.

4.15.9.1.1 Baghouse Inlet –First Quarter 2006

The start of valid sample data was collected from the Unit 8 baghouse inlet location on December 27, 2005. At this early stage of the project, valid data was defined as the measurement of stable and consistent mercury concentrations with several repeatable responses to calibration zero and span gas. The on-board data logger of the analyzer was configured to record one-minute averaged data and routine collection of the data was performed by ADA-ES to determine the performance of the system with continuous analysis of the data.

The mercury analyzer and calibrator were set up with the typical operating conditions as recommended for the Thermo Mercury CEMS. Although the recommended set points changed over the duration of the project and continued operation of the system, a table of the initial configuration of set points and alarms can be found in Table 4-36.

Table 4-36. PIPP Units 7–9 Inlet Analyzer Initial Set Point Configuration.

Setting	Minimum Alarm	Maximum Alarm	Set Point
Umbilical Temperature	135 °C	170 °C	150 °C
Probe Temperature	190 °C	230 °C	200 °C
Converter Temperature	750 °C	780 °C	760 °C
Dilution Pressure	40 psig	60 psig	45.4 psig
Blowback Pressure	40 psig	70 psig	55.8 psig
Eductor Pressure	10 psig	25 psig	18.6 psig
PMT Voltage	N/A	N/A	937.2 V

Shortly after installation and data collection, the Unit 8 boiler went into an outage and the mercury concentrations dropped to zero. When the unit returned to operation on January 6, 2006, the mercury concentrations increased to the previous levels and continued to produce valid mercury concentration measurements for the next two weeks. The mercury concentrations measured during the installation and conditioning period from the baghouse inlet location is shown in Figure 4-102.

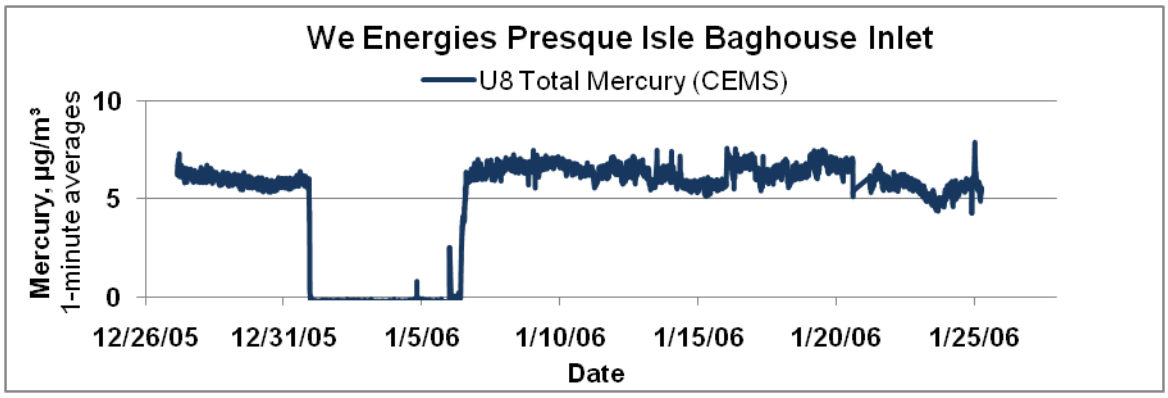


Figure 4-102. PIPP Units 7–9 Inlet Total Mercury, December 2005–January 2006.

The system was configured to perform daily calibration checks on January 7, 2006. The calibration routine was defined as a check of the zero and span responses directly to the analyzer followed by a check of the zero and span response of the entire system. The check of the system was performed by injecting calibration gas at the critical flow orifice upstream of the dilution module. The name of the type of calibration performed by injecting

calibration gases upstream of the critical flow orifice is called an "orifice calibration." The zero gas phase of the daily calibration check is commonly called "orifice zero" gas mode and the calibration span gas phase is called the "orifice span" gas mode.

The time and duration of the calibration routine was not clearly defined at the start of the project and the software of the analyzer was not completely developed to perform reliable calibration checks automatically. The software was initially programmed to perform a calibration check at midnight on each day. The communication between the mercury system and the ESC data logger was completed on January 14 and the data logger was programmed to send a request to the mercury system to perform a calibration routine every morning at 7:35 a.m. The calibration span gas concentration was defined as 5.0 µg/m³ on January 21. The software-initiated calibration routine would include the analyzer zero and span response check but the ESC-initiated calibration routine would only perform a 10-minute orifice zero check and a 10-minute orifice span response check. During this time, the software and the data logger would start their own calibration routine and two calibration checks were performed each day. Table 4-37 contains the record of the first week of calibration checks performed after January 14 by the ESC data logger.

Table 4-37. PIPP Unit 8 Inlet Calibration Check Responses; January 14–20, 2006.

Date	Time	Span	Level	Zero Response		Cal Response		Result
01/14/06	07:39	20.0	15.0	-0.14	-0.7%	14.47	-2.7%	PASS
01/15/06	07:39	20.0	15.0	-0.18	-0.9%	13.80	-6.0%	FAIL
01/16/06	07:38	20.0	15.0	0.04	+0.2%	15.91	+4.6%	PASS
01/17/06	07:38	20.0	15.0	-0.03	-0.2%	14.55	-2.3%	PASS
01/18/06	07:38	20.0	15.0	-0.23	-1.5%	14.31	-3.5%	PASS
01/19/06	07:37	20.0	15.0	0.05	+0.3%	14.58	-2.1%	PASS
01/20/06	07:37	20.0	15.0	0.00	+0.0%	14.86	-0.7%	PASS

On January 24, 2006, the mercury CEMS was powered down as the heated sample line at the inlet was disconnected and routed through a cable tray in the boiler house. During the startup procedure on January 25, the converter heater inside the mercury probe failed and the system was unable to sample total mercury. The converter heater and converter core were replaced on January 27 and the system was brought back up to operating temperatures for calibration and sampling. Figure 4-103 shows the failure of the converter heater and the decrease in converter core temperature.

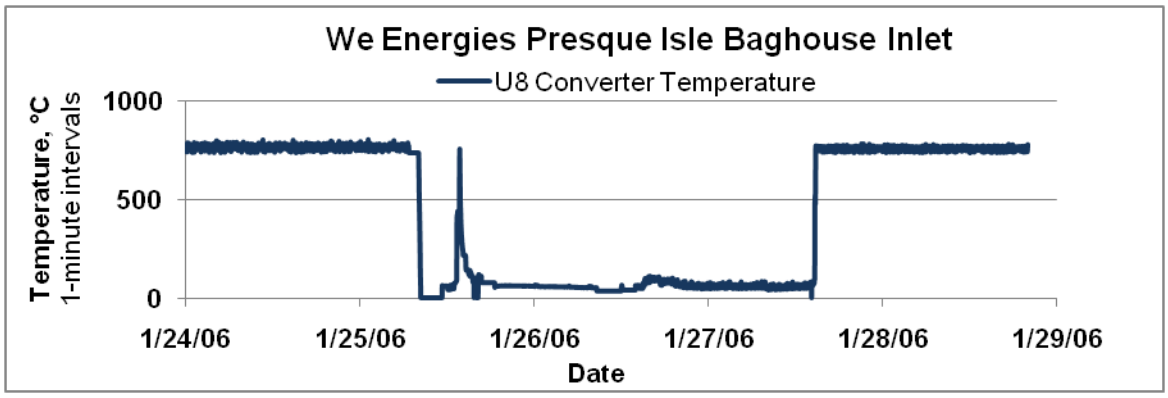


Figure 4-103. PIPP Unit 8 Inlet Probe Converter Heater Failure, January 2006.

The mercury system at the Presque Isle Inlet location was recalibrated after the mercury probe converter core was replaced and a new converter heater installed on January 28, 2006. While the PAC injection system was tested and calibrated, the inlet system was prepared for the official start of the TOXECON testing on February 13. After the initial installation and conditioning of the mercury CEMS, the system was monitored under continuous operation and the data collected for the first quarter 2006 is shown in Figure 4-104.

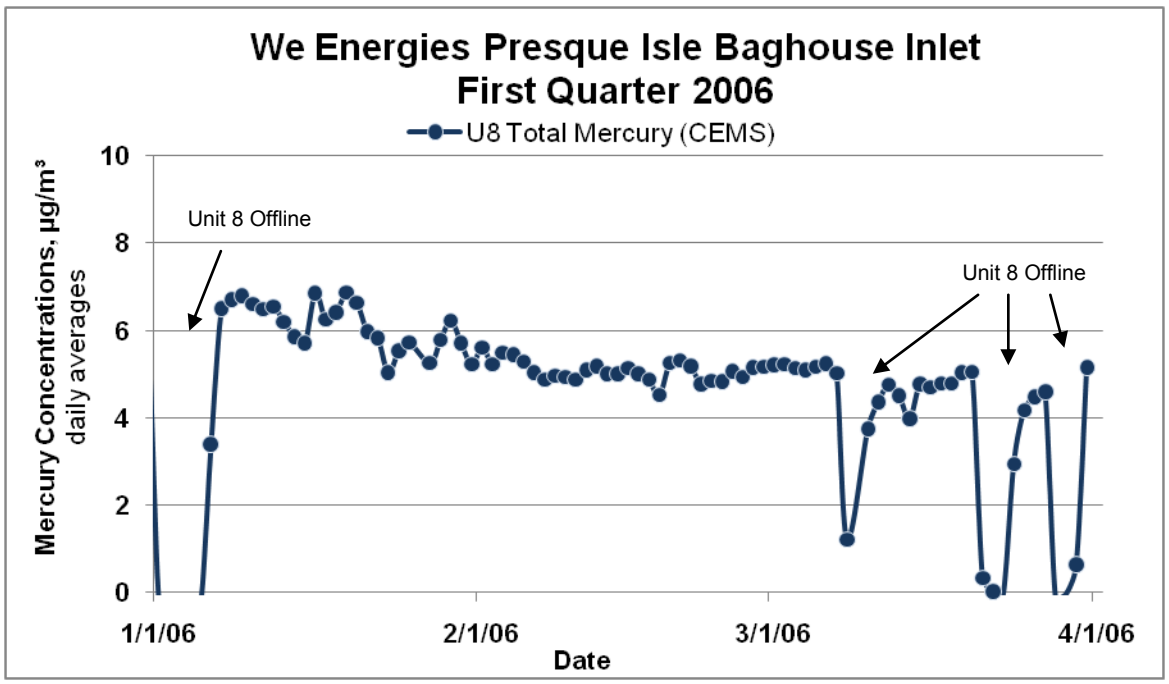


Figure 4-104. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q06.

The mercury analyzer software was upgraded from version 00.04.55.091 to 00.04.65.101 on January 29, 2006. The software upgrade allowed more data content to be stored by the internal data logger for more thorough analysis of the data and operating conditions. Some of the new content recorded by the software includes probe temperature, probe air pressures (dilution air, eductor, orifice, and venturi), sample flow rate, and calibration factors (background and coefficients).

The mercury calibrator was not communicating properly with the analyzer and was not sending any zero or span gas to the probe between January 29 and February 3, 2006. That caused the calibration responses to fail the criteria according to 40 CFR Part 75. The calibrator must be turned on before the analyzer in order for the analyzer to find the connection to the calibrator during its software boot sequence, otherwise any calibration commands sent from the analyzer to the calibrator would be ignored.

Along with the software upgrade, the span concentration used for the inlet mercury CEMS was automatically changed from 5.0 µg/m³ to 12.0 µg/m³ on February 4, 2006, in order to represent the expected range of mercury concentrations to be measured at the inlet.

The failed calibration response on February 18, 2006, was most likely caused by a decrease in the dilution air pressure. A decrease in the dilution air pressure causes the critical flow orifice to not operate under critical conditions and can cause an increase in the dilution ratio to result in lower than expected calibration span response. The dilution air pressure was restored to the proper set point on February 19 and resulted in a passing calibration check.

Baseline tests for the TOXECON project were performed during the week of February 13, 2006. Baseline testing was done without PAC injection to get measurements of the mercury concentrations without mercury capture at the outlet of the baghouse. Samples of coal and ash were taken during the baseline period as well as mercury (Ontario Hydro and Method 324), halogen (Method 26A), and particulate testing (Method 5) on the flue gas into and out of the baghouse. Mercury CEMS data was not available from the analyzer for brief periods on February 14 and February 16 but EDS data was collected and used to complete the data set.

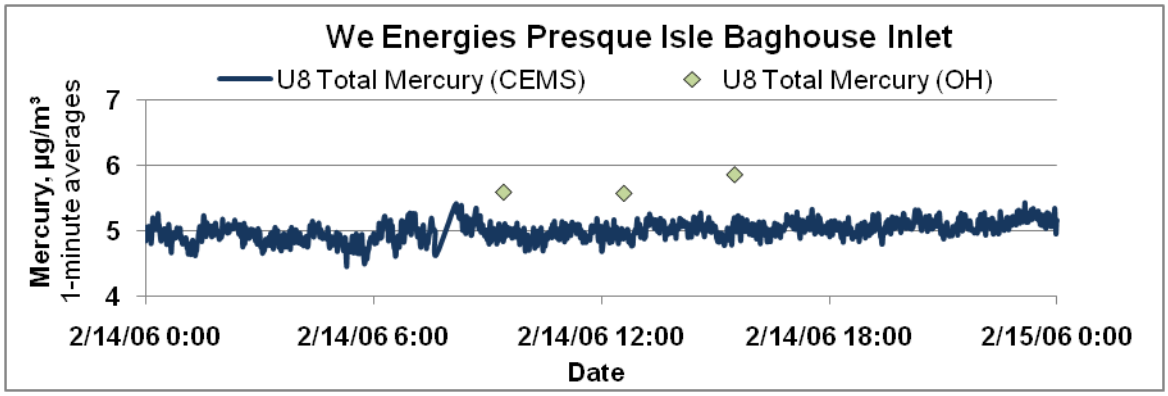


Figure 4-105. PIPP Unit 8 Inlet Total Mercury CEMS-Ontario Hydro; February 14, 2006.

The Unit 8 inlet mercury system performed two calibration checks each day. One calibration check was initiated by the ESC data logger. A manual recalibration was automatically performed by the analyzer software shortly after the data logger-initiated check and was designed to update the calibration factors loaded into the analyzer based on the response of the calibration zero and span gases. This second calibration was designed to make sure that any drift observed by the analyzer was corrected as soon as possible during the baseline testing.

The original method of recalibrating the system involved changing the background factor based on the zero response and then adjusting the dilution ratio based on the span response. The dilution ratio acts as a multiplier on the response to the span gas to increase or decrease the mercury measured by the analyzer. The coefficient factor was not changed in early calibrations.

For Ontario Hydro testing, twenty-four test points were sampled using six ports at the baghouse common inlet and outlet test locations. The speciated mercury sample trains met all specifications required by the Ontario Hydro method. Triplicate tests were performed at the inlet to the baghouse location. The results are shown in Table 4-38 and show that the CEMS and the Ontario Hydro results differed by 12% and the error is well within the 20% agreement required by the EPA to pass the Relative Accuracy Test Audit (RATA) for mercury.

Table 4-38. PIPP Unit 8 Inlet Ontario Hydro Test Results; February 14, 2006.

Date	Time	OH HgT µg/dscm	OH HgT µg/scm	CEMS HgT µg/scm	Differential	Result
02/14/06	09:25	6.28	5.59	4.89	12.5%	PASS
02/14/06	12:35	6.26	5.57	5.04	9.5%	PASS
02/14/06	15:30	6.58	5.86	5.05	13.8%	PASS
02/14/06	AVG	6.37	5.67	4.99	12.0%	PASS

Parametric tests of several different PAC injection rates were performed between February 20 and March 1, 2006. The overall goal of these tests was to establish a correlation between injection of activated carbon and mercury removal. No injection rates had an impact on the inlet mercury concentration and therefore no changes in mercury concentration were expected at this location.

Before parametric testing was completed, the PAC injection was turned off after hot embers were discovered inside all of the baghouse hoppers. The baghouse was put into bypass mode and all compartments were isolated. During this baghouse bypass, the inlet mercury system continued to operate and measure mercury concentrations from the Unit 8 baghouse inlet.

Unit 8 was taken offline from March 8–10, March 21–24, and March 27–30, 2006. The mercury CEMS continued to sample data when the unit was offline and registered a concentration of zero as it was sampling ambient air from the Unit 8 discharge duct.

4.15.9.1.2 Baghouse Inlet – Second Quarter 2006

During 2Q06, the Unit 8 baghouse inlet mercury CEMS was monitored for long-term operations while the baghouse was offline. The concentrations measured by the system are presented in Figure 4-106. Although Unit 8 was offline April 5–9 and May 24–June 20, the inlet mercury CEMS continued to perform daily calibration checks and corrective recalibration actions.

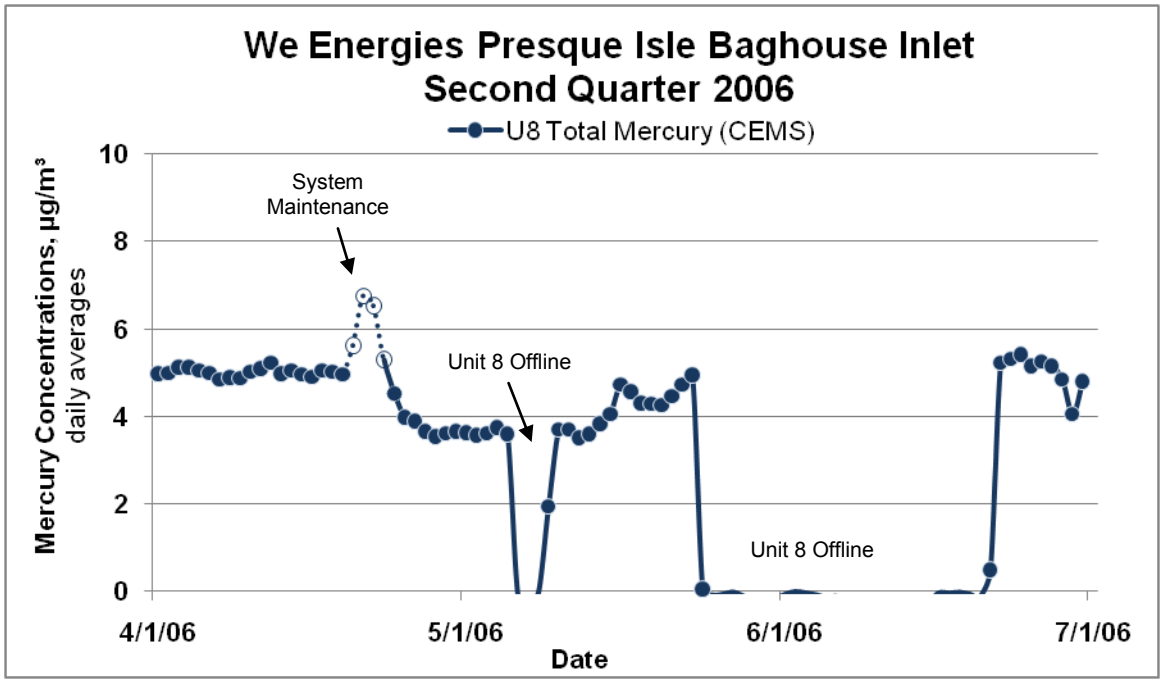


Figure 4-106. PIPP Units 7–9Inlet Total Mercury Concentrations, 2Q06.

The mercury CEMS continued to perform an EDS data logger-initiated calibration at 7:35 AM. Due to the differences between the EDS data logger time and the analyzer time, the record of the calibration as collected in the analyzer data does not always match the data logger time. Small corrections were often made to the analyzer time to match the data logger data but the analyzer time occasionally differed from the data logger by up to five minutes.

The mercury CEMS was also set up to perform an automatic recalibration action at 08:40. This calibration cycle was a corrective action after the true calibration response is recorded during the calibration cycle initiated by the data logger. The calibration factors were automatically updated during this calibration cycle with the background adjusted after a response to zero gas and the dilution ratio adjusted after a response from a calibration span gas of 12.0 µg/m³. An example record of each calibration check and attempts at automatic recalibration for April 5–10, 2006, can be found in Table 4-39. For the records indicated by "SET," the responses to the calibration gases represent the concentration measured prior to the update of the calibration factors during the calibration routine.

Table 4-39. PIPP Unit 8 Inlet Calibration Check and Recalibration; April 5–10, 2006.

Date	Time	Span	Level	Zero Response		Cal Response		Result
04/05/06	07:36	12.0	15	-0.02	-0.1%	12.61	+4.1%	PASS
04/05/06	08:40	12.0	15	0.01	+0.1%	12.72	+4.8%	SET
04/06/06	07:36	12.0	15	-0.05	-0.3%	11.37	-4.2%	PASS
04/06/06	08:40	12.0	15	-0.11	-0.7%	11.78	-1.5%	SET
04/07/06	07:36	12.0	15	0.00	0.0%	12.06	+0.4%	PASS
04/07/06	08:40	12.0	15	Aborted recalibration				
04/08/06	07:36	12.0	15	-0.30	-2.0%	11.74	-1.7%	PASS
04/08/06	08:40	12.0	15	-0.13	-0.9%	Aborted recalibration		
04/09/06	07:36	12.0	15	-0.12	-0.8%	11.64	-2.4%	PASS
04/09/06	08:40	12.0	15	-0.12	-0.8%	11.64	-2.4%	SET
04/10/06	07:36	12.0	15	0.00	0.0%	11.76	-1.6%	PASS
04/10/06	08:40	12.0	15	-0.24	-1.6%	11.47	-3.5%	SET

The recalibration routine continued to be unreliable because the cycle would occasionally abort the calibration and return to sample flue gas from the Unit 8 duct before the 20-minute cycle was completed. The calibration check initiated by the data logger did not have this problem. There was an on-going issue with the analyzer software that causes the recalibration cycle to end prematurely if a specific alarm was detected by the software. The

exact problem was difficult to determine but Thermo indicated that they would attempt to correct the error in future software releases.

The analyzer software continued to be upgraded with the installation of version 00.04.86.122 on April 21, 2006. The new version of the software was installed to correct some of the alarms that were passed to the plant DCS and data logger but it did not correct the issue with the automatic recalibration routines initiated by the analyzer software. In addition to the analyzer software upgrade, the DCS also was updated to allow several other alarms to be properly transmitted from the CEMS to the DCS.

However, the software upgrade also caused problems with many of the air pressure measurements. The dilution air, which is the most important air pressure to keep constant for the stability of the mercury measurements in a dilution probe, significantly changed behavior after the software was upgraded on April 21, 2006. The changes to the dilution air pressure are represented in Figure 4-107.

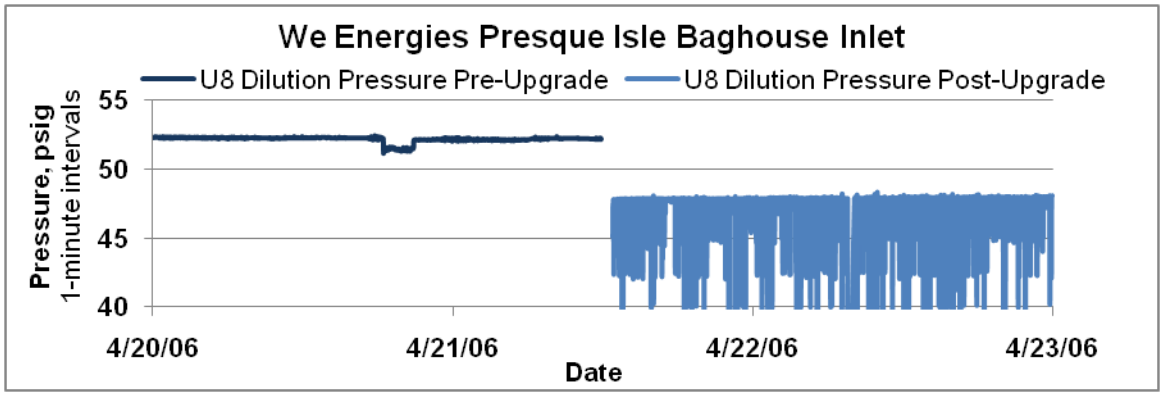


Figure 4-107. PIPP Unit 8 Inlet Mercury Probe Dilution Pressure, April 2006.

The cause of the unstable dilution air pressure was related to the increase of the eductor air pressure from 14 psig to over 20 psig during the software upgrade on April 21, 2006. The demand of air on the system is higher as the eductor air pressure is increased and that prevents other system pressures to accurately control to their set points. On May 10, the eductor air was decreased slightly from 20 psig to 18 psig and this caused the dilution pressure to become more stable as shown in Figure 4-108.

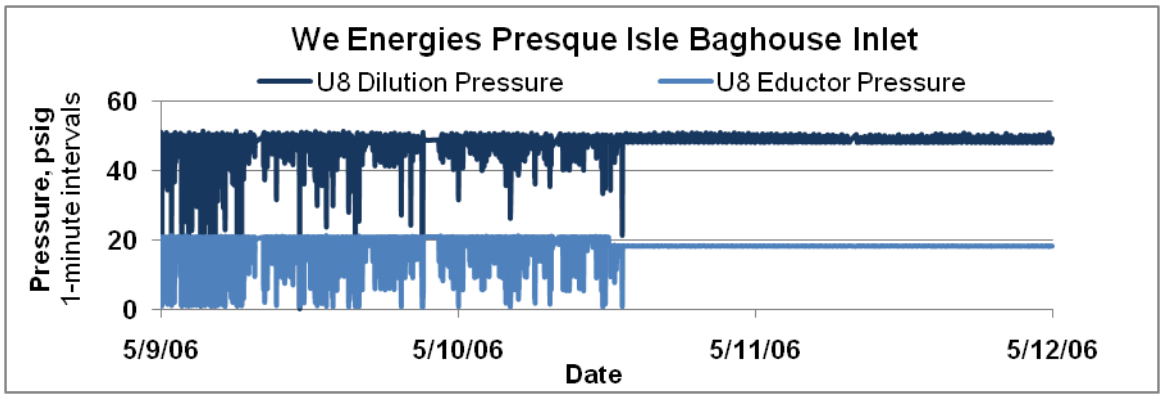


Figure 4-108. PIPP Unit 8 Inlet Mercury Probe Eductor/Dilution Pressure, May 2006.

Unlike the other heaters in the probe, the converter heater is a 120V ceramic heater that maintains the mercury converter core at a constant temperature of 760 °C. The power to this heater was wired through a UPS battery backup system along with the other power to the instruments. There was concern that the converter heater would quickly drain the battery if power were lost to the system. The power to the mercury system was rewired on April 20 to remove the converter heater from the UPS to prevent unnecessary drain on the battery backup.

The internal temperature measurements were also corrected during the maintenance activities on April 20–21, 2006. The internal temperature was measuring an "open" temperature reading since installation of the system until it was reconnected in the analyzer to report the internal temperature at 26–28 °C.

The temperature compensation function of the analyzer software had been turned on so the background calibration factor started to adjust each minute to correspond to the real-time changes to the internal temperature recorded inside the mercury analyzer. It was known that temperature has an impact on the zero offset of the analyzer and the temperature compensation attempts to correct for the zero drift based on the change in the internal temperature. According to Thermo, this function did not work properly and it was recommended that the temperature compensation function be turned off. This setting was not discovered until May 29, 2006, when the temperature compensation was correctly turned off. Even though the background was changing each minute in response to the internal temperature, the effects did not have a great impact on the background calibration factor as

shown in Figure 4-109. Since the internal temperature of the analyzer was very stable as it was installed in an instrument shelter, the backgrounds adjusted by the analyzer did not fluctuate by more than 0.01 µg/m³.

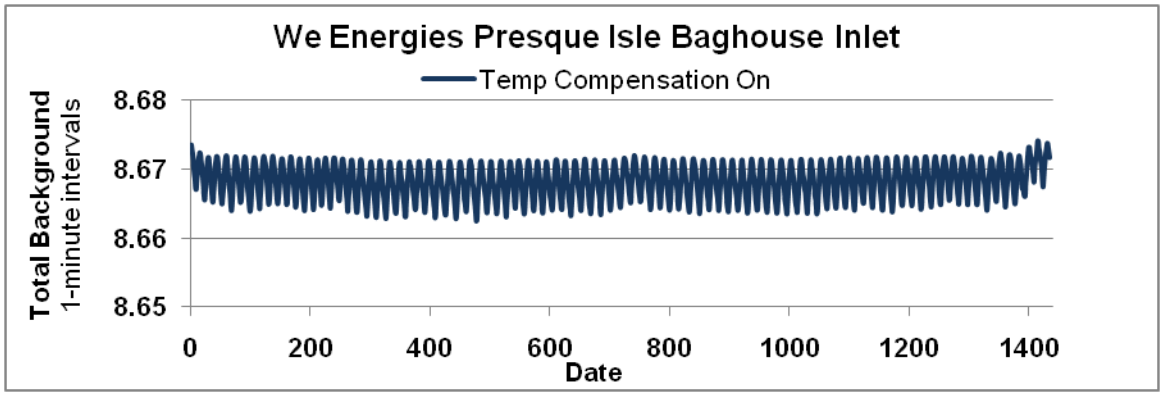


Figure 4-109. PIPP Unit 8 Inlet CEMS System Background Calibration Factor, 3Q06.

The temperature measurements recorded by the analyzer were very unstable since installation of the system. The converter temperature measurements are shown in Figure 4-110 as an example of the "noise" measured by the analyzer through the probe controller. A modification to the system was made to ground the thermocouple connections located at the back of the probe controller that measure the temperature from the umbilical, probe bench, and converter. The adapters on the thermocouples did not solve the problem with the unstable temperature readings but it was determined that the signals did not accurately portray the stable controlled temperatures of the heaters.

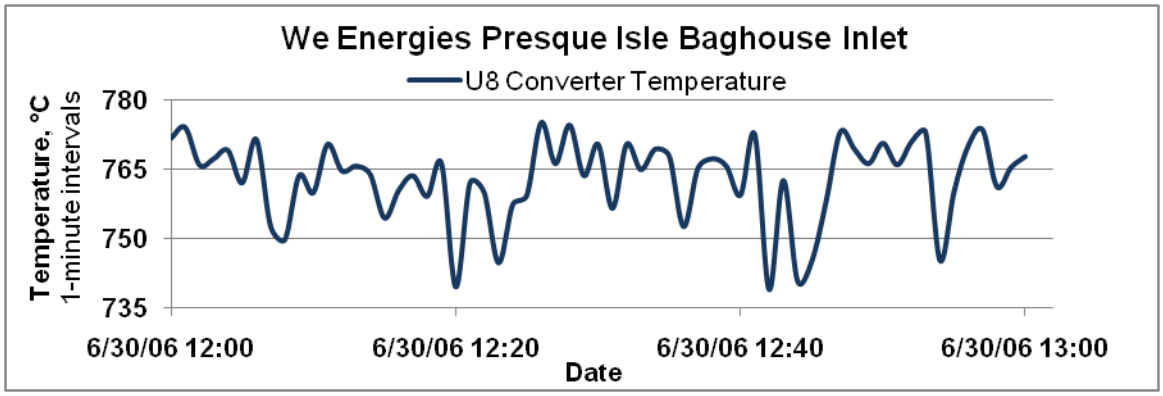


Figure 4-110. PIPP Unit 8 Inlet Mercury Probe Converter Temperature; June 30, 2006.

The calibrator software was also upgraded on April 21, 2006. The output mercury concentration for the calibrator was reset with the installation of new software and the calibration span gas concentration changed from 12.0 µg/m³ to 5.0 µg/m³. From April 21 to May 18, the calibration span gas concentration was not adjusted and the system was performing daily calibration checks with an incorrect lower calibration span gas concentration.

4.15.9.1.3 Baghouse Inlet – Third Quarter 2006

During the third quarter of 2006, the CEMs were monitored for long-term operation and several upgrades were made to the software and hardware. In order to sample from each of the three inlet locations and enable EPA-compliant filter calibrations on the inlet system, Thermo and ADA-ES engineers installed new equipment and conducted several maintenance items that had a great impact on the performance of the system. The concentrations measured by the system can be found in Figure 4-111.

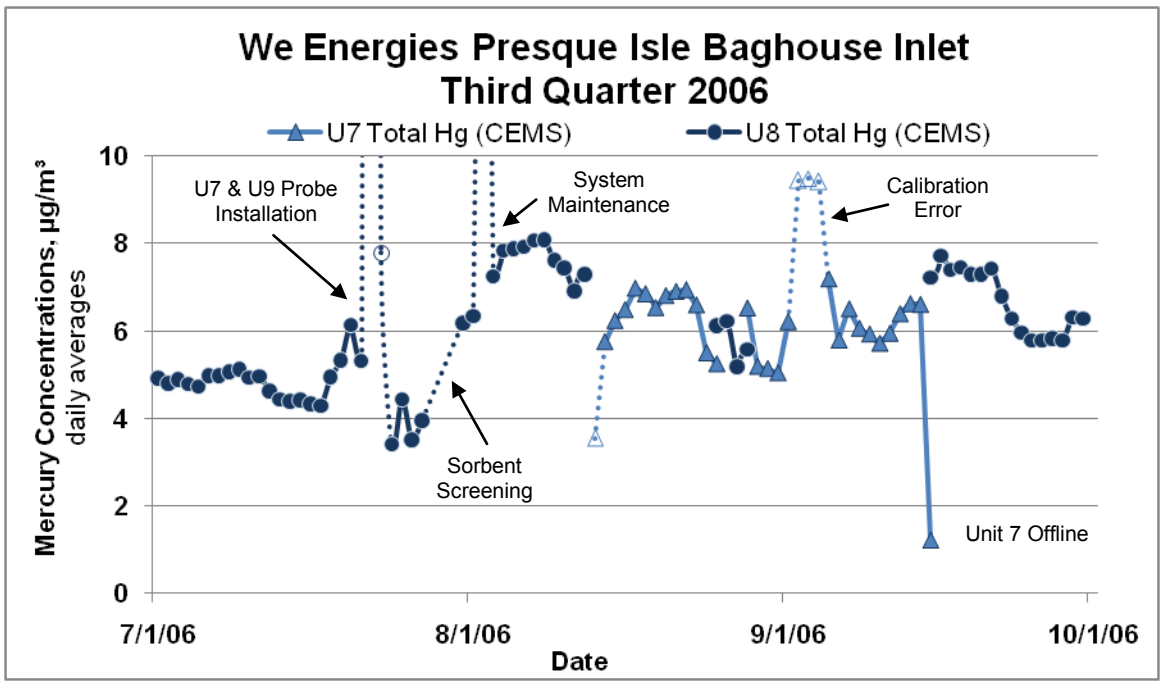


Figure 4-111. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q06.

During the week of July 18–23, 2006, two new mercury extraction probes were installed on the Unit 7 and Unit 9 ductwork that leads to the baghouse. The probes were an upgraded model of the existing probe that was installed on the Unit 8 inlet duct in June 2005 and were

modified to include an “actuator valve” mounted on the top of the probe. A picture of the Unit 7 probe installed in the duct to the baghouse inlet is shown in Figure 4-112.

Figure 4-112. PIPP Unit 7 Inlet Mercury Extraction Probe with Actuator Valve.

The actuator valve allows the probe to perform “filter” calibrations that are more compliant to EPA regulations and requirements than the “orifice” calibrations. During previous system calibration checks, the calibration zero and span gases would be injected into the probe downstream of the inertial filter and upstream of the critical orifice and dilution module. The modification was designed to inject the calibration gas directly into the fast loop upstream of the inertial filter in order to perform true calibrations through the entire flue gas path of the probe. The actuator valve located at the exhaust end of the fast loop will close during calibrations and force the calibration gas through one of the venturi pressure ports to flood the fast loop and sampled through the inertial filter. A picture of the actuator valve can be found in Figure 4-113. When the probe is sampling flue gas, the actuator valve would open and the probe would function as previously designed. To test the new calibration routine, automatic calibration checks were set up in the software to perform at 08:33 and 20:33 every day, in addition to the normal orifice calibration check initiated by the EDS data logger at approximately 7:35 AM every morning. The concentration of the calibration span gas was incorrectly adjusted on July 19 from 12.0 µg/m³ to 5.0 µg/m³ and adjusted again on August 1

to 8.0 µg/m³. The final change of the calibration concentration to 11.0 µg/m³ occurred on August 13. Filter calibrations became possible with the installation of the actuator valve and orifice calibrations were no longer performed as of September 8.

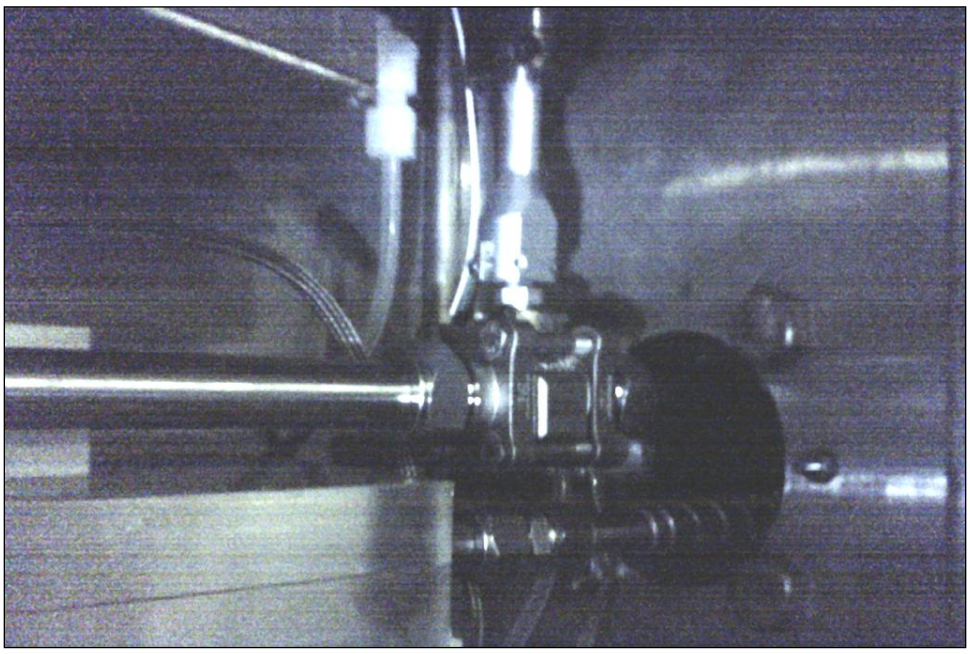


Figure 4-113. PIPP Unit 7 Inlet Mercury CEMS Probe Actuator Valve and Stem.

The Unit 8 probe did not have an actuator valve when the prototype system was originally installed in June 2005 and required to be retrofit before it could perform acceptable calibrations. The prototype probe was not designed with the extra room for an actuator valve and the converter assembly required repositioning inside the probe shell. The terminal block in the electrical compartment was positioned incorrectly and it was impossible to expand it to include the new connections for the actuator valve controls. The additional terminal blocks required could only be positioned to rest upon the other connections in the electrical panel. Due to the difficulty in retrofitting the Unit 8 probe, it was recommended that the prototype probe be replaced with a newer model mercury probe before the project is closed.

The two new mercury probes also required the installation during the week of July 18–23, 2006, of two additional probe controllers and the Thermo Hydra valve box to control the functions of the extraction probes. The components of the inlet system are pictured in Figure 4-114. The Hydra valve box provided a method of switching between the three inlet

probes to measure the mercury profile from Unit 7, Unit 8, and Unit 9 baghouse inlet ducts and to ensure that an inlet mercury concentration was always available when one of the boilers went offline. The Hydra was designed to direct the total mercury sample from one probe to the analyzer while the sample from the other two probes would be sent to bypass. The Hydra would also switch between the three probe controllers depending on which probe was being sampled to allow control and measurements to be obtained from the sampled probe. The Hydra and additional probe controllers were installed in the same shelter as the rest of the inlet system and connected to the umbilicals that were previously installed in December 2005.

Figure 4-114. PIPP Units 7–9 Inlet Mercury CEMS, Hydra Configuration.

The clean dry air supplied to the inlet system required modifications since the system was now supplying air to three mercury probes instead of one probe. The concern was that the extra demand on the air supply would interfere with the other compliance instruments operated in the CEMS shelter. Since the only critical air source is the instrument-quality air (zero air) required for calibration and dilution, a portion of the air was diverted from the drying system. This section of diverted air was installed with a simple dryer and regulator and was used to feed the clean dry air required of the eductor and blowback of the mercury

system. The current wall-mounted dryer system that creates zero-grade instrument air continued to be used for the dilution air and calibration.

The mercury calibrators were of a previous design that utilized a vacuum pump to keep the critical orifice in the probe from becoming over-pressurized during an orifice zero or orifice span. The new design called for the installation of a check valve to improve the performance of the calibrator by not using a pump to regulate this increase in pressure.

Software was also upgraded on the mercury analyzer to version 00.05.15.139 and the software of the mercury calibrator was upgraded to version 00.04.35.038. This software was designed to fix the minimum and maximum alarm settings, provide more reliable automatic calibration routines, record more measurement parameters to the internal data logger, and allow configuration for use with a Hydra system.

After the installation of the two new inlet probes and the Hydra valve box was completed, the new Thermo analyzer software prohibited complete control of the systems through a remote computer and the iPort program. Thermo released another upgrade of the analyzer software to version 00.05.18.142 which was installed on the inlet mercury analyzer to allow remote control of the system on July 31, 2006. The software required another upgrade to version 00.05.20.144 on August 2 to activate the Hydra control capabilities of the software. The system was completely recalibrated with an adjustment in the PMT voltage after the software was installed.

The new Hydra software allows for the switching and control of the three probes, labeled P1 through P3 on the analyzer display screen. P1 is the Unit 8 probe, P2 is the Unit 9 probe, and P3 is the Unit 7 probe with the inlet system configuration. The probe that is currently used for sampling will be displayed on the screen and indicated on the “eyes” of the Hydra creature pictured on the front of the valve control box. The probe selection is changed through the instrument controls menu on the analyzer. Each probe and probe controller can be controlled independently with the component power, temperature and pressure set points, blowback procedure, and calibration procedure all controlled by which ever probe controller is currently selected. The dilution ratio of each probe is only stored in the analyzer software

as a multiplier on the mercury signal so each probe requires recalibration when a switch is made.

The two additional probe controllers and probes were scheduled for startup operation on August 1, 2006. An issue with the power available to the shelter caused the startup to be delayed. The power box in the shelter that is used for all of our instruments was fed with a 40A breaker from the power box that controls the other CEM equipment at Presque Isle. The breaker for our systems tripped and needed continuous reset when the probes were being powered to heat the converter, probe bench, and umbilicals. The plant was able to change out the power supply to our instruments from 40A to 100A on August 24.

As the inlet system made the transition from orifice calibrations to filter calibrations, it was discovered that there could be contamination of the critical orifice as the dilution ratio increased from 30.1 to 76.4 between July 14 and August 4, 2006. While the Unit 8 probe fast loop and critical orifice were being cleaned on August 12, an electrical short caused the system and all power to the CEMS shelter to fail.

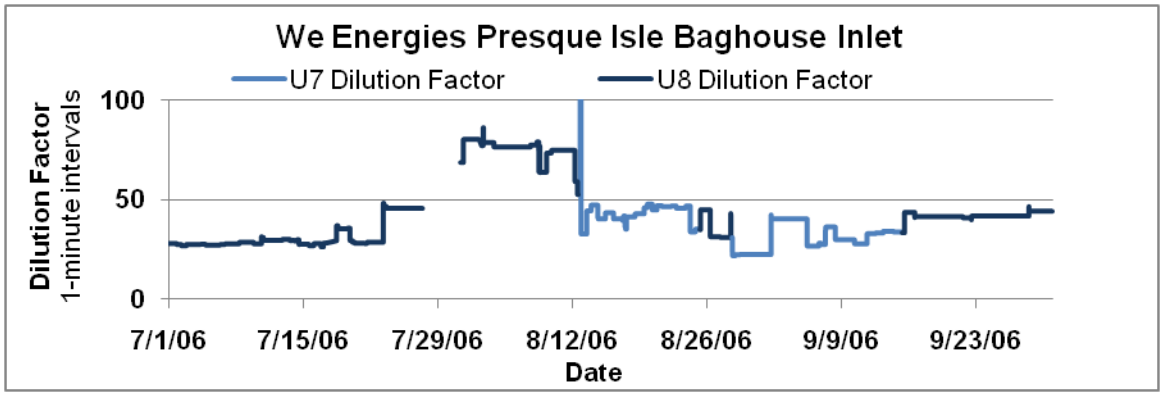


Figure 4-115. PIPP Units 7 and 8 Inlet Mercury Probe Dilution Ratio, 3Q06.

The failure of the Unit 8 probe could not be solved before the start of parametric carbon injection testing so sampling was switched to the Unit 7 probe. The system was not responding to the calibration gas through the filter so the system was calibrated using the responses through the critical orifice. A record of the dilution ratio recorded as the Unit 8 probe was serviced and then sampling switched to the Unit 7 probe can be found in Table 4-40.

Table 4-40. PIPP Units 7 and 8 Inlet Dilution Ratio Adjustments; August 12–13, 2006.

Date	Time	Probe	Event	Dilution Ratio
08/12/06	06:00	Unit 8	Sample mode	74.77
08/12/06	08:20	Unit 8	Install replacement check valve	59.16
08/12/06	15:40	Unit 8	Clean fast loop and filter, recalibrate	52.75
08/12/06	15:47	Unit 8	Unit 8 probe damaged	52.75
08/12/06	23:30	Unit 7	Unit 7 probe operational, recalibrate	32.40
08/13/06	13:45	Unit 7	Full calibration	44.07

During the recalibrations, it was discovered that the calibrator was not maintaining the correct concentration of the output gas as shown in Table 4-41. A set point of 11.0 µg/m³ would display a concentration of 10.3 µg/m³ on the screen, while a set point of 5.0 µg/m³ would calculate the output as 4.4 µg/m³. None of the corrective actions taken at the recommendations of Thermo would correct the calibrator and it was returned to Thermo for service on August 15, 2006.

Table 4-41. PIPP Units 7–9 Inlet Calibrator Output Error; August 15, 2006.

Date	Time	Target Output	Calibrator Display	Analyzer Response	Hg Flow Rate	Dilution Flow Rate
08/15/06	09:13	10.0	11.5	8.6	14.49 sccm	10.01 LPM
08/15/06	09:20	5.0	4.0	4.3	7.16 sccm	12.61 LPM
08/15/06	09:24	15.0	20.7	12.9	24.95 sccm	9.07 LPM

During the time that the inlet calibrator was being repaired, the mercury calibrator installed with the outlet system was physically transported to the inlet shelter every morning for connection into the system for recalibration. The exact problem with the defective mercury calibrator could not be determined and Thermo sent a different mercury calibrator back to Presque Isle for installation at the inlet on August 17, 2006.

Analysis of the data collected during calibrations showed that the orifice pressure during an orifice calibration was 4.2 psig and only 0.1 psig during sample mode. If the orifice pressure is much higher than sample mode, it will lead to inaccurate concentrations and calibrations. Thermo recommended that the check valve inside the calibration should be adjusted such that the orifice pressure during orifice calibrations is approximately 1.0 psig greater than measured during sample mode. The check valve was adjusted such that the orifice pressure during an orifice span was 1.2 psig and that resulted in a dilution ratio of 44–47.

Several experiments were performed to identify the effects of orifice pressure increases on the ability to get consistent calibration responses during orifice calibrations. The discoveries made while switching between the two calibrators and continuous adjustments made to the orifice pressure during orifice calibrations demonstrated that the calibration pressure affects the span responses and the ability to measure accurate mercury concentrations. Thermo has recommended that the increase in orifice pressure be kept to a minimum and should not exceed 1–2 psig higher than the orifice pressure in sample mode. Table 4-48 indicates that the dilution ratio decreases as the orifice pressure increases because the increase in pressure changes the operating specifications of the critical flow orifice upstream of the dilution module in the mercury probe.

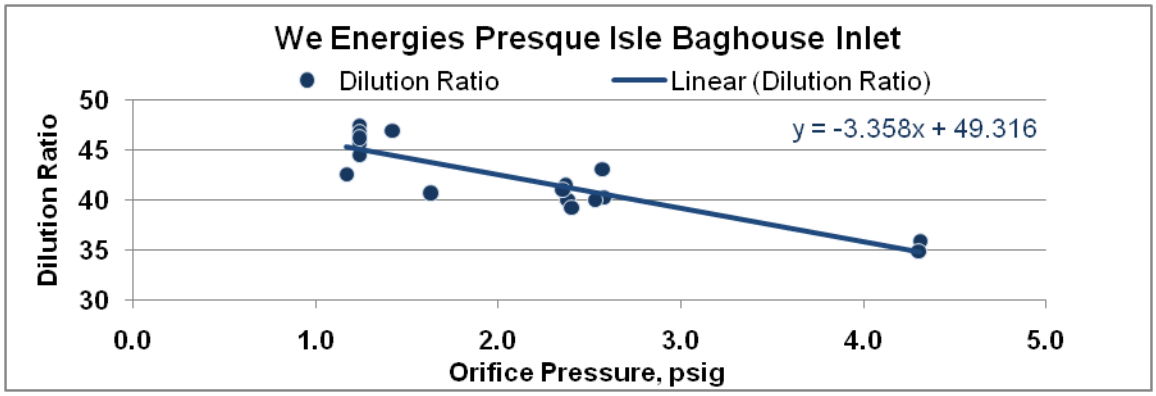


Figure 4-116. PIPP Unit 8 Inlet Mercury Probe Orifice Pressure and Dilution Ratio.

An electrical short was discovered with the actuator valve relay that was installed during the retrofit upgrade of the Unit 8 probe. At the time of the repair activities, Unit 7 went offline and sampling was switched to the repaired Unit 8 probe. The Unit 8 inlet mercury probe was powered up and put back into operation on August 25, 2006. A few days after the Unit 8

probe was put back into operation, the unit went offline and sampling was switched to the Unit 7 probe on August 28.

The mercury concentrations collected from the Unit 8 probe were more stable than the measurements from the Unit 7 probe. This is due to the air pressures being corrected on the Unit 8 probe on May 10 but not adjusted to proper set points for the Unit 7 probe when the switch to sampling from a different unit was made on August 12. The dilution air pressure was unstable while sampling from the Unit 7 probe on August 12–14 and September 6–15 as shown in Figure 4-117.

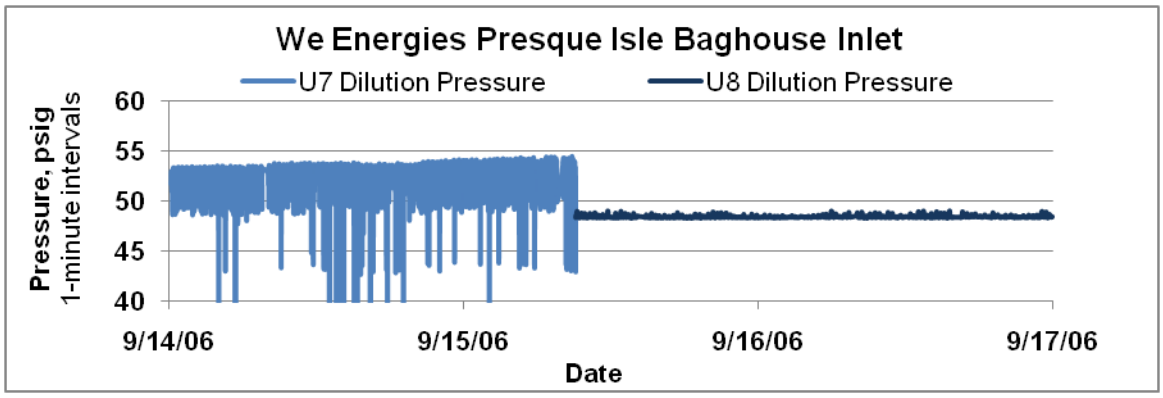


Figure 4-117. PIPP Units 7 and 8 Inlet Mercury Probe Dilution Pressure; September 14–17, 2006.

The inlet mercury system did not have the ability to record the dilution flow rate that would be helpful to perform a true calculation and analysis of the dilution ratio of the probe. The probe controller only records the dilution air pressure so an external mass flow meter was installed on the back of the Unit 8 probe controller to record the flow rate of the dilution air in addition to the dilution pressure. The analog signal from the external meter was connected to the analyzer data terminal located at the back of the instrument and allowed the flow rate to be recorded by the internal data logger of the analyzer. The analysis of the flow rate to the probe allowed for additional diagnostics of the system to make sure that the probe is functioning properly. The first set of data collected from the external mass flow meter via the analog input #1 channel on the analyzer is shown in Figure 4-118. Additional analysis and quality assurance of the system was maintained by monitoring for any changes in the measured flow rate of the dilution air during normal operation of the system.

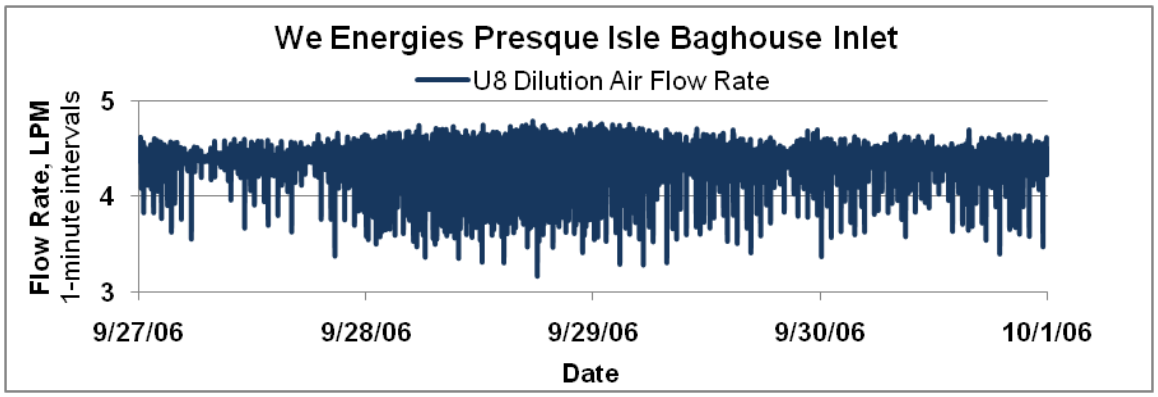


Figure 4-118. PIPP Unit 8 Inlet Mercury Probe Dilution Air Flow Rate; September 26-30, 2006.

The Unit 7 probe controller measured very large temperature fluctuations for the converter, umbilical, and probe bench that were well beyond acceptable deviations. The Unit 7 probe controller was not equipped with the grounded thermocouple adapters to reduce the signal noise and the difference between the Unit 7 and Unit 8 probe controllers was obvious. Although the swings in the temperature data were large, the temperatures appeared to be correct when considering the average of the temperature measurements over time. The magnitude of the signal noise for the probe temperature is displayed in Figure 4-119.

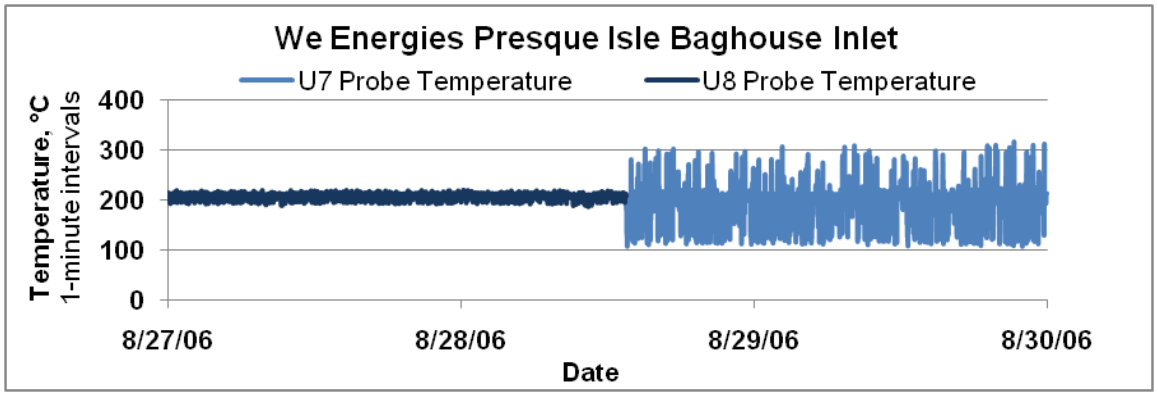


Figure 4-119. PIPP Units 7 and 8 Inlet Mercury Probe Temperature; August 27–30, 2006.

The operating specifications of the analyzer and the calibrator state they be operated at temperatures below 35 ºC in order for the instruments to function correctly but they may be safely operated up to a temperature of 45 ºC. Operating the instruments at temperatures which exceed 40 ºC causes a serious degradation of integrity of the data collected by the mercury CEMS. The air conditioning unit of the inlet mercury CEMS shelter failed on

July 31, 2006, and internal temperatures increased to above 43 ºC. This can cause the intensity of the lamp to become unstable as temperatures change and the calibrator cannot maintain a proper mercury chamber temperature in order to perform valid calibrations. Figure 4-120 shows the increase of internal temperature on July 31.

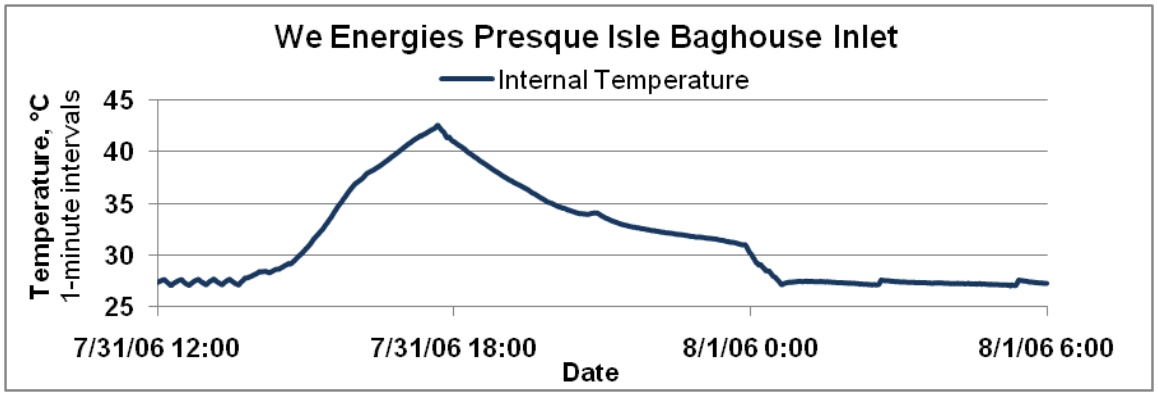


Figure 4-120. PIPP Units 7–9 Inlet Analyzer Internal Temperature; July 31–August 1, 2006.

The analyzer periodically requires recalibration as the intensity of the light emitted from the UV lamp degrades over time. As the lamp intensity decreases, the multiplier applied to the mercury signal observed by the analyzer needs to be increased. This is often indicated by an increasing calibration coefficient value. The analyzer software will not allow the coefficients to be set greater than 2.0 during recalibration. On September 21, 2006, the total coefficient value had increased to 1.871 and the decision was made to increase the PMT voltage in order to decrease the total coefficient to a more acceptable value. The PMT voltage was adjusted from 1015V to 1050V and the total coefficient was reduced to 1.547. The change in the PMT voltage is displayed in Figure 4-121.

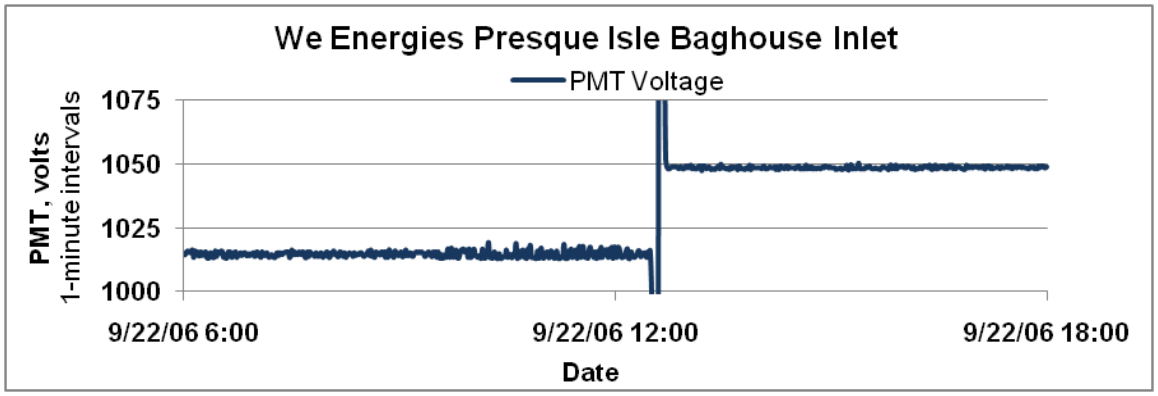


Figure 4-121. PIPP Units 7–9 Inlet Analyzer PMT Voltage; September 22, 2006.

In order to correct the inability of the system to perform filter calibrations and only able to be calibrated by sending zero and span gas upstream of the orifice, the inertial filters in the Unit 7 and Unit 9 probes were replaced on September 7, 2006. The problem with the original inertial filters that were in the two new probes was that the filters were improperly coated and the error was not discovered until the probes were already mounted to the inlet duct. The error with the coating was allowing valid mercury concentrations collected during sample mode but the filter would capture the mercury when trying to pass span gas through the filter.

When the filter is sampling flue gas, it is exposed to moisture from the duct. The moisture is captured by the small pores in the filter. When dry calibration gas passes through the filter, the moisture that was captured by the filter is released and mercury is captured by the pores instead. A properly coated inertial filter would decrease the amount of pores on the filter and limit the amount of moisture or mercury that can be captured by the filter. Thermo had discovered this error after the probes with the incorrectly coated filters were already installed. After the bad filters were replaced with properly coated filters, the responses to the filter calibration cycle were more accurate. The system was configured to perform filter calibrations instead of orifice calibrations as of September 8, 2006.

Parametric tests of PAC were performed in August 2006 before the filter calibrations could be utilized and this introduced errors into the mercury measurements. Due to the errors with the inlet system during the parametric tests, the data collected by the mercury system required correction in order to calculate the correct removal percentages of each activated carbon.

The check valve installed in the calibrator was installed incorrectly and caused an erroneous dilution ratio for Unit 8 in early August. The valve was fixed and a corrected dilution ratio calculated after the first valid calibration check was applied to the data collected when the valve was not installed correctly.

The calibration background factor was not set correctly using the orifice calibration. There was a 0.8–1.0 $\mu g/m^3$ difference between the analyzer zero response and the orifice zero

response. When the basis is not consistent, the resulting calculated mercury concentration shifts by the difference in the background.

The check valve in the exhaust line of the calibrator was set for two much restriction on August 24. This put too much pressure on the sampling orifice and forced too much flow through the orifice during calibrations. The result was a low dilution factor applied to the measured mercury and a measured mercury concentration which is biased low.

Filter calibrations on the inlet mercury system were possible starting on September 8, 2006. The benefits of the filter calibrations are a more accurate zero and span gas response as the gases pass through the inertial filter and avoid any bias due to over pressurization by the calibrator. The recovery through the filter was calculated to be approximately 20% lower than the orifice calibration.

All of the corrections were applied to the mercury concentration data collected during the parametric carbon injection tests to provide a more reliable removal efficiency of each activated carbon. The result of the data correction can be found in Figure 4-122. The correction resulted in a more stable and accurate mercury concentration measured at the baghouse inlet location.

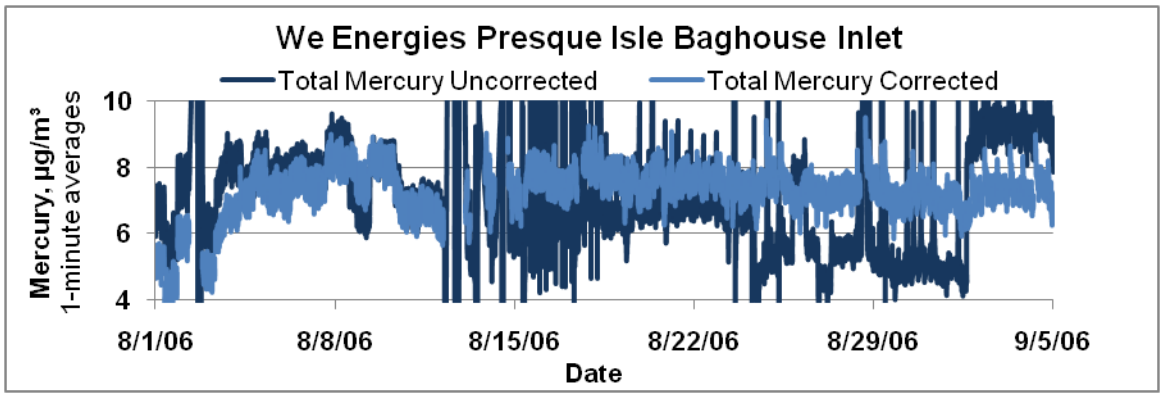


Figure 4-122. PIPP Units 7–9 Inlet Mercury CEMS Corrected Data, August–September 2006.

The inlet mercury system was configured to sample total and elemental mercury from the Unit 8 duct on September 28, 2006, to test the performance of the CEMS when sampling

from both channels. The system would operate in this condition through the end of the third quarter and analysis would continue into the fourth quarter.

4.15.9.1.4 Baghouse Inlet –Fourth Quarter 2006

The concentrations measured by the mercury system for the fourth quarter of 2006 can be found in Figure 4-123. Most of the data collected by the inlet mercury system was from the total channel only during the fourth quarter of 2006. Very limited speciation data was collected as an experiment on the functionality of the speciation mode of the mercury system.

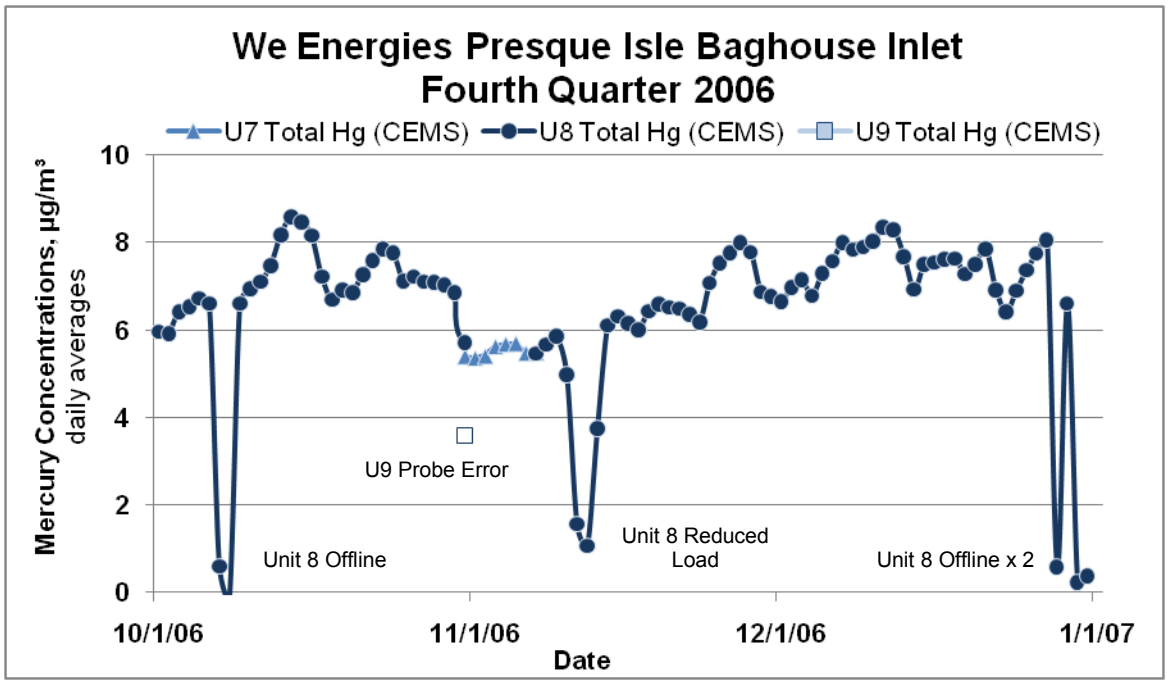


Figure 4-123. PIPP Units 7–9 Inlet Total Mercury Concentrations, 4Q06.

Total and elemental mercury measurements was collected from the Unit 8 probe from September 28 to October 11, 2006, as an experiment on the functionality of the speciation mode of the mercury system. The list of the probe configurations for the quarter is shown in Table 4-42.

Table 4-42. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 4Q06.

Start Date	End Date	Total Channel	Elemental Channel
10/01/06 00:00	10/11/06 10:13	Unit 8 Total Hg	Unit 8 Elemental Hg
10/11/06 10:13	10/31/06 08:40	Unit 8 Total Hg	None
10/31/06 08:41	10/31/06 14:32	Unit 9 Total Hg	None
10/31/06 14:33	11/07/06 16:51	Unit 7 Total Hg	None
11/07/06 16:52	12/31/06 23:59	Unit 8 Total Hg	None

After the upgrades and modifications to the system in the third quarter of 2006, the inlet mercury system was allowed to operate under stable conditions from October through December. The practice of using the Hydra system to switch quickly from one unit to another was performed on October 31 when the Unit 8 boiler was scheduled to operate at a reduced load for a couple of weeks due to problems with the coal mill. The inlet system was sampling from the Unit 8 duct but sampling was switched to the Unit 9 probe in order to keep full-load mercury measurements. Sampling of flue gas from the Unit 9 probe was for an extremely brief period because the system could not be calibrated due to a stuck isolation valve in the probe. Therefore, sampling was switched to the Unit 7 probe on October 31.

The inlet system measured mercury concentrations from the Unit 7 probe until November 11, 2006, when it was switched back to the Unit 8 probe. The concentrations from the Unit 7 probe were more unstable and less accurate than acceptable. This was caused by the extreme fluctuations in the probe bench temperature measurements recorded by the analyzer. The system is designed with a failsafe to protect the components of the probe when the temperature of the probe is below a specific temperature. When the temperature is measured to be below that level, the eductor air and dilution air is turned off to the probe to prevent a cold probe from drawing flue gas into the fast loop. The failsafe temperature was set to 160 °C but the noise of the thermocouple signal often indicated that the temperature of the probe bench was below the failsafe temperature. Reducing the failsafe temperature would put the components in jeopardy if power were lost to the probe heaters so the decision was

made to switch back to the Unit 8 probe as soon as the Unit 8 boiler was online. The comparison of the Unit 7 probe bench temperature and the failsafe temperature is shown in Figure 4-124.

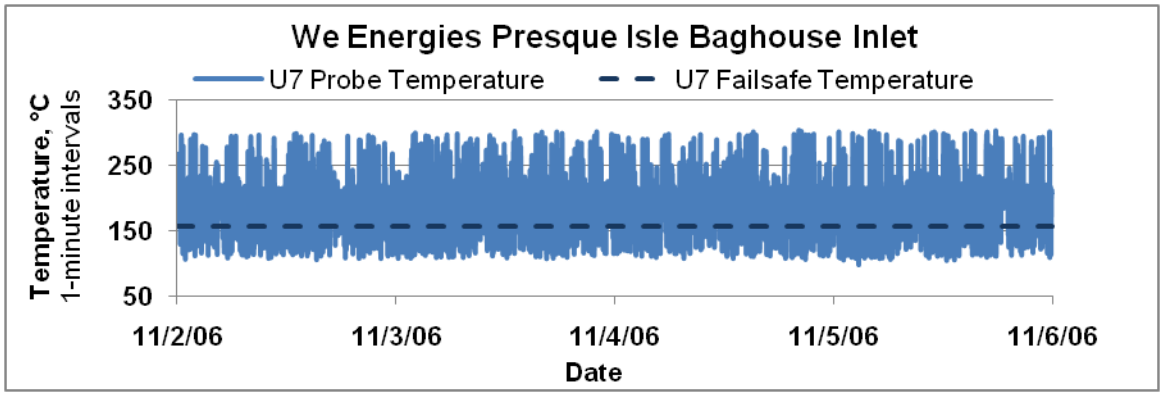


Figure 4-124. PIPP Unit 7 Inlet CEMS Probe and Failsafe Temperatures; November 2–6, 2006.

The chamber pressure of the inlet mercury CEMS increased from 23 mmHg to 50 mmHg between October 10 and November 10, 2006. A spare vacuum pump was available for the Presque Isle personnel to make the replacement on November 11. The absolute vacuum that the sample pumps are expected to hold through the analyzer was expected to increase as it is continuously in use by the system. The replacement of the pump was determined to be a typical maintenance issue and rebuild kits were available to return the worn sample pump back to original operating specifications. The sample pump usually loses its ability to hold a stable vacuum slowly but it does have an impact on the stability of the daily calibrations over time because the pressure inside the detection chamber of the analyzer is dependent on a stable pressure. The slow increase of the chamber pressure and the corrective action is shown in Figure 4-125.

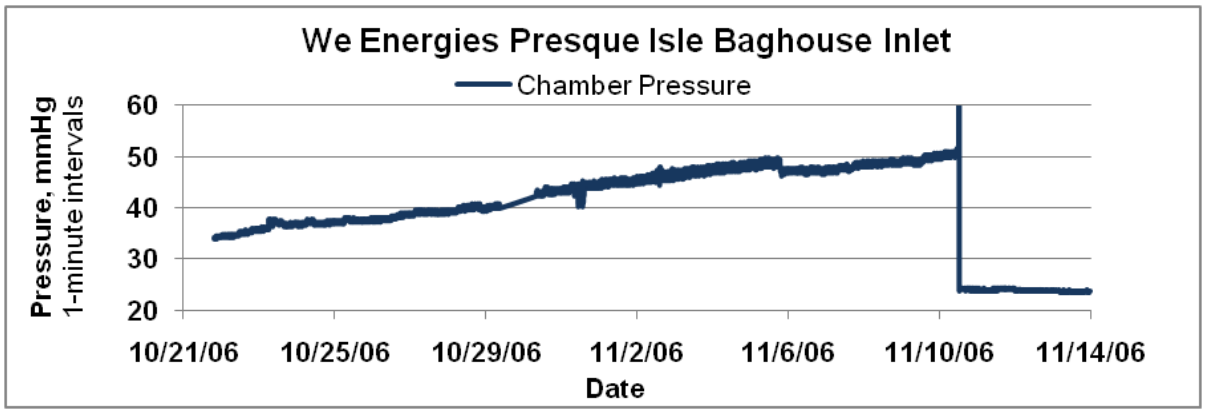


Figure 4-125. PIPP Unit 8 Inlet Chamber Pressure, October–November 2006.

The inlet mercury system was configured to sample speciated mercury from the Unit 8 duct from September 28 to October 11, 2006. This was the first long-term test of the abilities of the mercury system to measure total and elemental mercury concentrations at the baghouse inlet location. The concentrations measured by the analyzer during the speciated mercury test are displayed in Figure 4-126. Unit 8 was temporarily offline on October 7–8.

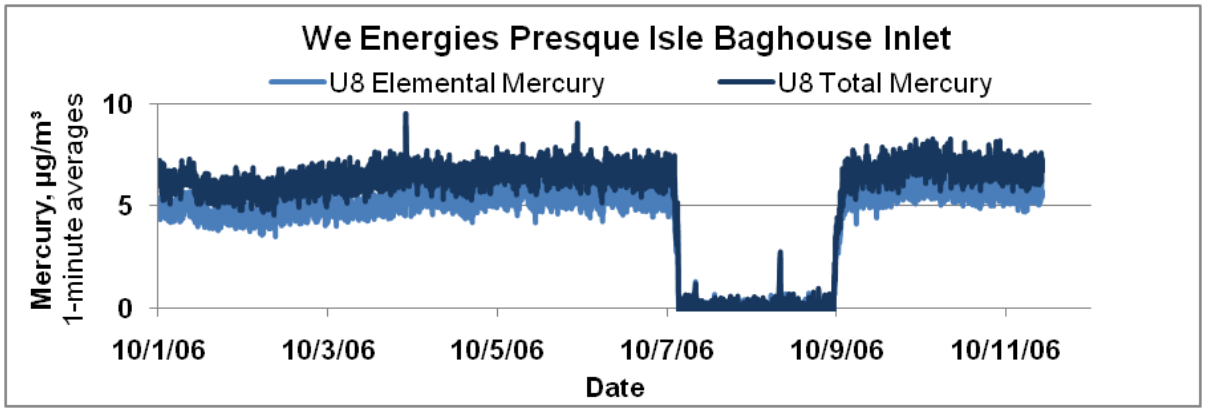


Figure 4-126. PIPP Unit 8 Inlet Total and Elemental Mercury; October 1–11, 2006.

When the analyzer was collecting data in speciation mode, the calibration gas responses were observed for the total and elemental channels independently. Although the criteria that the calibration check must satisfy are based only on the total mercury response to zero and span gas, it was important to record the elemental mercury responses while sampling in speciation mode. The calibrator was designed to output a known concentration of elemental mercury and therefore both the total and elemental channels should respond identically to the elemental calibration gas. The elemental and total calibration factors of the Thermo mercury

analyzer are dependent on each other so both responses must be taken in to consideration when performing recalibration or data correction activities.

The inlet mercury system was configured to sample speciated mercury from September 28 to October 11, 2006. The total mercury responses to the zero and span gas was closely monitored and satisfied all of the requirements of CAMR criteria as recorded in Table 4-43. However, the elemental responses to the calibration gas were poor as the calibration error was higher than what was acceptable. The elemental zero and span gas responses are recorded in Table 4-44.

Table 4-43. PIPP Unit 8 Inlet Total Mercury Check Responses; September 29–October 3, 2006.

Date	Time	Span	Level	Zero Response		Cal Response		Result
09/29/06	7:36	20.0	11.0	-0.35	-1.8%	11.34	+1.7%	PASS
09/30/06	7:36	20.0	11.0	-0.51	-2.5%	11.03	+0.2%	PASS
10/01/06	7:36	20.0	11.0	-0.18	-0.9%	11.47	+2.4%	PASS
10/02/06	7:36	20.0	11.0	-0.45	-2.3%	10.15	-4.3%	PASS
10/03/06	7:36	20.0	11.0	0.36	+1.8%	10.80	-1.0%	PASS

Table 4-44. PIPP Unit 8 Inlet Elemental Mercury Check Responses; September 29–October 3, 2006.

Date	Time	Span	Level	Zero Response		Cal Response		Result
09/29/06	7:36	20.0	11.0	0.24	+1.2%	8.99	-10.1%	FAIL
09/30/06	7:36	20.0	11.0	0.57	+2.8%	9.14	-9.3%	FAIL
10/01/06	7:36	20.0	11.0	0.81	+4.0%	8.02	-14.9%	FAIL
10/02/06	7:36	20.0	11.0	0.09	+0.5%	8.26	-13.7%	FAIL
10/03/06	7:36	20.0	11.0	0.52	+2.6%	8.62	-11.9%	FAIL

Despite the occasional failures of the inlet mercury CEMS to pass each daily calibration check and automatically correct the calibration factors in the event of any failed calibration responses, the data was routinely analyzed and corrected by ADA-ES based on the responses.

Data was collected by the analyzer and downloaded daily by ADA-ES operating from an off-site computer. Based on the zero and span gas responses during a valid calibration check, the calibration factors were adjusted and applied to the mercury concentration data to provide the most accurate mercury measurements possible. The calibration factors saved in the analyzer software, however, were not always updated and resulted in several uncorrected calibration check failures.

By calculating the background and coefficient factors that would result in a perfect calibration response, the mercury concentration data were corrected using the calculated calibration factors. This allowed the data to be corrected "instantaneously" in the data file based on any daily fluctuations in the calibration responses. The corrected mercury concentrations were used in all reported mercury concentrations and removal calculations. An example of the comparison between uncorrected data captured by the analyzer and the corrected data based on calibration factors can be found in Figure 4-127.

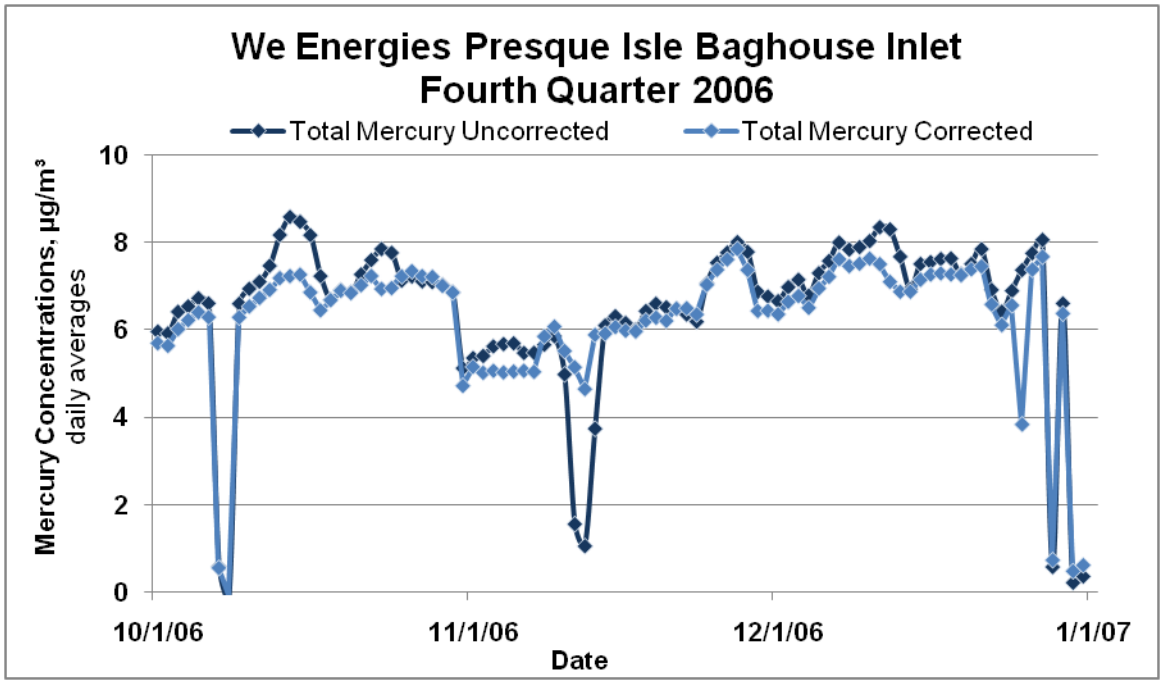


Figure 4-127. PIPP Units 7–9 Inlet Total Mercury Corrected Concentrations, 4Q06.

As the upgraded inlet mercury CEMS entered the first full quarter of stable operation, the quality control and quality assurance program was officially developed to maintain and validate the data collected by the mercury analyzer.

4.15.9.1.5 Baghouse Inlet – First Quarter 2007

The Thermo mercury CEMS located at the baghouse inlet continued to be monitored for long-term operation for the first quarter of 2007. Due to outstanding issues with the Unit 7 and Unit 9 probes, Unit 8 offline for part of the quarter, and sorbent screening tests on January 26–29, the data collected at the baghouse inlet was punctuated by numerous sections of invalid data.

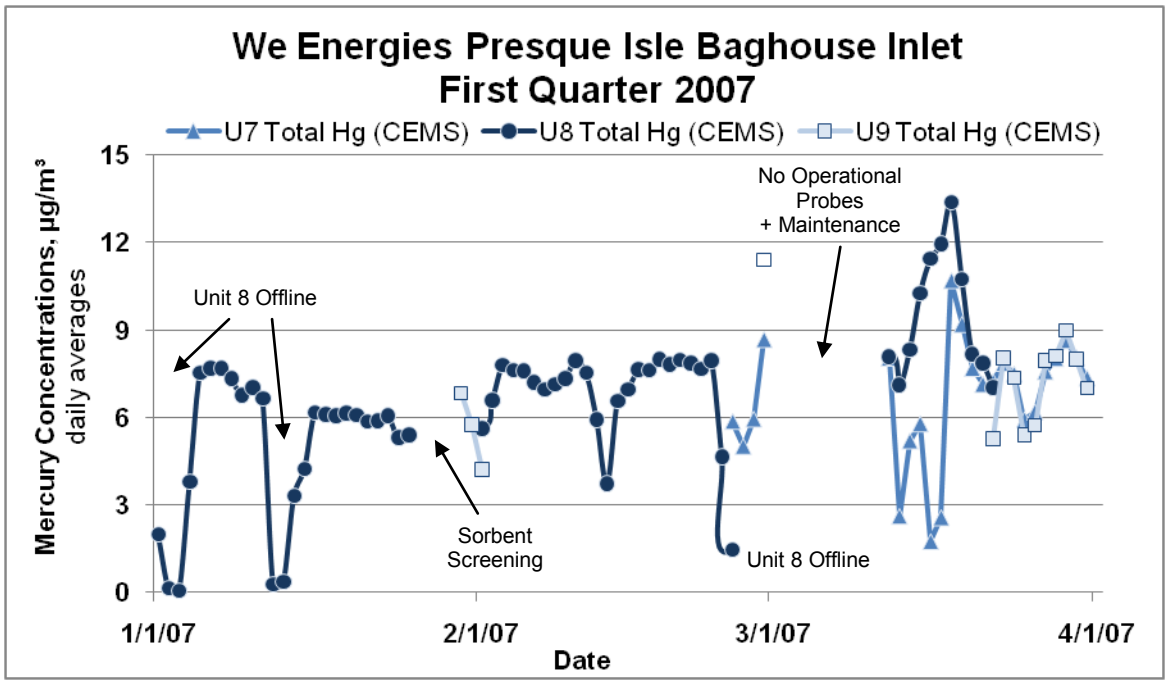


Figure 4-128. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q07.

The ability of the Hydra valve box to switch between three different probes was put into use during the first quarter of 2007. Each one of the three probes was selected to record total mercury concentrations depending on if the unit was online or offline. This function could be controlled through the analyzer software that allowed for remote control of the system. Total and elemental mercury was collected from the Unit 8 probe in March but when the Unit 8 boiler went offline, sampling was configured to collect total mercury from the Unit 9 probe on the total channel and total mercury from the Unit 7 probe on the elemental channel. The simultaneous sampling of total from two different probes was an expansion on the original design of the Hydra valve box. The list of the probe configurations for the quarter is shown in Table 4-45.

Table 4-45. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 1Q07.

Start Date	End Date	Total Channel	Elemental Channel
01/01/07 00:00	01/26/07 08:53	Unit 8 Total Hg	None
01/26/07 08:54	01/29/07 15:35	Sorbent Screening Tests	
01/30/07 14:40	02/01/07 19:04	Unit 9 Total Hg	None
02/01/07 19:05	02/25/07 20:23	Unit 8 Total Hg	None
02/25/07 20:43	02/28/07 13:40	Unit 7 Total Hg	None
02/28/07 13:41	03/12/07 15:19	Unit 9 Total Hg	None
03/13/07 16:10	03/22/07 12:25	Unit 8 Total Hg	Unit 7 Total Hg
03/23/07 14:46	03/31/07 23:59	Unit 9 Total Hg	Unit 7 Total Hg

The temperatures recorded by the mercury analyzer were unstable since installation and this especially proved difficult to sample from the Unit 7 probe because the probe temperature would often fluctuate below the failsafe temperature causing the dilution and eductor air to turn off. Several solutions to stabilize this temperature had failed and Thermo redesigned the probe controller interface boards to stabilize the thermocouple temperatures from the probe and umbilical. The new boards were installed in all three of the probe controllers at the inlet on January 23, 2007. The immediate effect that the new controller boards had on the Unit 8 probe bench temperature measurements can be found in Table 4-60. A direct comparison of the probe temperatures from 24 hours of data from the Unit 7 probe is shown in Figure 4-129.

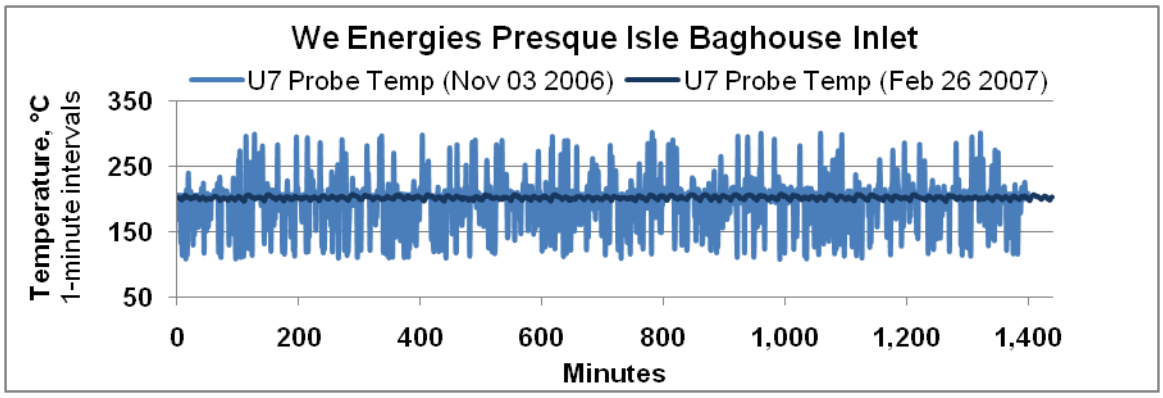


Figure 4-129. PIPP Unit 7 Probe Bench Temperature Comparisons; February 26, 2007.

The mercury lamp inside the analyzer had degraded to 21,200 Hz by February 2007. The level in which Thermo recommends replacement of the mercury lamp is when the intensity is below 20,000 Hz so the lamp was replaced on February 24. Note that the unit of measure of the mercury lamp intensity is represented as a frequency in Hertz. The voltage associated with the light measured by the detector is converted to a frequency so the signal is transported to the interface board with less electronic interference. Figure 4-130 is a chart representing the change in lamp intensity during replacement.

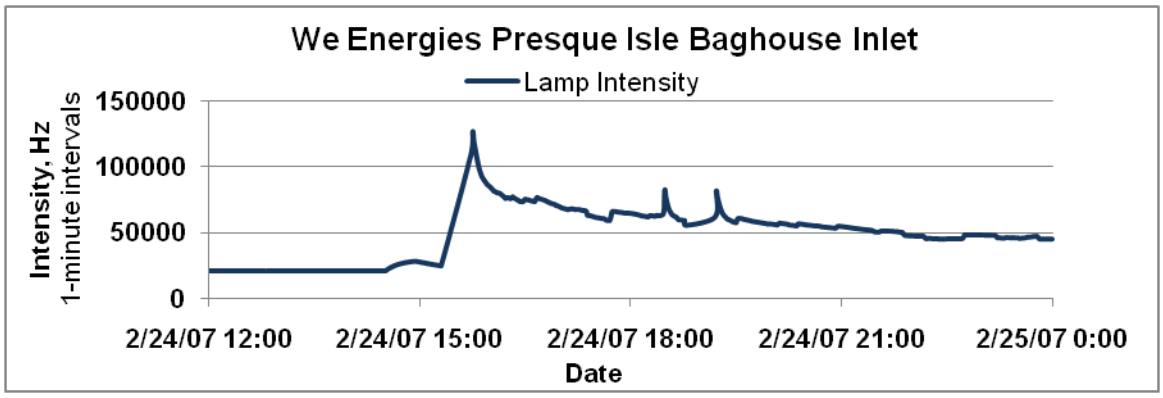


Figure 4-130. PIPP Units 7–9 Mercury Analyzer Lamp Intensity; February 24, 2007.

Along with the replacement of the mercury lamp, other maintenance was performed on the optics and detection chamber of the mercury analyzer at the baghouse inlet. The background measured by the analyzer during an instrument zero response had increased to between 2.0 and 6.0 µg/m³. This was extremely high for a background calibration factor and it indicated a problem because a typical background value is less than 1.0 µg/m³. To correct this error, the photomultiplier tube (PMT) was replaced and the detection cell was cleaned on February 24, 2007. The initial design of the analyzer optics bench called for a solar blind filter to be installed in front of the PMT; however, the newest model of the PMT does not require an additional solar blind filter as one is built into the PMT. The solar blind filter is designed to prevent any response of the PMT from visible light and improve the transmission of UV light but there were questions if the solar blind filter was causing excessive noise on the inlet mercury measurements due to a high PMT voltage setting. Because of the removal of the solar blind filter, the PMT voltage was reduced to 832V and the system background calibration factor decreased to 0.85 µg/m³. The changes to the PMT voltage after the solar blind filter was removed are shown in Figure 4-131.

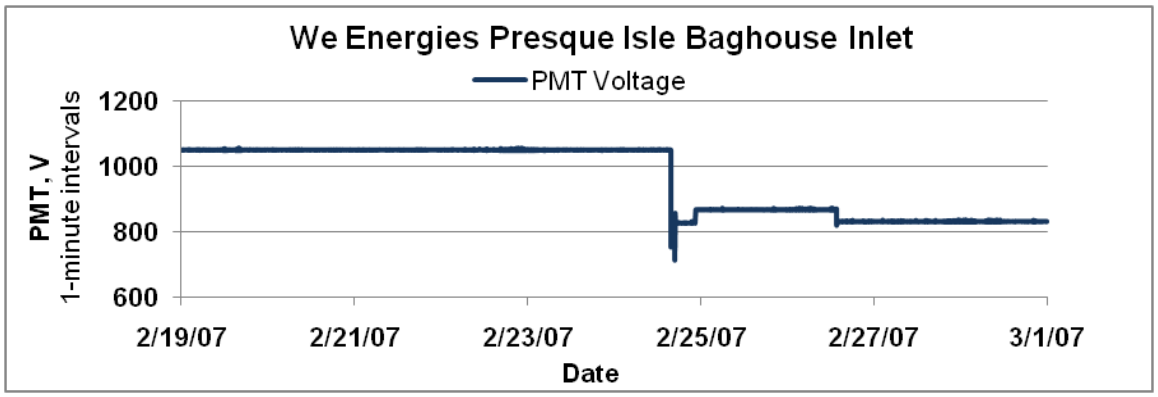


Figure 4-131. PIPP Units 7–9 Mercury Analyzer PMT Voltage Adjustment, February 2007.

The analyzer and calibrator software was upgraded on February 25, 2007. The new version of the analyzer software was 00.05.50.174 and the new calibrator software was version 00.04.39.042. The software for the analyzer and calibrator was upgraded again before the end of the quarter, with the analyzer upgraded to version 00.05.68.192 and the calibrator was upgraded to 00.04.54.058 on March 13. The newest software version made some major changes to the functions of the mercury CEMS. In previous versions of the software, the instrument calibration routine and the system calibration routine shared the same set of calibration factors. The only way to calibrate the system was to change the dilution ratio while sending calibration gas to the probe. This new version of the software created two sets of calibration factors (backgrounds and coefficients) so the instrument factors could be different from the system factors. This allowed the dilution ratio to remain constant while changing only the coefficients during a manual system recalibration. The new analyzer software also allowed for automatic calibration checks while in speciation sampling mode.

The analyzer software allowed mercury measurements to be compensated based on the drift in lamp intensity and changed in temperature and pressure inside the analyzer. When the system was installed in 2006, the lamp compensation and temperature compensation were turned on. As the software development progressed, Thermo advised that only the lamp compensation should be turned on as the pressure and temperature compensations did not work correctly. Starting in February 2007, the system was configured to use only lamp compensation at all times.

After the first software upgrade on February 25, 2007, the daily calibration check was not functioning properly and a true calibration response could not be recorded. In addition to the problems with the analyzer software, the Unit 7 probe experienced an electrical short on March 1 and the umbilical was unable to heat. The Unit 8 probe was not responsive to system calibrations and it was suspected that there was a loose fitting or cracked weld between the filter and the sampling cross since the old method of performing orifice calibrations was still creating a response. Unit 9 was offline in March 2007 and therefore no sampling can be collected from the duct. The problems experienced with the inlet system resulted in no mercury concentrations measured from the baghouse inlet from February 28 to March 12.

On-site maintenance activities were performed on March 12–14, 2007. An electrical short was discovered and corrected in the Unit 8 probe that allowed the system to sample mercury again. There was also an electrical short in the Unit 7 probe as the wires to control the actuator valve had shorted against the probe heater firerods inside the probe. The wires were repaired and repositioned inside the Unit 7 probe to prevent future electrical problems. The plumbing of the Unit 7 sample lines were also not plumbed correctly to the Hydra valve box and required repair before any mercury concentrations from Unit 7 could be collected.

The configuration of the Hydra valve box was modified on March 13, 2007, to allow the total channel to measure total mercury from the Unit 8 probe and the elemental channel to measure total mercury from the Unit 7 probe. In this configuration, it was possible to measure total mercury from two different units simultaneously. The simultaneous total mercury concentrations measured from Unit 7 and Unit 8 is shown in Figure 4-132.

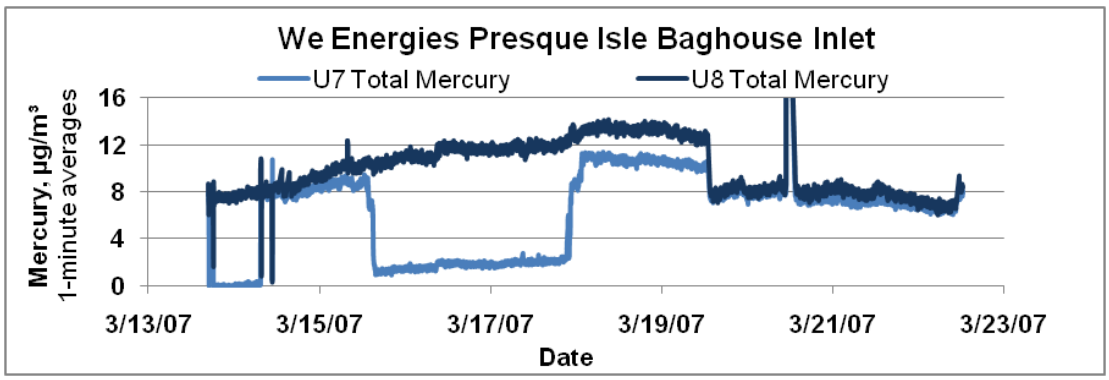


Figure 4-132. PIPP Units 7 and 8 Simultaneous Total Mercury, March 2007.

The system experienced significant zero drift of nearly +5.0 µg/m³ from March 15–20, 2007, as the system was left to condition after the maintenance activities of March 12–14. This increase in the zero response caused the concentrations to be measured from the Unit 7 and Unit 8 baghouse inlet ducts to be incorrect and higher than expected. The drift of the system was corrected on March 19 and the mercury concentrations measured were more accurate through March 23.

Unit 8 went into an outage on March 23, 2007, and the probe sampling at the inlet was changed to measure mercury concentrations from the Unit 9 and Unit 7 probes. This was accomplished by using the Hydra valve box to switch the sampling from the Unit 8 probe to the Unit 9 probe while the Unit 7 sample line was plumbed directly into the back of the analyzer on the elemental channel. The comparison of the mercury concentrations from Unit 7 and Unit 9 can be found in Figure 4-133. The calibration responses were extremely unstable during this period as manual recalibrations were performed on March 27, 28, and 30 to correct for the increasing drift of the zero response.

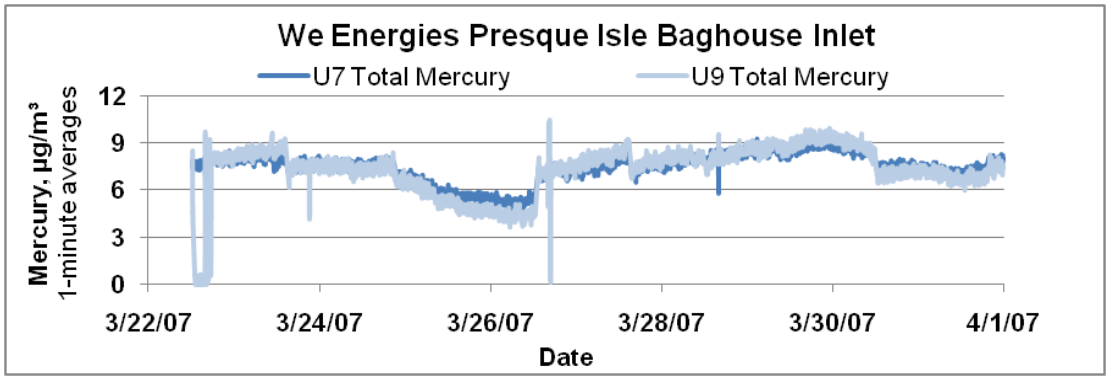


Figure 4-133. PIPP Units 7 and 9 Simultaneous Total Mercury, March 2007.

4.15.9.1.6 Baghouse Inlet – Second Quarter 2007

The baghouse inlet mercury CEMS started the second quarter of 2007 measuring total mercury from Unit 9 on the total sampling channel and total mercury from the Unit 7 probe on the elemental sampling channel. The inlet mercury system experienced a long period of uninterrupted operation during the quarter.

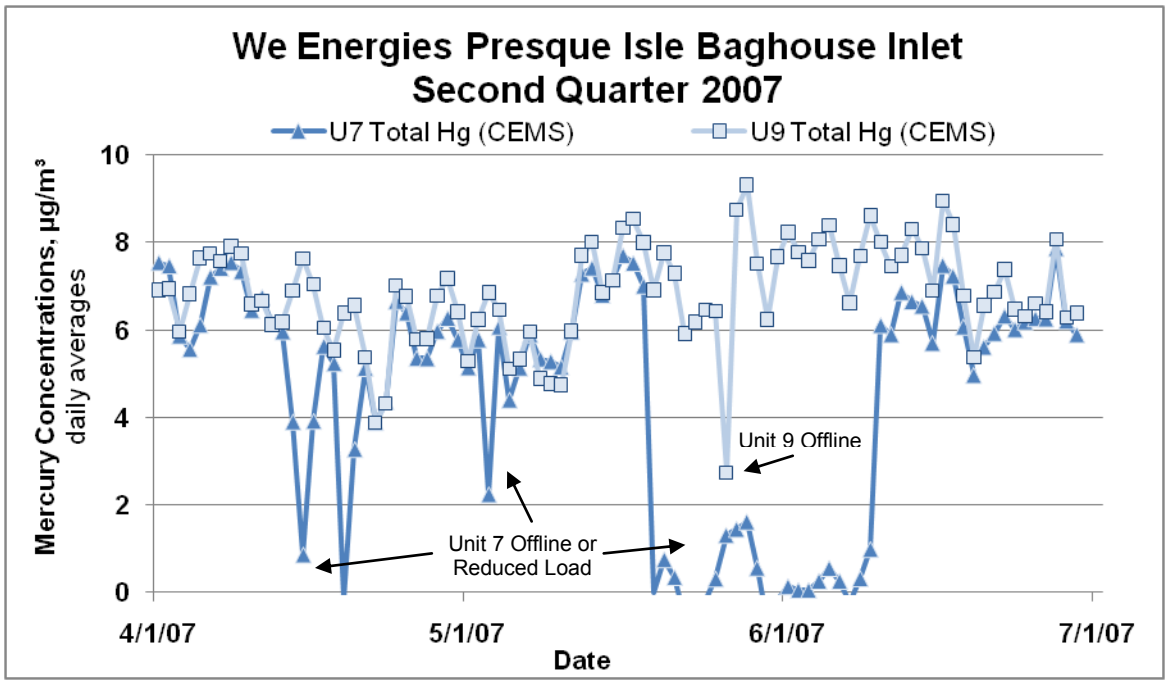


Figure 4-134. PIPP Units 7–9 Inlet Total Mercury Concentrations, 2Q07.

The inlet system was configured to sample total mercury from the Unit 9 inlet duct on the total channel and total mercury from the Unit 7 inlet duct on the elemental channel of the analyzer. This configuration was not changed for the entire second quarter of 2007 despite the Unit 7 boiler being in an outage for part of the quarter. The list of the probe configurations for the quarter is shown in Table 4-46.

Table 4-46. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 2Q07.

Start Date	End Date	Total Channel	Elemental Channel
04/01/07 00:00	06/30/07 23:59	Unit 9 Total Hg	Unit 7 Total Hg

Mercury concentration data was not collected due to on-site maintenance performed on the Unit 9 probe eductor and venturi on April 3–5, 2007. The Unit 9 probe had become filled with ash from the duct and the eductor was not able to pull gas out of the duct and into the plugged fast loop of the probe. The maintenance activities were successful to repair the probe and the eductor was turned on April 6 following the cleaning of the probe.

The mercury concentrations and the responses to the zero and span gas continued to be unstable. A successful installation of a nitrogen generator at the outlet sampling location proved to be very beneficial to the stability and accuracy of the mercury system. An order was placed with Thermo for a nitrogen generator for the inlet system and delivery was expected for the third quarter of 2007. Thermo also recommended a method to hydrate the zero and calibration air sent to the probe during the calibration routine. The hydration of the calibration gas would prevent a change of the operating condition of the inertial filter and prevent interference with the calibration responses. An example of the total mercury calibration responses from May 2–7 can be found in Table 4-47.

Table 4-47. PIPP Unit 9 Inlet Total Mercury Calibration Responses; May 2–7, 2007.

Date	Time	Span	Level	Zero Response		Cal Response		Result
05/02/07	07:40	20.0	11.0	0.02	+0.1%	11.05	+0.3%	PASS
05/03/07	07:40	20.0	11.0	0.88	+4.4%	11.40	+2.0%	PASS
05/04/07	07:40	20.0	11.0	1.65	+8.3%	12.06	+5.3%	FAIL
05/05/07	07:40	20.0	11.0	-0.27	-1.4%	10.35	-3.3%	PASS
05/06/07	07:40	20.0	11.0	-1.10	-5.5%	9.84	-5.8%	FAIL
05/07/07	07:40	20.0	11.0	0.35	+1.8%	11.54	+2.7%	PASS

Because of the inconsistent responses to the zero and span gas, the system was programmed to perform frequent instrument calibration checks to determine if the drift measured by the system is related to the performance of the instrument itself (detection cell) or the entire system (probe and umbilical). In addition to the normal daily system calibration checks, the CEMS performed instrument calibration checks every three hours on May 7–11, 2007. Out

of the 32 instrument calibration checks performed over the five days, all of the calibration zero responses were between +0.5% and +0.7% error. The instrument calibration responses to a span gas of 5.0 µg/m³ were between -1.4% and -2.1% error. This resulted in a very tight calibration error range for the instrument zero and span responses. In contrast, the system calibration responses from May 7–11 ranged from a zero error of -4.9% to -8.9% and span gas error of -4.1% to -9.9%.

The air supply to the inlet system was limited and the operation of the three probes caused some problems with the normal operation of the mercury CEMS. While Unit 7 was offline, the blowbacks on the probe caused positive spikes in the mercury concentration that did not recover quickly as typical of a blowback cycle, and the concentration measured on the Unit 9 probe increased slightly and then decreased when Unit 7 returned online. When sorbent screening tests were performed in late June 2007, the increase in the air used for the sorbent screening tests caused significant drains on the air supply to the Unit 7 and Unit 9 probes. Figure 4-135 shows the effects of Unit 7 boiler operation on the mercury concentrations measured from the Unit 9 probe on April 14–16 and April 18–20.

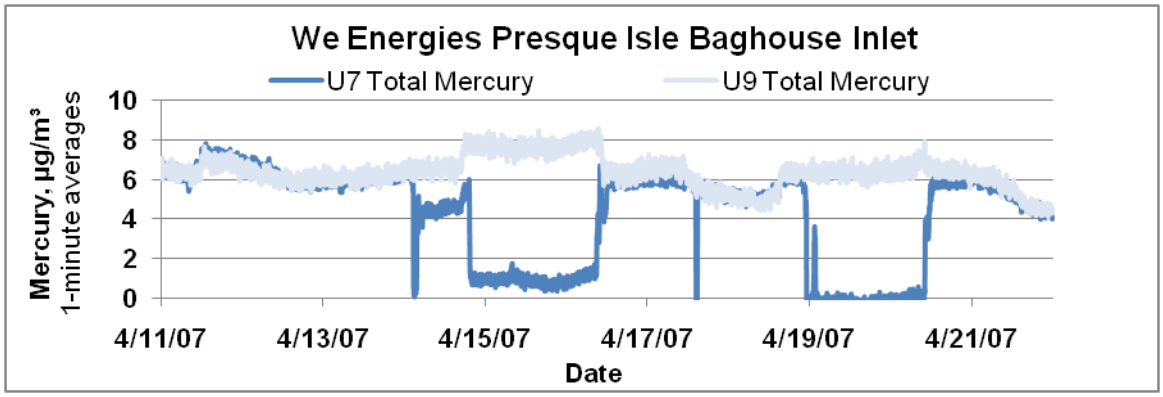


Figure 4-135. PIPP Units 7 and 9 Total Mercury Concentrations; April 11–21, 2007.

The calibration checks performed with the inlet system were very unstable and suspected inaccurate. The daily calibration checks frequently failed CAMR criteria of greater than 5.0% error of the span value and the changes with the responses appeared to be related to the new software installed on the analyzer since March 2007. The lamp intensity measured by the analyzer should not be affected by any change in calibration factors, however the new software and lamp compensation appeared to affect lamp intensity when the system

recalibrated. That error caused changes in the response of the analyzer to mercury, including unstable calibration responses. A comparison of the mercury concentration measurements with the changes in lamp intensity is shown in Figure 4-136. Thermo began working on improvements to the analyzer software to correct the errors and scheduled a updated release of the software in the third quarter of 2007.

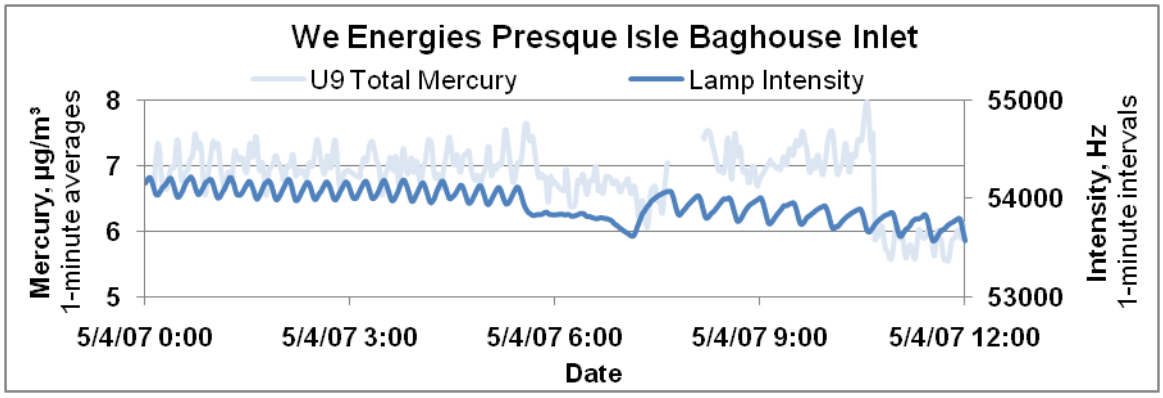


Figure 4-136. PIPP Unit 9 Mercury and Lamp Intensity Comparison, May 2007.

The inlet system was scheduled to go through a complete set of recertification procedures in July 2007 as described by CAMR due to the many changes with the systems since original installation of the mercury CEMS. The recertification tests include a seven-day drift test, a three-point linearity check, and a cycle time test. A relative accuracy audit test at the baghouse inlet location was not scheduled for 2007.

4.15.9.1.7 Baghouse Inlet – Third Quarter 2007

The baghouse inlet mercury CEMS started the third quarter of 2007 measuring total mercury from the Unit 7 and Unit 9 probes simultaneously. After the Unit 9 boiler went offline in July, sampling was switched to collect total mercury concentrations from the Unit 8 probe and later from the Unit 9 probe.

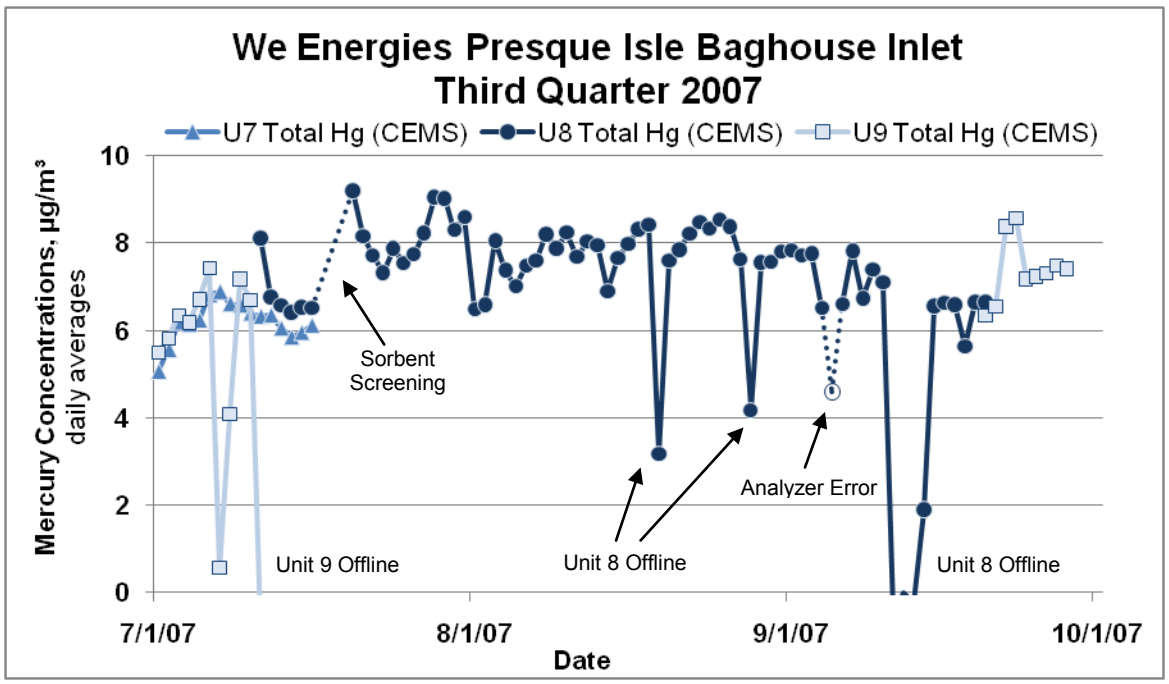


Figure 4-137. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q07.

The mercury CEMS started the third quarter of 2007 sampling from total mercury from the Unit 7 and Unit 9 inlet ducts. The total channel was switched to sample mercury from the Unit 8 probe instead of the Unit 9 probe on July 11. After sorbent screening tests were completed on July 20, the system sampled speciated mercury from Unit 8. When Unit 8 boiler went offline on September 20, sampling was switched to collect only total concentrations from the Unit 9 probe. The list of the probe configurations for the quarter is shown in Table 4-48.

Table 4-48. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 3Q07.

Start Date	End Date	Total Channel	Elemental Channel
07/01/07 00:00	07/11/07 10:42	Unit 9 Total Hg	Unit 7 Total Hg
07/11/07 10:46	07/16/07 19:23	Unit 8 Total Hg	Unit 7 Total Hg
07/16/07 19:24	07/20/07 13:52	Sorbent Screening Tests	
07/20/07 14:00	09/20/07 15:25	Unit 8 Total Hg	Unit 8 Elemental Hg
09/20/07 15:26	09/30/07 23:59	Unit 9 Total Hg	None

A linearity check was performed on the baghouse inlet mercury CEMS on July 6, 2007. A linearity check had not been completed since the installation of the Hydra components and changing of the system configuration. There was interest in checking the quality of the data collected despite the system not being considered a "compliance mercury CEMS." The system was temporarily set to sample only on the total channel of the analyzer and therefore only Unit 9 was checked for linearity. The results of the linearity check can be found in Table 4-49. Although the low-level average response of the system was greater than the 10.0% criteria required by CAMR, the alternate specification of less than 1.0 µg/m³ absolute error was achieved.

Table 4-49. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 3Q07.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	07/06/07	13:00	5.0	5.51	+0.51	+10.2%	PASS
1 M	07/06/07	13:15	11.0	11.00	0.00	0.0%	PASS
1 H	07/06/07	13:31	18.0	18.16	+0.16	+0.9%	PASS
2 L	07/06/07	13:46	5.0	5.47	+0.47	+9.4%	PASS
2 M	07/06/07	14:02	11.0	11.34	+0.34	+3.1%	PASS
2 H	07/06/07	14:22	18.0	18.06	+0.06	+0.3%	PASS
3 L	07/06/07	14:53	5.0	5.63	+0.63	+12.6%	PASS
3 M	07/06/07	15:08	11.0	11.61	+0.61	+5.5%	PASS
3 H	07/06/07	15:23	18.0	18.45	+0.45	+2.5%	PASS
Low-Level Average			5.0	5.54	+0.54	+10.8%	PASS
Mid-Level Average			11.0	11.32	+0.32	+2.9%	PASS
High-Level Average			18.0	18.22	+0.22	+1.2%	PASS

The cycle time test for the inlet mercury CEMS was not completed according to the procedures defined in Appendix A of Part 75. The downscale response was calculated using the profile of the zero response of the daily calibration check on July 6, 2007. The upscale value, which should be performed from a stable sample concentration, was instead calculated as the response time of the system from the stable zero gas response to the end of the

calibration gas response on July 6. In both calculations, the response time of the system was much less than the 15-minute response time criteria. The results of the response time are shown in Table 4-50.

Table 4-50. PIPP Unit 9 Inlet Total Mercury System Cycle Time, 3Q07.

Scale	Date	Ref	Hg Start	Hg End	95% Time	Result
Downscale	07/06/07	0.0	7.20	0.65	6 minutes	PASS
Upscale	07/06/07	11.0	0.69	10.82	6 minutes	PASS

A seven-day drift check was performed on the inlet mercury CEMS from July 1–7, 2007. The calibration factors were updated during the seven days. The uncorrected responses for the seven days were recalculated and found in Table 4-51. The drift over the first six days of the month passed the requirements of CAMR, but an unusual shift on the seventh day caused the drift check to fail. It was a known issue that the calibration responses at the inlet were unstable and might not be as accurate as they should be. Thermo recommended the installation of a nitrogen generator on the inlet system to reduce the interference of the mercury fluorescence in the optics chamber caused by the oxygen present in the dilution and calibration zero air. Thermo also recommended that the calibration gas going to the probe should be hydrated to keep the inertial filter hydrated during the calibration routine and reduce capture of mercury on the filter.

Table 4-51. PIPP Unit 9 Inlet Total Mercury System Seven Day Drift, 3Q07.

Date	Time	Span	Level	Zero Response		Cal Response		Result
07/01/07	07:40	20.0	11.0	-0.02	-0.1%	10.25	-3.7%	PASS
07/02/07	07:40	20.0	11.0	0.19	+1.0%	11.38	+1.9%	PASS
07/03/07	07:40	20.0	11.0	-0.13	-0.6%	10.62	-1.9%	PASS
07/04/07	07:40	20.0	11.0	0.08	+0.4%	10.26	-3.7%	PASS
07/05/07	07:40	20.0	11.0	-0.94	-4.7%	10.18	-4.1%	PASS
07/06/07	07:40	20.0	11.0	-0.09	0.4%	10.01	-5.0%	PASS
07/07/07	07:40	20.0	11.0	0.29	1.4%	12.11	+5.6%	FAIL

Sorbent screening tests were performed at the inlet location from July 16–21, 2007. During the sorbent screening tests, several upgrades and repairs were done to the inlet system to improve the performance of the mercury CEMS. The mercury concentrations measured by the analyzer were unstable during the periods of maintenance since the sampling was frequently switched between the Unit 7, Unit 8, and Unit 9 probes.

The system was configured to sample total and elemental mercury from the Unit 8 probe after the sorbent screening tests were completed on July 20, 2007. The system was left in this configuration for two months before switching to sample only total mercury from Unit 8 on September 20. The extended sampling of speciated mercury from Unit 8 allowed for steady collection of both total and elemental mercury data for a reliable mercury profile at this location.

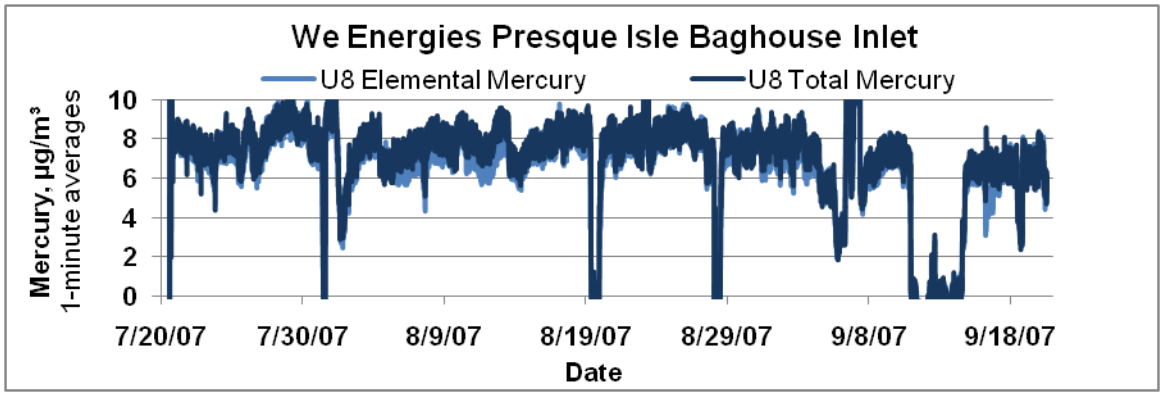


Figure 4-138. PIPP Unit 8 Total and Elemental Mercury, 3Q07.

The analyzer software was upgraded to version 01.00.04.212 on July 19, 2007. This software was designed to correct some of the issues created with the previous version and mitigate the effects of lamp intensity drift on the measured mercury concentrations.

The orifice pressure transducer installed in the Unit 9 probe had been defective since installation in June 2006. The orifice pressure measurement is not a critical component of the probe and an incorrect reading from the transducer does not affect the ability of the probe to measure accurate mercury concentrations. The purpose of the orifice pressure transducer is to measure the pressure immediately upstream of the critical flow orifice and it is used

only as a reference for troubleshooting potential leaks and plugs in the probe. The orifice transducer was replaced on July 18, 2007.

The calibrator was designed to use dry zero air as the source of the calibration zero and span gas. A temporary hydrator was installed on the inlet system and this allowed the calibration gas to pick up moisture on its way to the probe. The Perma Pure ME™-Series moisture exchangers use Nafion® membrane tubing technology to transfer water to a dry gas stream. The Perma Pure humidifiers transfer water vapor from a water-saturated environment to the dry calibration gas flowing within the tubing. This process is commonly used to humidify calibration gases, which allows calibration of analyzers at humidity levels equal to those seen in samples and provides a more consistent calibration/sample baseline.

The purpose of the hydrator was to add a small amount of moisture to the calibration gas to eliminate the possibility of the inertial filter scrubbing or releasing captured mercury as the moisture characteristics of the filter change. Even though the inertial filter is coated, the surfaces of the filter become "wet" and the small pores of the inertial filter become saturated with moisture as it samples flue gas. When the sampled gas switched from the wet flue gas to the dry zero or span gas, the moisture is released from the pores of the inertial filter and the filter will instead capture mercury on the surface. The interference that could affect the accuracy of the mercury concentrations will be kept to a minimum by keeping the surface of the inertial filter wet in all sampling and calibration modes.

The inlet mercury CEMS stopped responding to system calibration zero and span gas on September 18, 2007. The zero and span gas responses were the same as the typical sample concentration during each of the failed calibrations. A few troubleshooting steps were taken by changing specific settings with the system and observing the response in an attempt to identify the problem. One of the potential problems of measuring a valid sample mercury concentration but unable to measure a zero or span response is a mechanical error with the actuator valve causing it to be stuck in the open position. The actuator valve should be closed during a system calibration routine but open during normal sampling of mercury from the duct.

The venturi pressure measures the pressure differential of the flue gas pulled through the fast loop by the eductor in sample mode. The eductor pressure was increased to observe an increase in the venturi pressure and this indicated that the actuator valve was open while in sample mode. The inspection and repair to the actuator valve was scheduled to occur during on-site activities in October 2007. In order to continue sampling from a probe that was able to perform calibration checks, the system was switched to sample only total mercury from the Unit 9 probe on September 20.

There was continued concern that the temperatures measured inside the analyzer are affecting the ability of the system to measure stable mercury concentrations. As the internal temperature of the analyzer increases, the mercury observed by the analyzer decreases. A chart of this relationship is shown in Figure 4-139.

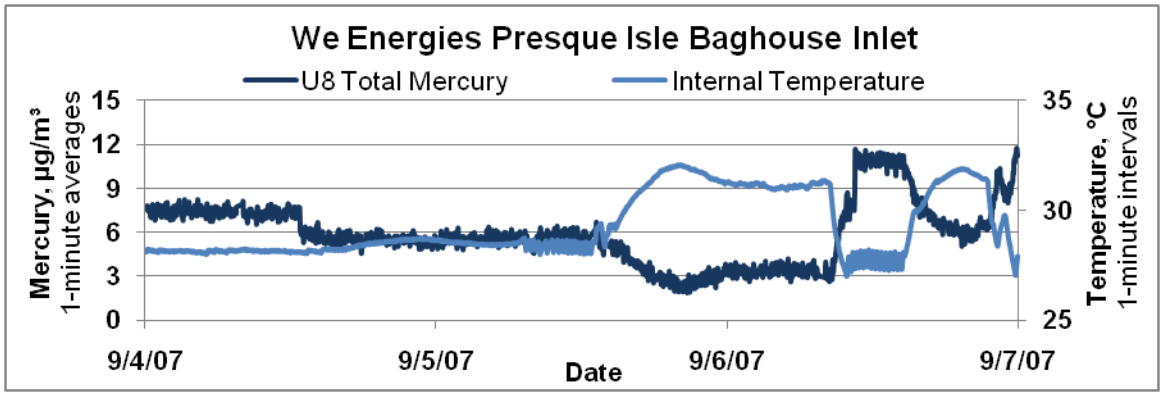


Figure 4-139. PIPP Unit 8 Total Mercury and Internal Temperature; September 4–7, 2007.

It was explained that the temperature of the lamp affects the integrity of the mercury concentrations measured by the analyzer. In order to improve the stability of this system, Thermo released an upgrade kit that includes a permanent hydrator assembly for the calibration gas, a new mercury lamp and a mercury lamp heater assembly to maintain the temperature of the lamp at all times. This upgrade kit was scheduled for installation in October 2007.

4.15.9.1.8 Baghouse Inlet – Fourth Quarter 2007

The inlet mercury CEMS was left to sample only total mercury from the Unit 9 duct after the actuator valve in the Unit 8 probe failed open on September 18, 2007. On October 9, the actuator valve was repaired and sampling was switched to measure total and elemental mercury from the Unit 8 probe. An error with the Unit 8 probe from October 24–25 caused mercury concentrations to measure zero. Sampling was temporarily switched back to the Unit 9 probe on November 1 as Unit 8 was offline but switched back to Unit 8 on November 5. Maintenance and sorbent screening tests were performed on December 11–17 with the sorbent screening done using the Unit 7 probe. After sorbent screening and maintenance was completed, sampling switched back to total from the Unit 8 duct measured on the total channel and total from the Unit 7 duct measured on the elemental channel on December 17 and continued through the rest of the quarter.

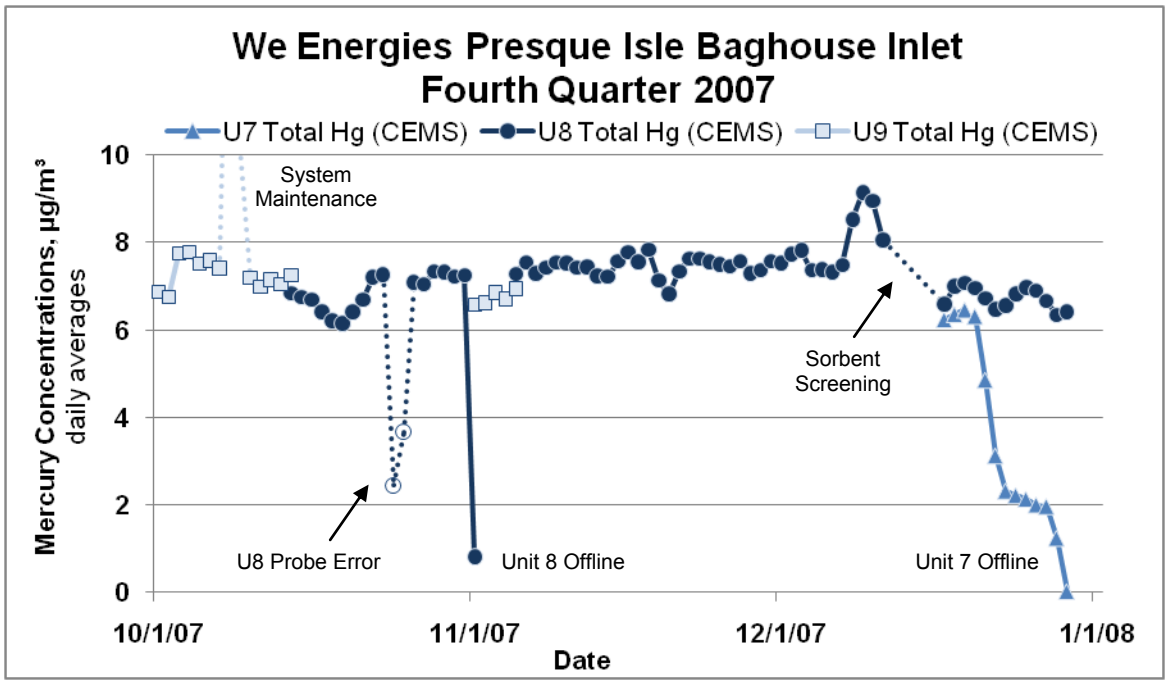


Figure 4-140. PIPP Units 7–9 Inlet Total Mercury, 4Q07.

Most of the sampling was performed on the Unit 8 inlet duct with total and elemental mercury concentrations measured by the mercury CEMS. The sampling configuration was changed only when the Unit 8 boiler was offline and the CEMS was switched to sample only

total mercury from the Unit 9 inlet duct. The list of the probe configurations for the quarter is shown in Table 4-52.

Table 4-52. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 4Q07.

Start Date	End Date	Total Channel	Elemental Channel
10/01/07 00:00	10/14/07 18:58	Unit 9 Total Hg	None
10/14/07 18:59	11/01/07 10:46	Unit 8 Total Hg	Unit 8 Elemental Hg
11/01/07 10:50	11/05/07 18:16	Unit 9 Total Hg	None
11/05/07 18:17	12/11/07 10:19	Unit 8 Total Hg	Unit 8 Elemental Hg
12/11/07 10:47	12/16/07 09:00	Sorbent Screening Tests	
12/17/07 01:13	12/31/07 23:59	Unit 8 Total Hg	Unit 7 Total Hg

The nitrogen generator was installed at the baghouse inlet mercury CEMS on October 9, 2007. The nitrogen generator was a MaxSense™ Nitrogen Generation Package that creates clean, dry compressed nitrogen gas from compressed air in order to feed the calibrator for calibration gas and the dilution module in the probe for dilution air. The nitrogen generator was able to reduce the background noise of the system by removing oxygen from the calibration and dilution air. The result of the nitrogen source gas to these components was that the mercury concentration measurements were up to five times more stable and the calibration responses were much more accurate. Figure 4-141 shows the nitrogen generator assembly installed on the mercury CEMS at the baghouse inlet.

Figure 4-141. PIPP Units 7–9 Inlet Mercury CEMS Nitrogen Generator.

The range of mercury concentration measured for the twelve hours before the nitrogen generator was installed was 5.61 to 7.59 µg/m³ for a range of 1.98 µg/m³. In the twelve hours after the nitrogen generator was installed, the range of mercury measured was 6.92 to 7.49 µg/m³ for a range of 0.54 µg/m³. The effects of the nitrogen generator on the mercury concentrations measured at the inlet location can be found in Figure 4-142.

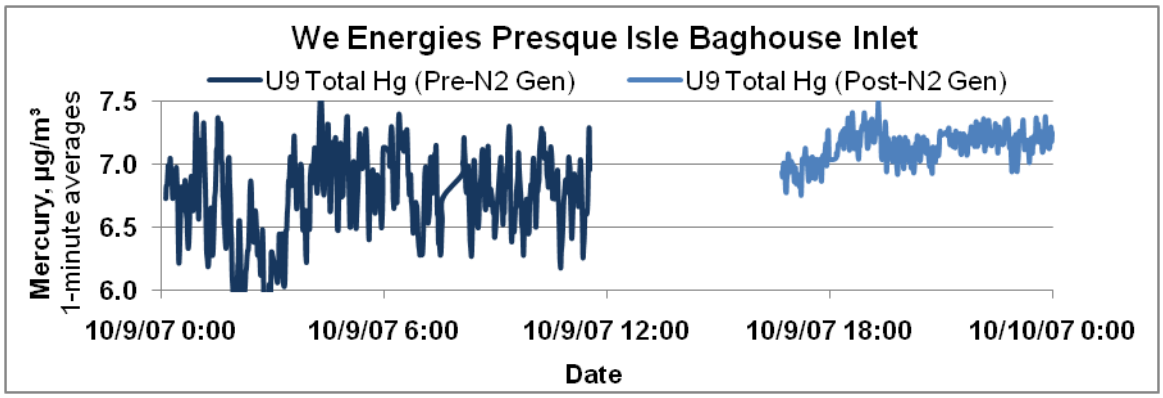


Figure 4-142. PIPP Unit 9 Total Mercury with Nitrogen Generator; October 9, 2007.

The installation of the nitrogen generator had a direct impact on the ability of the ultraviolet lamp to measure the mercury atoms in the detection chamber. Without the added interference from the oxygen fraction of compressed air, the PMT voltage was reduced from 918V to 732V. This also dropped the calibration background factor of the instrument from 2.50 µg/m³ to 0.33 µg/m³, which represents an improvement of over seven times the signal clarity.

Maintenance was required for the Unit 8 probe that was not responding to the calibration zero and span gas on September 18. The probe was inspected and it was discovered that the actuator valve was not turning when the gas mode of the system was switched from a sample mode to a calibration mode. The black stem that connected the actuator motor to the actuator valve was cracked near the hex-key screw and the motor was not able to turn the valve. The screw on the valve stem was tightened to secure the motor to the valve to repair the functionality of the valve. This problem had been experienced on other mercury probes and it was recommended that a setscrew be installed on the valve stem to ensure reliability.

The permanent hydrator was installed on the inlet mercury CEMS on October 13, 2007. The hydrator is designed with two water reservoirs and a communication cable from the hydrator to the analyzer. The calibration zero and span gas is passed through smaller water reservoir located at the bottom of the hydrator so that it can pick up an appropriate amount of moisture on its way to the probe. The larger reservoir holds a reserve amount of water. When the level in the small reservoir decreases, it triggers the larger reservoir to fill the smaller

reservoir while the system is in a non-calibrating gas mode. A picture of the hydrator assembly can be found in Figure 4-143.

Figure 4-143. PIPP Units 7–9 Inlet Mercury CEMS Calibration Gas Hydrator.

The inlet mercury analyzer went through the final round of upgrades to the optical and detection components to improve the performance of the mercury measurements. The mercury signal was still not as stable as anticipated and the photomultiplier tube was replaced on December 12, 2007. The new PMT voltage was reduced from 732V to a much lower 505V. The largest improvement was in the calibration background factor for the instrument that decreased from 0.43 µg/m³ to 0.05 µg/m³. In addition to the replacement of the PMT, a new mercury lamp was installed as the lamp intensity had degraded to 18,000 Hz and required replacement. The new lamp was housed in a lamp heater assembly that maintains the temperature of the lamp such that fluctuations in the internal temperature of the analyzer do not affect the mercury concentrations measured by the analyzer. A chart showing the comparison of the mercury concentrations before and after the lamp upgrade can be found in Figure 4-144.

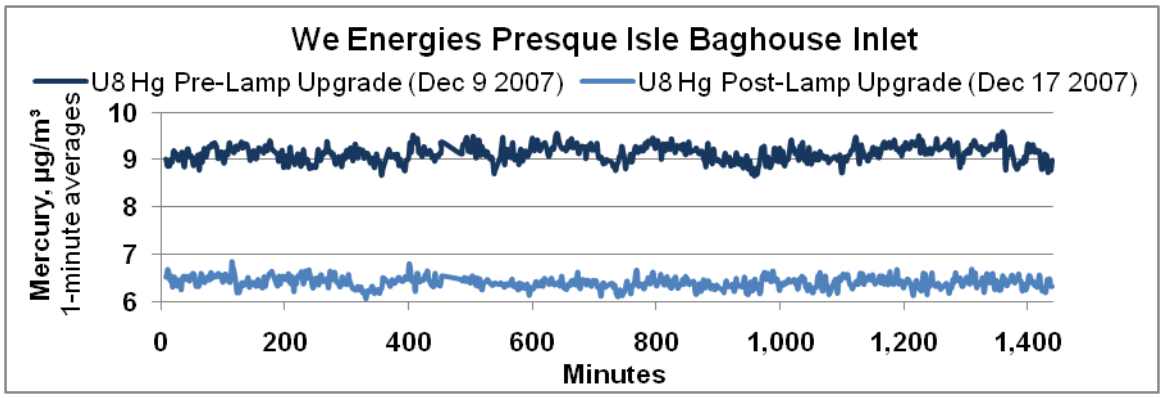


Figure 4-144. PIPP Unit 8 Total Mercury with Lamp Upgrade, December 2007.

By the end of 2007, the inlet mercury CEMS had been upgraded with all of the new components and assemblies recommended and released by Thermo and there were no more upgrades to the system planned for the duration of the project.

4.15.9.1.9 Baghouse Inlet – First Quarter 2008

The inlet mercury CEMS was sampling total mercury from the Unit 8 duct until January 7, 2008, when sampling was switched to the total mercury from Unit 9 when Unit 8 was offline. Unit 9 went offline and sampling was switched to the Unit 7 probe on February 18. Unit 7 went offline and sampling was switched to the Unit 9 probe on March 24.

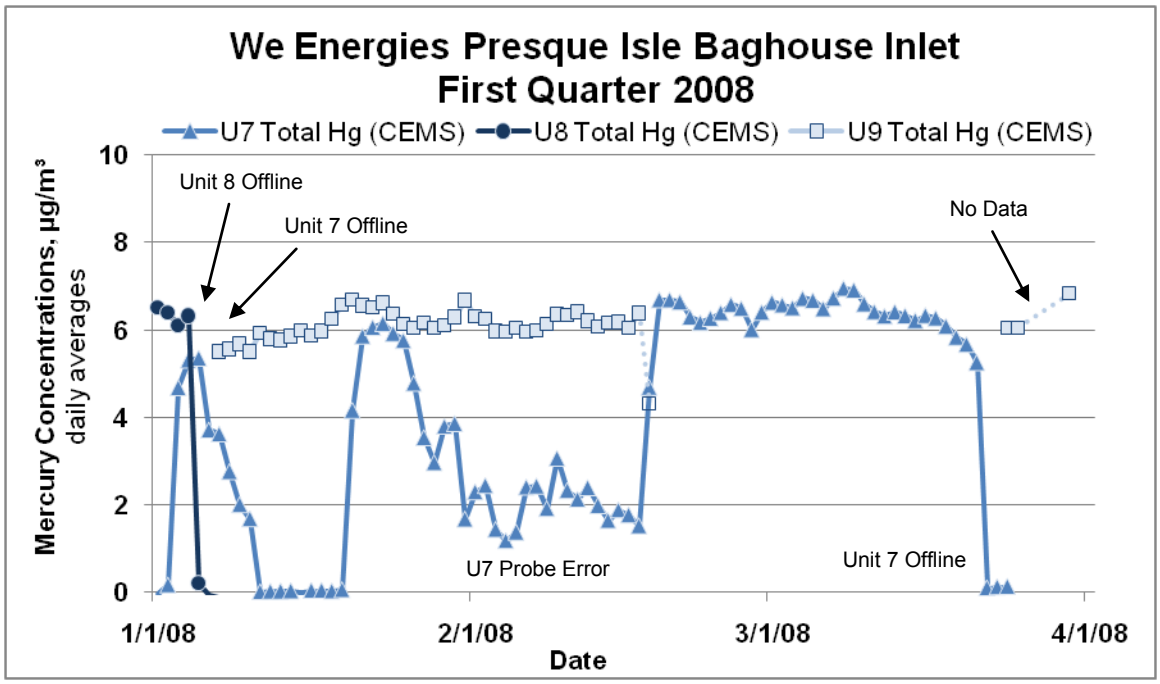


Figure 4-145. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q08.

The sampling configuration of the inlet mercury system changed several times during the first quarter of 2008. The probe in which mercury was being sampled required the changes due to specific units being down for maintenance. The list of the probe configurations for the quarter is shown in Table 4-53.

Table 4-53. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 1Q08.

Start Date	End Date	Total Channel	Elemental Channel
01/01/01 00:00	01/07/08 11:17	Unit 8 Total Hg	Unit 7 Total Hg
01/07/08 11:18	02/18/08 11:42	Unit 9 Total Hg	Unit 7 Total Hg
02/18/08 11:43	02/26/08 15:43	Unit 7 Elemental Hg	Unit 7 Total Hg
02/26/08 15:44	03/24/08 13:25	Unit 7 Total Hg	Unit 7 Elemental Hg
03/24/08 13:26	03/25/08 08:15	Unit 9 Total Hg	Unit 7 Elemental Hg
03/25/08 08:16	03/31/08 23:59	Unit 9 Total Hg	Unit 9 Elemental Hg

The calculation of the availability of the inlet mercury CEMS for the first quarter of 2008 can be found in Table 4-54. The availability of the system in March 2008 was greatly affected by the disruption in remote communications with the on-site computer which resulted in the loss of data collected by the instrument and prevented the correction of failed daily calibration checks.

Table 4-54. PIPP Units 7–9 Inlet Mercury CEMS Availability, 1Q08.

Month	Operating Hours	Downtime Hours	Availability
January 2008	744 hours	56 hours	92.5%
February 2008	696 hours	74 hours	89.4%
March 2008	744 hours	163 hours	78.1%

The availability calculated for the inlet mercury system is further complicated by the ability of ADA-ES to download and analyze the data to ensure that the system is properly calibrated and functioning properly. The data was analyzed each workday and this allowed calibration

failures that occurred on the weekend to be uncorrected until the next regularly scheduled workday. This limitation occasionally leads to longer periods of invalid data than what would be expected from typical operation of mercury system. For ADA's analysis of the data, a failed calibration was one that did not pass the criteria on the total channel or the elemental channel. Most regulations only require the analysis of the total calibration response but this was unsuitable for the measurement of speciated mercury.

While the system was sampling total mercury from Unit 9 on the total channel and total mercury from Unit 7 on the total channel, the concentrations measured from the Unit 7 probe were decreasing over time after the daily calibration check. An example of the mercury concentrations from both units from February 5–9, 2007, is shown in Figure 4-146.

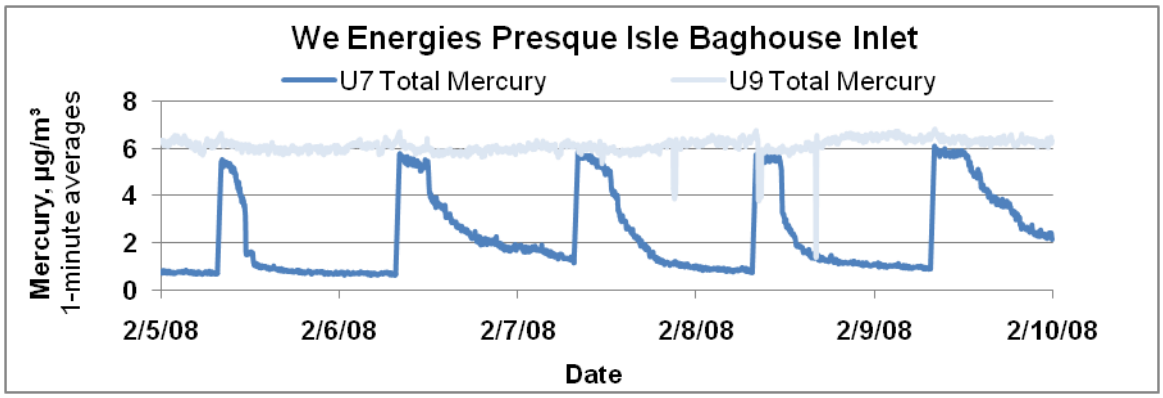


Figure 4-146. PIPP Unit 7 Total Mercury Degradation; February 2–10, 2008.

Only one probe controller is monitored and controlled when sampling two mercury gas streams from two different probes. The primary probe controller is selected based on the probe number that represents each of the Unit 7, Unit 8, and Unit 9 probes. When the system is sampling total mercury from Unit 9 on the total channel, the Unit 9 probe controller is the only one that is controlled and monitored. The Unit 7 concentrations measured on the elemental channel and the probe controllers are functioning in a "passive" secondary configuration, meaning that the secondary probe controller is not communicating with the analyzer and probe functions are not activated by the analyzer requests. The degradation in the mercury channel was caused by the inability for the probe controller to open the blowback valve in the secondary mercury probe and therefore causing the inertial filter to become plugged with ash and unable to correctly sample mercury from the duct. The

calibration routine is controlled by the function of the calibrator supplying calibration gas to each of the probes. There are no additional valves in the probe to open in order for it to receive calibration gas. The introduction of the calibration gas performed a secondary action of cleaning any loose debris in the probe and allowed the Unit 7 probe to measure mercury for a limited time before the probe becomes plugged again. The solution to this problem would be to switch to each probe controller assigned to the sampled probes and perform a regular blowback function in order to keep the filter and fast loop clean. There was nothing in the software that could automatically control the system to perform this routine.

The sample flow rate of the inlet system had been reading higher than expected since installation of the system. The sampled calibration gas flows through two glass orifices during an instrument calibration, one for the zero and one for the span gas. The tolerances of the flow rate of the glass orifices inside the analyzer are very tight and should have a stable flow rate of 0.250 LPM. The flow rate measured through the glass orifices was 0.800 LPM and this indicated an improperly calibrated flow transducer as no leaks were found in the system. The adjustment of the sample flow rate while in the instrument zero and span gas mode is displayed in Figure 4-147.

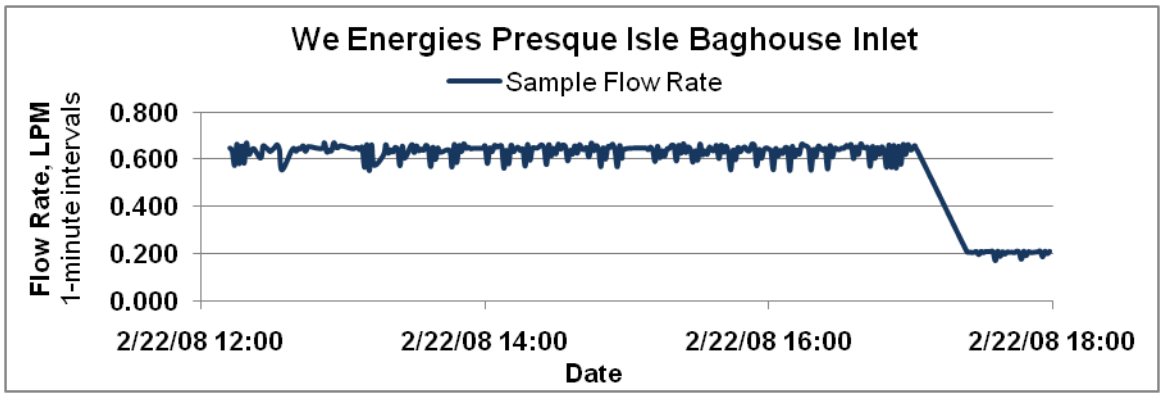


Figure 4-147. PIPP Units 7–9 Inlet Analyzer Sample Flow Rate; February 22, 2008.

The umbilical temperature set point has been historically set to 160 °C since the mercury CEMS was installed in June 2005. Thermo reduced their recommendation of the umbilical temperature set point to 120 °C as they discovered that running the umbilical heaters at a lower temperature does not have a negative impact on the ability of the system to transport mercury from the probe to the analyzer. Lowering the temperature of the umbilical was also

recommended to increase the life of the large umbilical heaters. The umbilical temperature set point was reduced to the recommended 120 °C on March 12. A chart of the change in umbilical temperature is shown in Figure 4-148. The set point adjustments for any temperatures or pressures have to be performed on each probe controller individually because the set points are saved by the specific probe controller interface board.

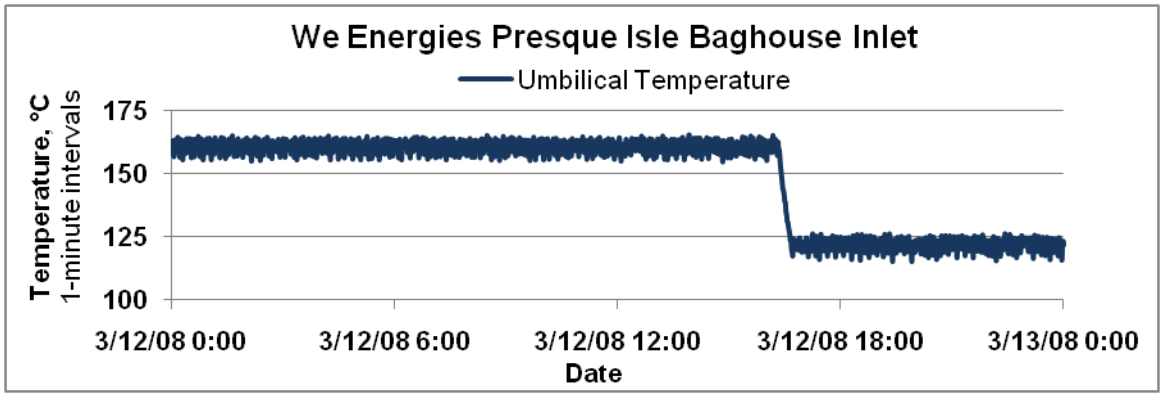


Figure 4-148. PIPP Unit 7 Inlet Umbilical Set Point Temperature; March 12, 2008.

The on-site computer used to connect to the mercury CEMS at Presque Isle was upgraded during the last week of March 2008. There were problems with establishing a remote connection to the system and data could not be collected until April 10. The analyzer had the ability to store up to five megabytes of data in the internal data logger. Due to the expanded data content programmed into the software for the analyzer to record, this electronic storage space limitation translates to about 11 days of data and records from March 25–30 were lost.

4.15.9.1.10 Baghouse Inlet – Second Quarter 2008

The inlet mercury CEMS was sampling total and elemental mercury from the Unit 9 duct until April 8, 2008. Communication and power failures on April 8 caused the probe sampling to default to the Unit 8 probe without proper probe switching procedures and the eductor pressure for the Unit 8 probe was turned off. Communication was restored on April 10 and the probe was switched back to sample from the Unit 9 probe. On May 20, the inlet system was reconfigured to sample total and elemental mercury from the Unit 7 probe and continued through the end of the quarter.

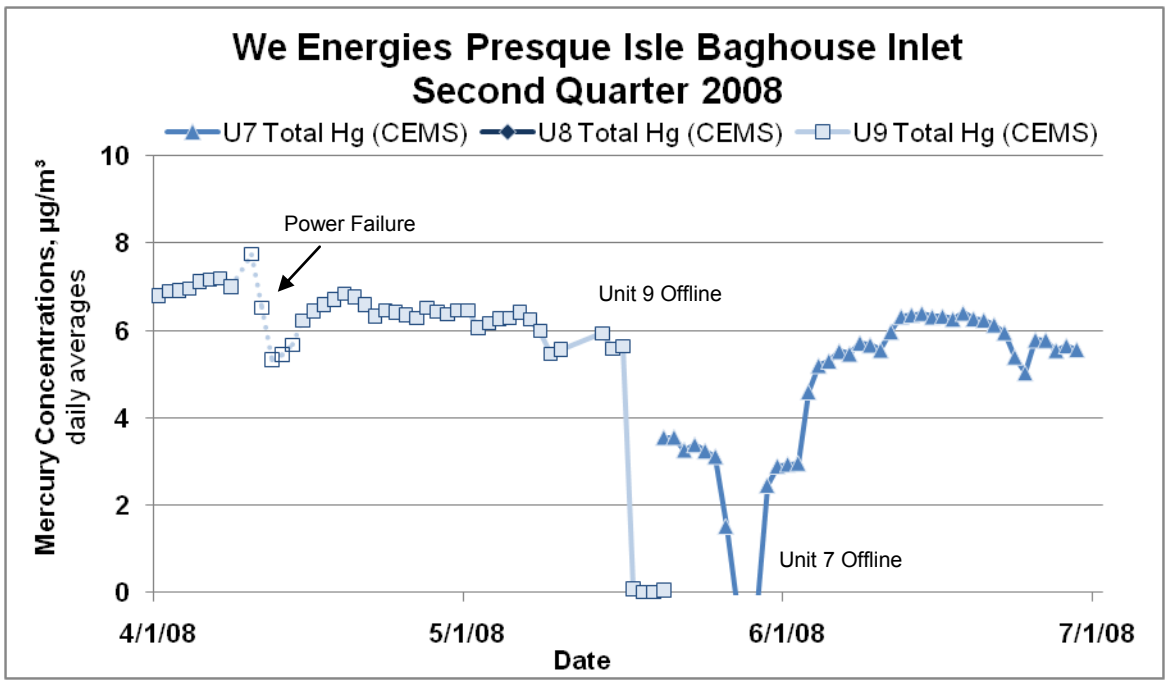


Figure 4-149. PIPP Units 7–9 Inlet Total Mercury, 2Q08.

The sampling configuration of the inlet mercury system changed a few times during the second quarter of 2008. The probe was sampling incorrectly on April 8–10 due to power failure and communication errors. Unit 9 was offline on May 20 and sampling was switched to the Unit 7 probe. The list of the probe configurations for the quarter is shown in Table 4-55.

Table 4-55. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 2Q08.

Start Date	End Date	Total Channel	Elemental Channel
04/01/08 00:00	04/08/08 12:23	Unit 9 Total Hg	Unit 9 Elemental Hg
04/08/08 12:24	04/10/08 16:20	Unit 8 Total Hg	Unit 9 Elemental Hg
04/10/08 16:21	05/20/08 11:59	Unit 9 Total Hg	Unit 9 Elemental Hg
05/20/08 12:27	06/30/08 23:59	Unit 7 Total Hg	Unit 7 Elemental Hg

The quarterly linearity check was performed on April 30, 2008. The responses of the system during the three-point linearity check are recorded in Table 4-56 and they satisfy the requirements of CAMR.

Table 4-56. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 2Q08.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	4/30/08	10:08	5.0	4.98	-0.02	-0.4%	PASS
1 M	4/30/08	10:19	11.0	10.93	-0.07	-0.6%	PASS
1 H	4/30/08	10:30	18.0	17.73	-0.27	-1.5%	PASS
2 L	4/30/08	10:41	5.0	4.94	-0.06	-1.2%	PASS
2 M	4/30/08	10:51	11.0	10.83	-0.17	-1.6%	PASS
2 H	4/30/08	11:02	18.0	17.74	-0.26	-1.4%	PASS
3 L	4/30/08	11:13	5.0	5.00	0.00	0.0%	PASS
3 M	4/30/08	11:23	11.0	10.92	-0.08	-0.7%	PASS
3 H	4/30/08	11:34	18.0	17.76	-0.24	-1.3%	PASS
Low-Level Average			5.0	4.97	-0.03	-0.6%	PASS
Mid-Level Average			11.0	10.89	-0.11	-1.0%	PASS
High-Level Average			18.0	17.74	-0.26	-1.4%	PASS

The calculation of the availability of the inlet mercury CEMS for the second quarter of 2008 can be found in Table 4-57. The availability of the system in April 2008 was greatly affected by the loss in remote communications with the system that prevented the correction of failed daily calibration checks until April 15. The availability calculated for May 2008 was affected by repeated failure of the system to produce a passing calibration check on the elemental channel. The failure of the system calibration checks was permitted to continue as a troubleshooting activity to understand the reason for the failure on the elemental channel.

Table 4-57. PIPP Units 7–9 Inlet Mercury CEMS Availability; 2Q08.

Month	Operating Hours	Downtime Hours	Availability
April 2008	720 hours	346 hours	51.9%
May 2008	744 hours	282 hours	62.1%
June 2008	720 hours	107 hours	85.1%

Other routine analyzer and system maintenance was completed in the second quarter of 2008. Most of the adjustments could be made from the remote connection to the on-site computer connected to the inlet mercury CEMS. A complete recalibration of the analyzer and system were performed with the PMT voltage adjusted from 505V to 571V and the dilution ratio adjusted from 63.50 to 32.50. The reason that the dilution ratio was adjusted was because each probe has its own distinct dilution module and changes are required when the sampling is changed from one probe to the other. This recalibration procedure was performed on the Unit 9 system components on April 14, 2008.

The umbilical temperature set point was adjusted for the Unit 7 probe controller in February 2008 but this was not corrected for the Unit 9 probe. The umbilical temperature set point for the Unit 9 probe was adjusted from 160 °C to 120 °C on April 17.

The inlet analyzer UV lamp intensity decreased to 27,000 Hz and it was replaced with a new lamp on May 19, 2008. The starting intensity of the replacement lamp was over 140,000 Hz but quickly stabilized to about 90,000 Hz within 24 hours.

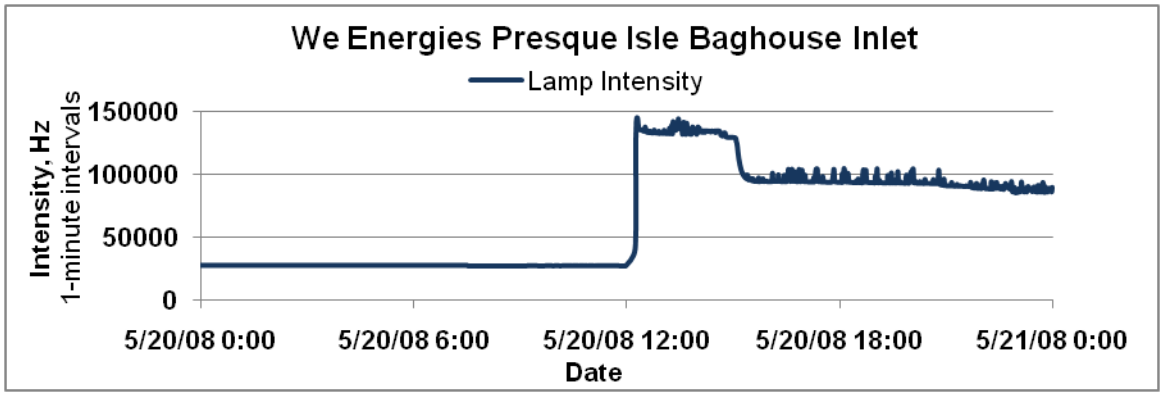


Figure 4-150. PIPP Units 7–9 Inlet Mercury Lamp Intensity; May 20, 2008.

The sampling probe was switched from the Unit 9 probe to the Unit 7 probe on May 20, 2008. During this switch from one probe to the other, the power to the eductor pressure valve of the new sampled probe was not turned on as required and the lamp compensation setting was not enabled. The errors were not discovered until June 3 and were likely the cause of the poor calibration responses and high zero drift. The eductor pressure during this time is shown in Figure 4-151.

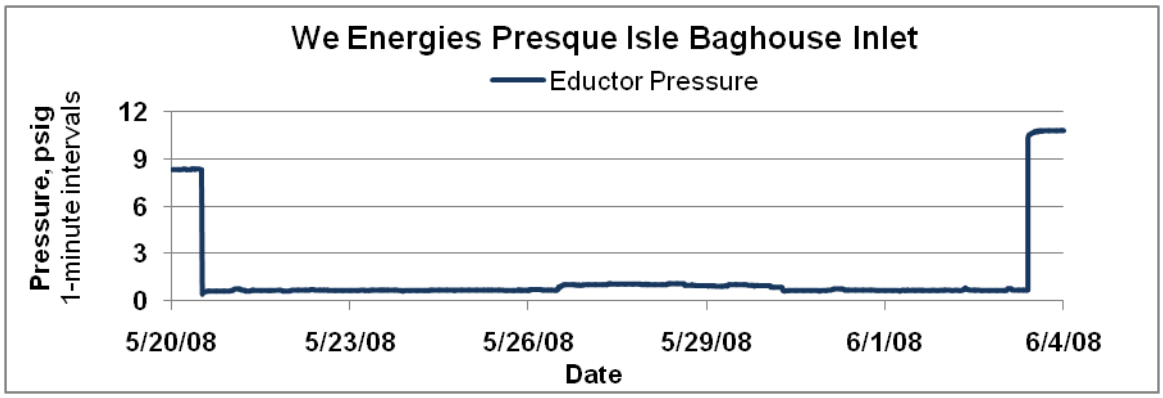


Figure 4-151. PIPP Unit 7 Inlet Probe Eductor Pressure; May 20–June 4, 2008.

The blowback pressure was stable at its set point when the eductor pressure of the Unit 7 probe was turned off. When the power to the eductor pressure regulator was turned back on and the valve was opened, the blowback pressure transducer was unable to maintain the set point pressure on June 3, 2008. This is an indication of a problem with the air supply to the system as the blowback and eductor pressure are both fed off the same clean, dry air source. This relationship between the eductor pressure and blowback pressure at the inlet is shown in Figure 4-152.

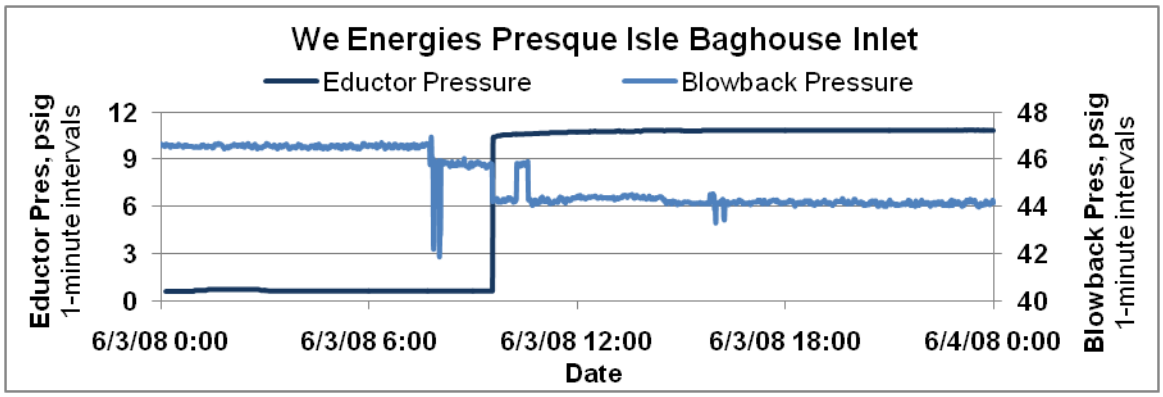


Figure 4-152. PIPP Unit 7 Inlet Eductor and Blowback Pressures; June 4, 2008.

The internal temperature of the analyzer reached a critical limit of 40 °C on May 6, 2008. Thermo does not recommend operating the analyzer or the calibrator in temperatures exceeding 35–40 °C as it May influence performance of the instruments and cause potential damage to the system. The increase in internal temperatures had an effect on the temperature of the optics bench despite the lamp heaters installed to keep the temperature of the lamp stable. This increase in the internal temperature and lamp temperature is charted in

Figure 4-153. This increase in temperature was attributed to a problem with the air conditioning unit located inside the CEMS shelter at the baghouse inlet and it was quickly repaired after a few hours.

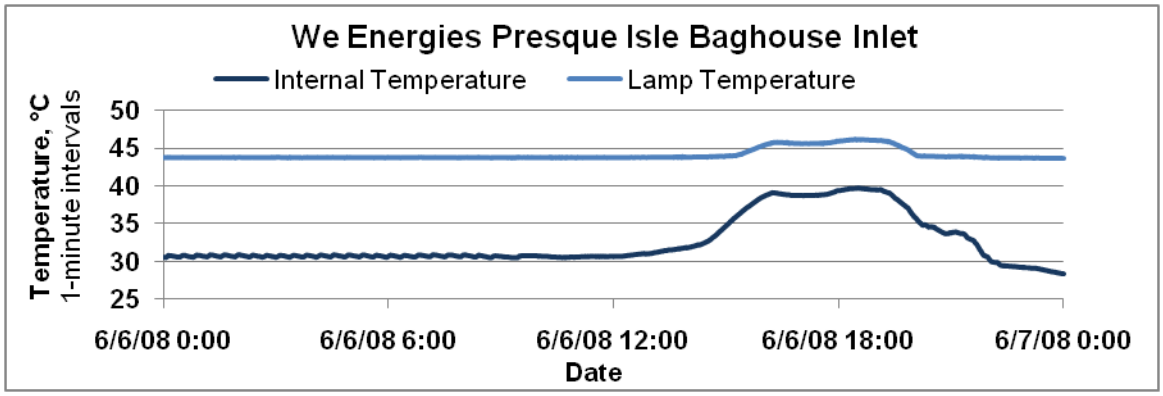


Figure 4-153. PIPP Units 7–9 Inlet Internal and Lamp Temperatures; May 6, 2008.

The calibration responses were incorrect on May 23–24, 2008. This error was caused by a fault with the mercury calibrator that recorded the cooler temperature as -99.0 °C. The calibrator uses the mercury reservoir chamber pressure and the cooler temperature to adjust the zero and saturated mercury gas flow rates in order to achieve the desired output concentration. The cooler temperature was malfunctioning which caused the calibrator to not control the proportion of the zero gas and saturated mercury gas flow rates for the correct concentration. The cooler temperature malfunction is shown in Figure 4-154. When the calibrator temperature began to record correctly again on May 25, the calibration responses were accurate and passed CAMR criteria for the daily calibration checks.

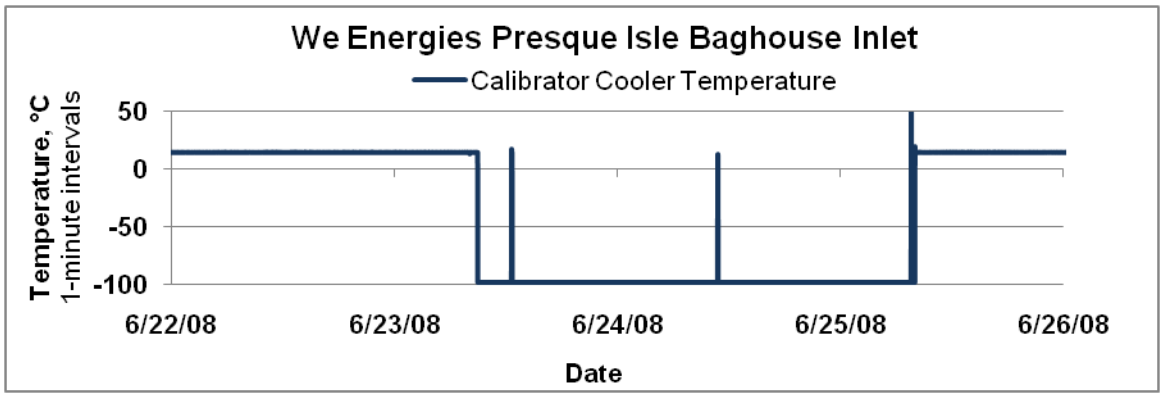


Figure 4-154. PIPP Units 7–9 Inlet Calibrator Cooler Temperature; June 22–26, 2008.

4.15.9.1.11 Baghouse Inlet – Third Quarter 2008

The inlet mercury CEMS was sampling total and elemental mercury from the Unit 7 duct until a round of sorbent screening tests began on July 22, 2008. The sorbent screening tests completed on July 28 and the system was configured to switch between sampling mercury from the Unit 8 and Unit 9 ducts depending on which boiler was currently in operation.

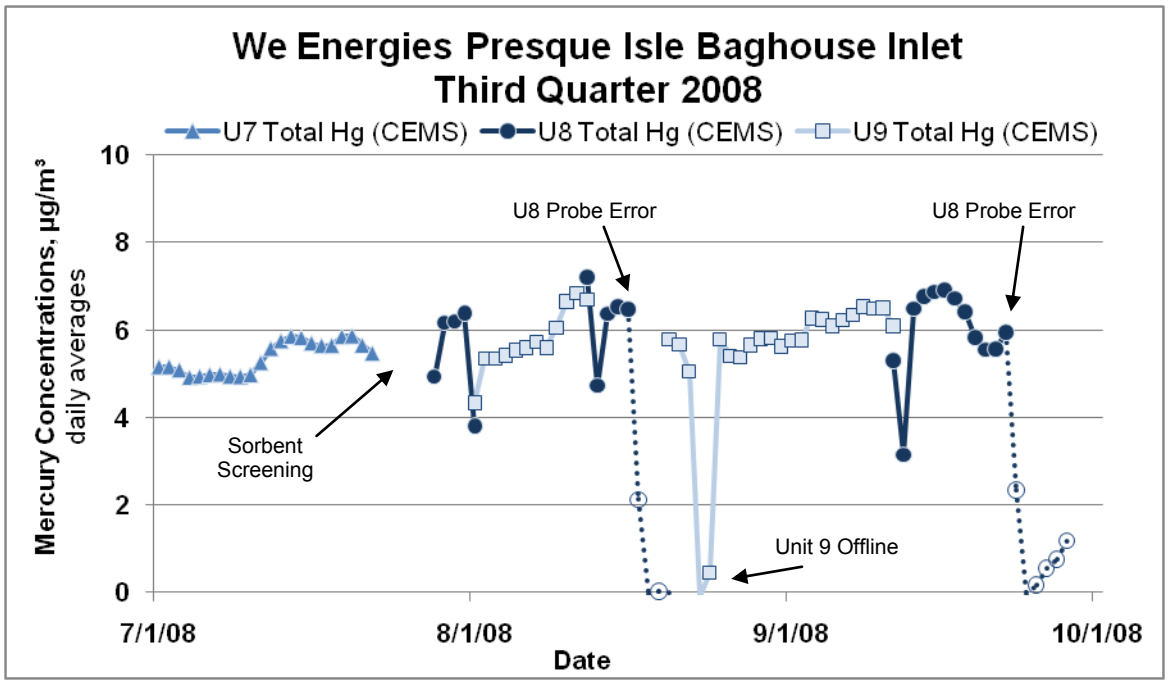


Figure 4-155. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q08.

The system was configured such that the total channel could be switched between Unit 7, Unit 8, or Unit 9 total mercury measurements. The elemental channel, however, was set up to only sample the elemental mercury from the Unit 8 probe. Therefore, whenever the system was sampling from Unit 8, both total and elemental mercury concentrations were captured. When Unit 9 was being sampled while Unit 8 was offline, only the total mercury concentrations were available. The list of the probe configurations for the quarter is shown in Table 4-58.

Table 4-58. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 3Q08.

Start Date	End Date	Total Channel	Elemental Channel
07/01/08 00:00	07/22/08 08:16	Unit 7 Total Hg	Unit 7 Elemental Hg
07/22/08 08:17	07/28/08 22:34	Sorbent Screening Tests	
07/28/08 22:45	08/01/08 16:01	Unit 8 Total Hg	None
08/01/08 16:02	08/12/08 14:21	Unit 9 Total Hg	None
08/12/08 14:23	08/20/08 16:27	Unit 8 Total Hg	Unit 8 Elemental Hg
08/20/08 16:41	09/11/08 07:17	Unit 9 Total Hg	None
09/11/08 13:47	09/30/08 23:59	Unit 8 Total Hg	Unit 8 Elemental Hg

The calculation of the availability of the inlet mercury CEMS for the third quarter of 2008 can be found in Table 4-59. Sorbent screening tests that took place July 22–29 negatively affected the availability of the system in July 2008 by taking the inlet CEM offline. The availability calculated for August 2008 was low because of an actuator valve failure on the Unit 8 probe that prevented valid calibration checks from being performed. The same actuator valve failed at the end of September to affect the availability for that month as well.

Table 4-59. PIPP Units 7–9 Inlet Mercury CEMS Availability, 3Q08.

Month	Operating Hours	Downtime Hours	Availability
July 2008	744 hours	168 hours	77.4%
August 2008	696 hours	137 hours	80.3%
September 2008	720 hours	276 hours	61.7%

The mercury lamp in the analyzer was replaced in May 2008 but it required another replacement on August 1 as the lamp intensity had decreased to less than 25,000 Hz. Thermo stated that the mercury lamps should last at least one year but this latest replacement occurred after only about 10 weeks of use. The intensity degradation over the life of the lamp is shown in Figure 4-156.

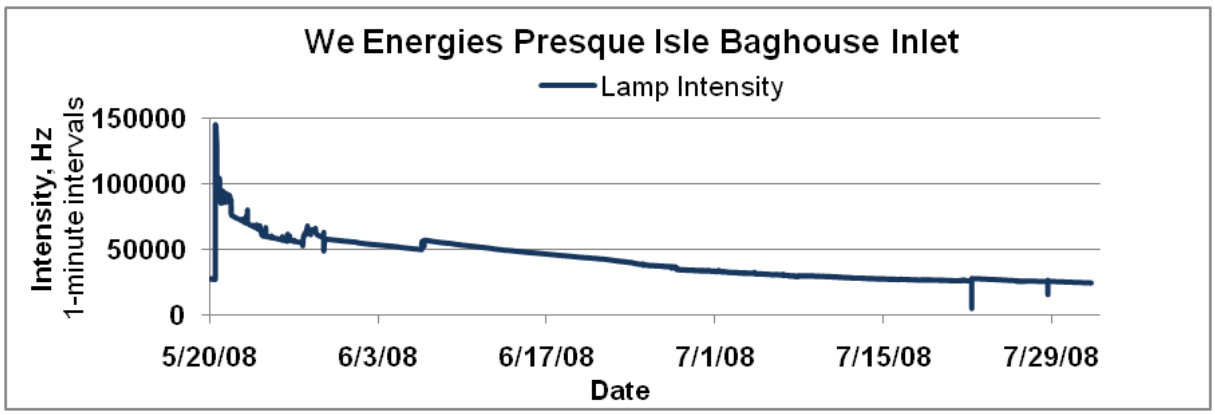


Figure 4-156. PIPP Units 7–9 Inlet Mercury Lamp Intensity; May–July 2008.

Mercury concentrations measured by the Unit 7 probe appeared to decrease over time between calibration routines as shown in Figure 4-157. This was also seen with mercury concentrations with secondary sampling of the Unit 7 total mercury on the elemental channel while connected to the probe controller of a different probe. The cause of the drop in mercury concentrations over time was attributed to the lack of blowbacks on the system. The decrease in mercury concentrations between calibration routines may indicate that the inertial filter and fast loop require cleaning and maintenance.

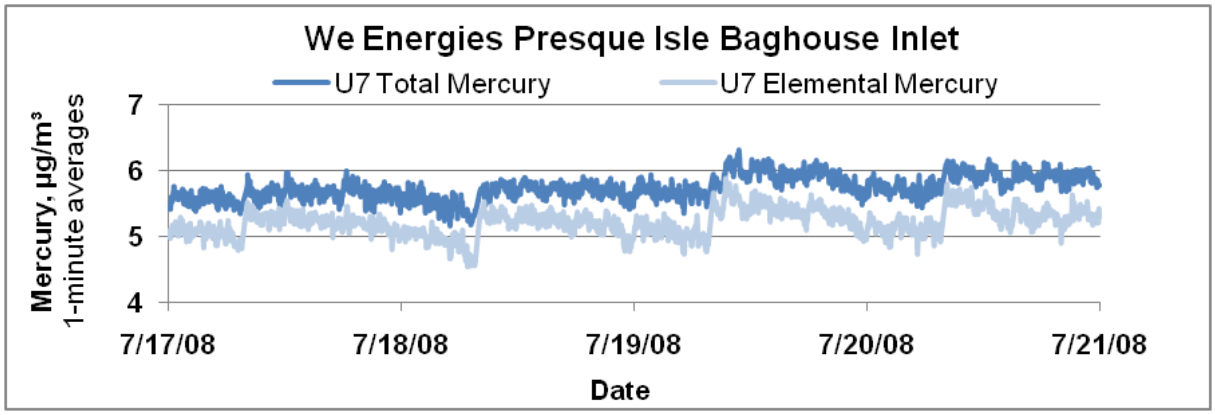


Figure 4-157. PIPP Unit 7 Inlet Total and Elemental Mercury; July 17–20, 2008.

Three recurring problems with the inlet system surfaced again in the third quarter of 2007. The actuator valve on the Unit 8 probe became stuck in the closed position after the daily calibration routine on August 17, 2008. The closed actuator valve prevents flue gas from being pulled into the probe fast loop from the duct. Instead, the eductor air would be forced

backwards and out through the stinger as the opposite end of the fast loop is closed. This also causes all calibration responses to continue to be accurate despite a problem with the probe. The effect of a closed actuator valve is displayed in Figure 4-158.

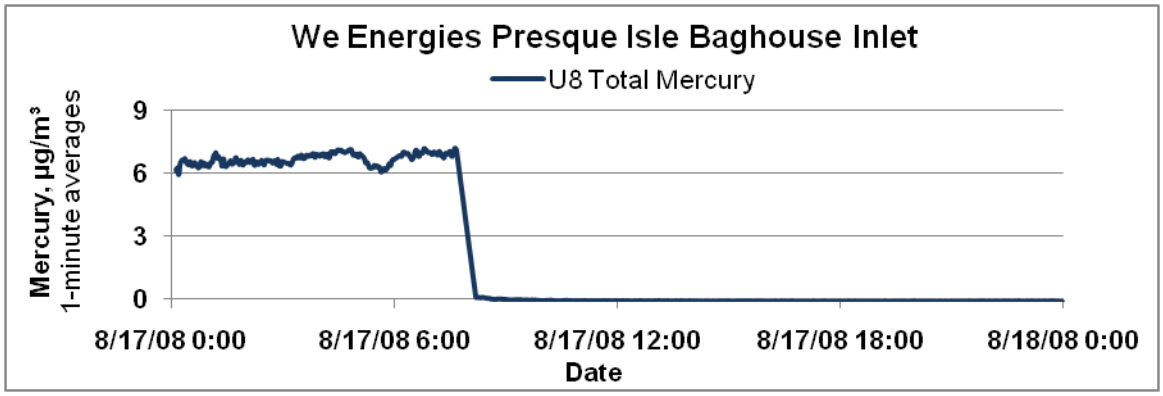


Figure 4-158. PIPP Unit 8 Inlet Total Mercury; August 17, 2008.

The system was switched to sample from the Unit 9 probe in August 20 until the actuator valve in the Unit 8 probe was repaired on September 11. The fix to the actuator valve was short lived as the valve became stuck again on September 23.

In addition to the problems with the actuator valve, the inlet mercury calibrator once again experienced the problem with the cooler temperature measuring a temperature of -99.0 °C. This error with the cooler temperature does not affect any operation of the calibrator unless it is in a calibration mode where the instrument is attempting to control the output mercury concentration. The daily calibration check of September 19 was affected by this error and therefore was not a valid calibration response.

The third recurring problem is not specific to any component of the inlet mercury system but rather an ongoing issue with the internal temperature of the analyzer in the CEMS shelter. As the internal temperature increases to above 35 °C, the ability of the lamp heater to maintain a stable temperature is compromised as shown in Figure 4-159.

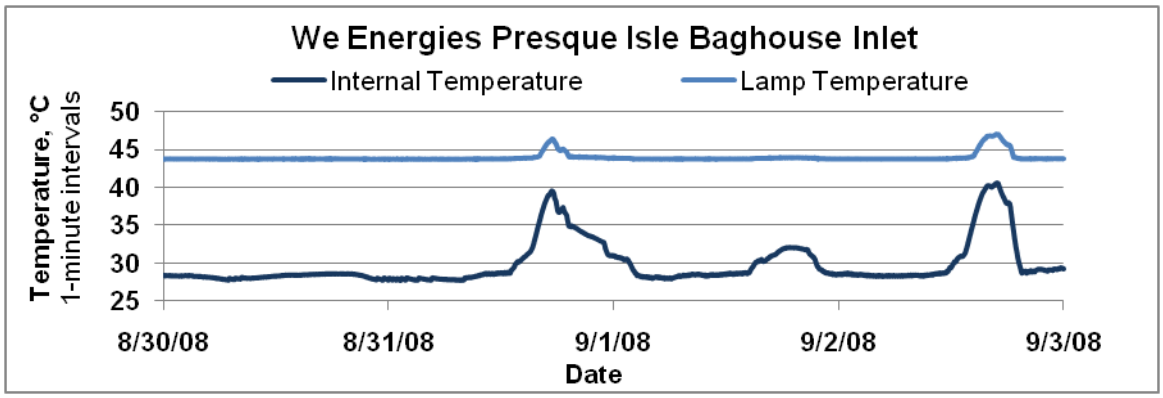


Figure 4-159. PIPP Units 7–9 Inlet Internal Temperatures; August 30–September 3, 2006.

4.15.9.1.12 Baghouse Inlet – Fourth Quarter 2008

The inlet mercury CEMS was sampling total and elemental mercury from the Unit 8 duct but a problem with the Unit 8 probe actuator valve required a change to the Unit 9 probe on October 1, 2008. Many small problems occurred with the system and probes during the fourth quarter of 2008 that caused multiple changes to which probe collecting the mercury sample. Sorbent screening tests on October 21–28 and December 7–14 also added to the limited mercury concentrations analyzed by the inlet system.

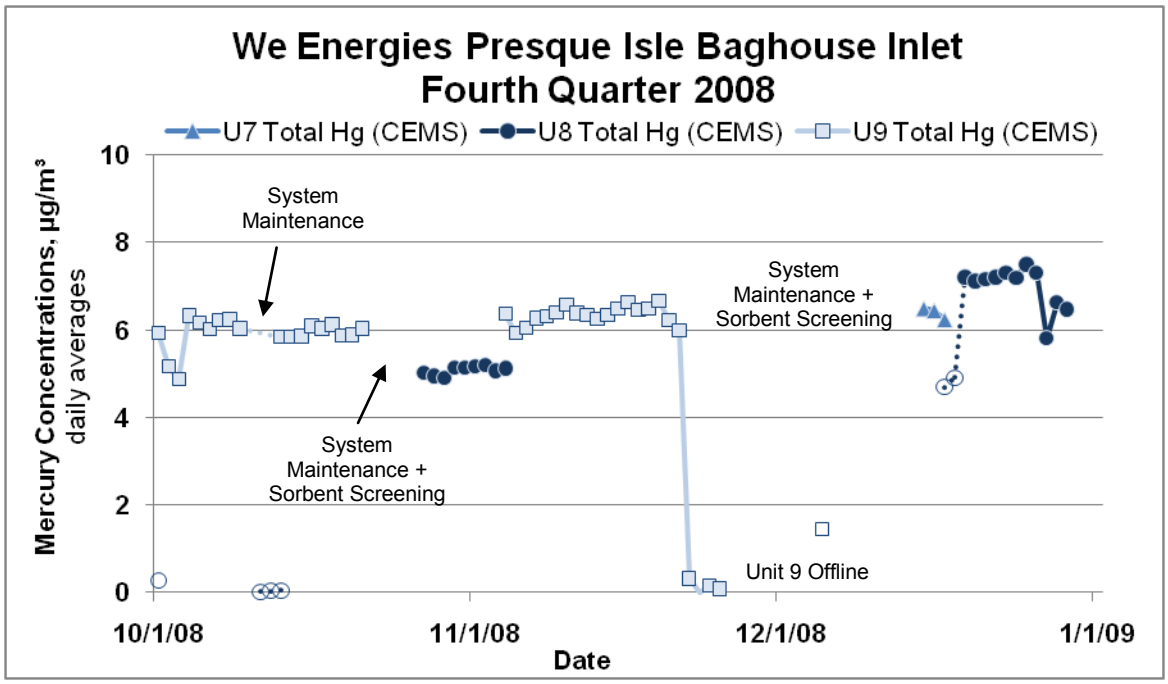


Figure 4-160. PIPP Units 7–9 Inlet Total Mercury Concentrations, 4Q08.

The system was configured such that the total channel could be switched between Unit 7, Unit 8, or Unit 9 total mercury measurements. Many sampling configurations were used for the fourth quarter of 2008 due to numerous problems with the mercury probes and two sorbent screening tests. The list of the probe configurations for the quarter is shown in Table 4-60.

Table 4-60. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 4Q08.

Start Date	End Date	Total Channel	Elemental Channel
10/01/08 00:00	10/01/08 11:47	Unit 8 Total Hg	Unit 8 Elemental Hg
10/01/08 11:48	10/09/08 08:53	Unit 9 Total Hg	None
10/10/08 08:54	10/13/08 14:08	Unit 8 Total Hg	Unit 8 Elemental Hg
10/13/08 14:09	10/21/08 10:22	Unit 9 Total Hg	None
10/21/08 10:23	10/27/08 08:56	Maintenance / Sorbent Screening Tests	
10/27/08 08:57	11/04/08 13:28	Unit 8 Total Hg	Unit 8 Elemental Hg
11/04/08 13:29	11/25/08 11:44	Unit 9 Total Hg	Unit 9 Elemental Hg
11/25/08 12:12	12/07/08 18:09	No Probes Operational	
12/07/08 18:10	12/15/08 13:59	Maintenance / Sorbent Screening Tests	
12/15/08 14:00	12/17/08 14:51	Unit 7 Total Hg	Unit 7 Elemental Hg
12/17/08 15:08	12/18/08 12:06	Unit 8 Total Hg	None
12/18/08 12:22	12/19/08 13:48	Unit 9 Total Hg	None
12/19/08 13:49	12/31/08 23:59	Unit 8 Total Hg	None

The quarterly linearity check was performed on November 20, 2008. The responses of the system during the three-point linearity check are recorded in Table 4-61 and they satisfy the requirements of CAMR.

Table 4-61. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 4Q08.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	11/20/08	14:40	5.0	4.96	-0.04	-0.8%	PASS
1 M	11/20/08	14:51	11.0	11.01	+0.01	+0.1%	PASS
1 H	11/20/08	15:03	18.0	17.82	-0.18	-1.0%	PASS
2 L	11/20/08	15:13	5.0	5.08	+0.08	+1.6%	PASS
2 M	11/20/08	15:24	11.0	11.00	0.00	0.0%	PASS
2 H	11/20/08	15:34	18.0	17.89	-0.11	-0.6%	PASS
3 L	11/20/08	15:45	5.0	5.11	+0.11	+2.2%	PASS
3 M	11/20/08	15:55	11.0	11.07	+0.07	+0.6%	PASS
3 H	11/20/08	16:05	18.0	17.94	-0.06	-0.3%	PASS
Low-Level Average			5.0	5.05	+0.05	+1.0%	PASS
Mid-Level Average			11.0	11.03	+0.03	+0.3%	PASS
High-Level Average			18.0	17.88	-0.12	-0.7%	PASS

The calculation of the availability of the inlet mercury CEMS for the fourth quarter of 2008 can be found in Table 4-62. A replacement of the mercury lamp (103 hours) and sorbent screening tests (145 hours) performed in October 2008 had a negative impact on the availability of the system to collect valid. The Unit 7 probe heater failed on November 25 to reduce the availability of the mercury CEMS for that month. Another round of sorbent screening tests affected the availability of the mercury CEMS in December 2008.

Table 4-62. PIPP Units 7–9 Inlet Mercury CEMS Availability, 4Q08.

Month	Operating Hours	Downtime Hours	Availability
October 2008	744 hours	296 hours	60.2%
November 2008	637 hours	175 hours	72.5%
December 2008	563 hours	246 hours	56.3%

The 2008 RATA tests were performed on the Unit 9 duct upstream of the PAC injection location using Method 30B sorbent traps on November 6, 2008. Paired sorbent traps were used at each of the three inlet ducts and the results analyzed on site using an Ohio Lumex analyzer for total gaseous mercury. The mercury system was only sampling total mercury from the Unit 9 duct at the time of the RATA tests and comparison to the M30B traps was within the 20% required. The samples were collected by Platt Environmental Services and the results of the Method 30B sorbent trap tests are found in Table 4-63.

Table 4-63. PIPP Units 7–9 Inlet Method 30B Sorbent Trap Test Results, November 2008.

Date	Location	M30B HgT µg/scm	CEMS HgT µg/scm	Relative Accuracy	Result
11/06/08	Unit 7 Inlet Average	5.52	N/A	N/A	N/A
11/06/08	Unit 8 Inlet Average	6.11	N/A	N/A	N/A
11/06/08	Unit 9 Inlet Average	5.76	6.11	8.3%	PASS

The analyzer mercury lamp required another replacement only 10 weeks after the lamp was installed in the analyzer on August 1, 2008. Due to the rapid degradation of the mercury lamps, Thermo continued to replace the lamps under warranty. A replacement lamp was received and installed on October 9 after the lamp had decreased to an intensity of 15,000 Hz. A chart of the intensity degradation over the life of the mercury lamp can be found in Figure 4-161. The mercury lamp installed in October only lasted another 10 weeks before another replacement was necessary on December 17.

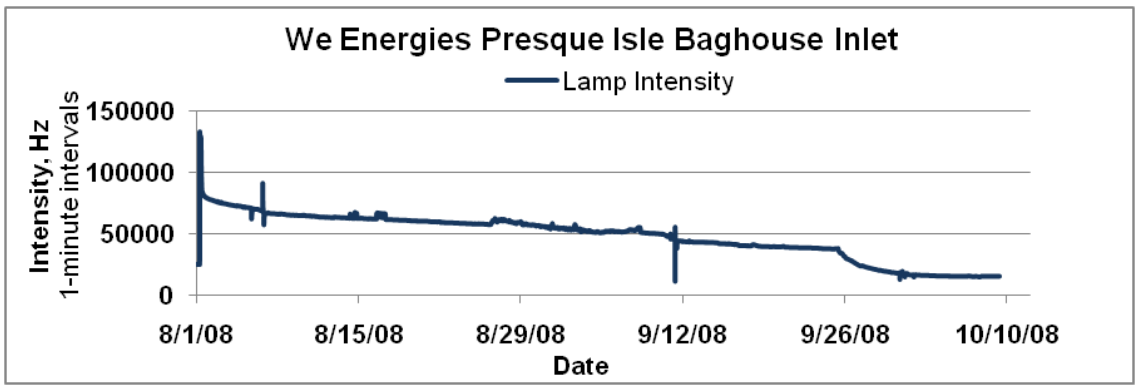


Figure 4-161. PIPP Units 7–9 Inlet Mercury Analyzer Lamp Intensity, August–October 2008.

Sampling from the Unit 8 probe continued to be problematic as the actuator valve was consistently unreliable and the probe could not be trusted to provide valid data even after on-site maintenance activities on October 9, 2008. Mercury concentrations measured from the Unit 8 probe from October 10 to October 13 were zero and the system did not respond to the daily calibration checks. The probe went through a complete inspection and cleaning during the sorbent screening tests on October 21–27 and returned to service on October 28.

The Unit 8 probe experienced more problems with a failure of the probe bench heaters on November 4, 2008. The measurements of the probe temperature are shown in Figure 4-162. The decrease in temperature triggered the low-level software failsafe temperature of 158 °C and forced the system into blowback mode. The Unit 8 probe was serviced in December 2008 with the probe bench firerod heaters, thermocouple probe, and high-temperature failsafe thermistor replaced.

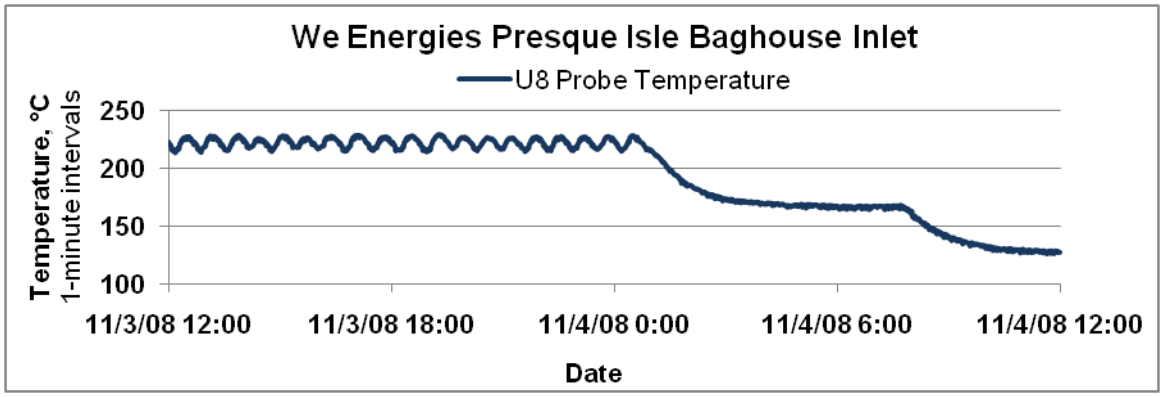


Figure 4-162. PIPP Unit 8 Inlet Mercury Probe Bench Temperature; November 3–4, 2008.

The Unit 7 also experienced failure of the probe bench heaters on November 25, 2008. The measurements of the probe temperature are shown in Figure 4-163. The failsafe thermistor located on the bottom of the probe bench completes the electrical circuit to power the probe heaters and it is designed to fail if the temperature is above 250 °C. The connections to the failsafe thermistor on this probe had become brittle and failed. This broke the electrical circuit to the probe firerod heaters and prevented them from keeping the probe bench hot. Like the Unit 8 probe earlier in the month, the decrease in temperature activated the low temperature failsafe and placed the system into blowback mode. The thermistor was replaced during the maintenance activities in December 2008.

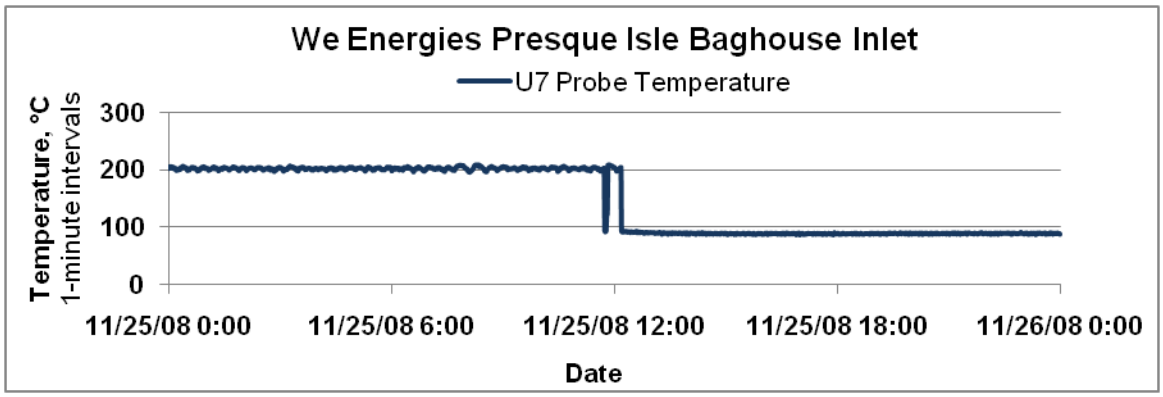


Figure 4-163. PIPP Unit 7 Inlet Mercury Probe Temperature; November 25, 2008.

Both the Unit 7 and Unit 8 probes were out of order in early December 2008. The Unit 9 boiler was also in an outage and ability to collect a mercury concentration. Maintenance activities to bring the probes back into service were completed on December 2–8 and the Unit 7 probe started collecting mercury measurements after sorbent screening tests on December 8–15.

Shortly after the Unit 7 probe started to collect inlet mercury data, the communication between the analyzer and the probe controller failed on December 18, 2008. All of the temperature and pressure measurements monitored by the Unit 7 probe controller stopped recording data and measured only "open" values. The system was eventually switched to sample only total mercury from the Unit 8 probe on December 19 and continued in that configuration for the rest of the quarter.

4.15.9.1.13 Baghouse Inlet – First Quarter 2009

The inlet mercury CEMS was sampling total mercury from the Unit 8 probe for the majority of the time between January 1 and February 26, 2009. Maintenance activities on January 27–29 and February 11 briefly interrupted sampling from Unit 8. On March 1, sampling was switched from the Unit 9 probe with a temporary probe switch from March 22–24 to the Unit 7 probe.

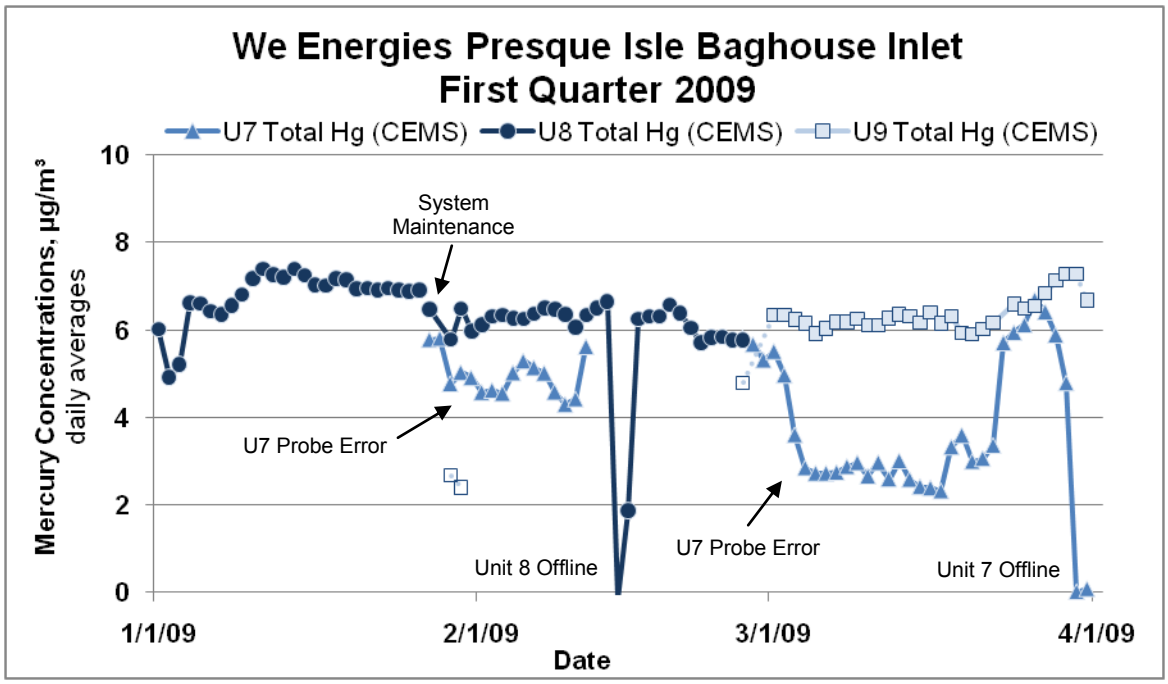


Figure 4-164. PIPP Units 7–9 Inlet Total Mercury Concentrations, 1Q09.

The system sampled total mercury from either Unit 8 or Unit 9 for most of the quarter. The tubing connected from the probes to the analyzer was configured to allow total mercury concentrations to be collected from probes from two different units simultaneously. The Unit 7 total mercury concentration was commonly collected on the elemental channel for most of the month. The list of the probe configurations for the quarter is shown in Table 4-64.

Table 4-64. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 1Q09.

Start Date	End Date	Total Channel	Elemental Channel
01/01/09 00:00	01/27/09 16:01	Unit 8 Total Hg	None
01/27/09 16:02	1/28/09 20:38	Unit 7 Total Hg	None
01/28/09 20:39	1/29/09 09:04	Unit 9 Total Hg	Unit 7 Total Hg
01/29/09 18:40	02/10/09 12:38	Unit 8 Total Hg	Unit 7 Total Hg
02/10/09 12:39	02/11/09 11:08	Unit 7 Total Hg	None
02/11/09 11:09	02/26/09 15:33	Unit 8 Total Hg	Unit 8 Elemental Hg
02/26/09 17:16	03/01/09 13:30	Unit 7 Total Hg	None
03/01/09 13:31	03/22/09 12:07	Unit 9 Total Hg	Unit 7 Total Hg
03/22/09 12:08	03/24/09 15:45	Unit 7 Elemental Hg	Unit 7 Total Hg
03/24/09 15:46	03/31/09 23:59	Unit 9 Total Hg	Unit 7 Total Hg

The quarterly linearity check was performed on March 13, 2009. The responses of the system during the three-point linearity check are recorded in Table 4-65 and they satisfy the requirements of CAMR.

Table 4-65. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 1Q09.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	3/13/09	14:15	5.0	5.17	+0.17	+3.4%	PASS
1 M	3/13/09	14:25	11.0	11.11	+0.11	+1.0%	PASS
1 H	3/13/09	14:37	18.0	18.04	+0.04	+0.2%	PASS
2 L	3/13/09	14:47	5.0	5.16	+0.16	+3.2%	PASS
2 M	3/13/09	14:56	11.0	11.13	+0.13	+1.2%	PASS
2 H	3/13/09	15:06	18.0	17.94	-0.06	-0.3%	PASS
3 L	3/13/09	15:19	5.0	5.13	+0.13	+2.6%	PASS
3 M	3/13/09	15:28	11.0	11.19	+0.19	+1.7%	PASS
3 H	3/13/09	15:38	18.0	17.90	-0.10	-0.6%	PASS
Low-Level Average			5.0	5.15	+0.15	+3.0%	PASS
Mid-Level Average			11.0	11.14	+0.14	+1.3%	PASS
High-Level Average			18.0	17.96	-0.04	-0.2%	PASS

The calculation of the availability of the inlet mercury CEMS for the first quarter of 2009 can be found in Table 4-66. The availability of the mercury system was much better than previous months due to the limited number of failed calibration checks and maintenance activities. The biggest contributor to unavailability calculations was the necessary downtime required to switch sampling from one probe to another and to recalibrate the system after the switch.

Table 4-66. PIPP Units 7–9 Inlet Mercury CEMS Availability, 1Q09.

Month	Operating Hours	Downtime Hours	Availability
January 2009	744 hours	76 hours	89.8%
February 2009	629 hours	37 hours	93.8%
March 2009	744 hours	58 hours	92.2%

The Unit 9 probe was unavailable for sampling total mercury while the probe fast loop and components were cleaned on January 30 and February 23, 2009. Other maintenance items included the replacement of the converter cores in the Unit 7 and Unit 8 probes. Thermo recommends that the converter cores be replaced every six months and the ability of the converter cores should be checked with a system integrity check by exposing the core to oxidized mercury and recording conversion back to elemental mercury. Since the inlet system is not equipped with an oxidizer and most of the mercury is measured as elemental, the true performance of the converter core cannot be quantified. Therefore, the converter cores were replaced as a preventative maintenance event. After new converter cores were installed in these probes, there was no noticeable change in the total mercury measurements from Unit 7 or Unit 8.

The daily calibration check responses failed CAMR criteria on January 2–3, 2009. However, the calibration check passed the criteria on January 4–5 without any corrections performed to the calibration factors or the mercury system. The moisture content of the filter is less under low load than it is under high load conditions and that caused the calibration gas that passes through the inertial filter would produce a different response.

The shift in the ability to record a consistent calibration gas response under changing boiler load conditions had been previously observed at Presque Isle as well as at other plant sites and it is recommended that calibrations should not be performed while the unit is offline to prevent a false error from being introduced into the mercury measurements. Typically, the mercury CEMS should be put into a blowback mode as soon as the unit is offline and this should be communicated to the data logger to prevent invalid data from being collected by the analyzer or any debris or contamination from being pulled into the probe during startup. The comparison between high load and low load boiler operation during the daily calibration check and the calibration span gas responses is found in Table 4-67.

Table 4-67. PIPP Unit 8 Inlet Total Mercury Calibration Responses; January 1–5, 2009.

Date	Time	Span	Level	Span Response		Unit 8 Load / Pct		Result
01/01/09	07:44	11.0	20.0	10.96	-0.2%	85 MW	100%	PASS
01/02/09	07:44	11.0	20.0	12.22	+6.1%	41 MW	~ 50%	FAIL
01/03/09	09:44	11.0	20.0	12.28	+6.4%	41 MW	~ 50%	FAIL
01/04/09	07:44	11.0	20.0	11.29	+1.5%	85 MW	100%	PASS
01/05/09	07:44	11.0	20.0	11.40	+2.0%	85 MW	100%	PASS

The mercury CEMS sampling configuration was changed to collect total mercury measurements from the Unit 8 probe on the total channel and the Unit 7 probe on the elemental channel on January 30, 2009. This was set up this way to collect baseline mercury concentrations from both units in preparation for the ash reburn testing. When Unit 7 is being sampled from a passive probe controller, the probe does not experience the routine scheduled blowbacks and the mercury concentrations quickly degrade over a short time. The effect of the dirty probe on the mercury measurements from Unit 7 are displayed in Figure 4-165.

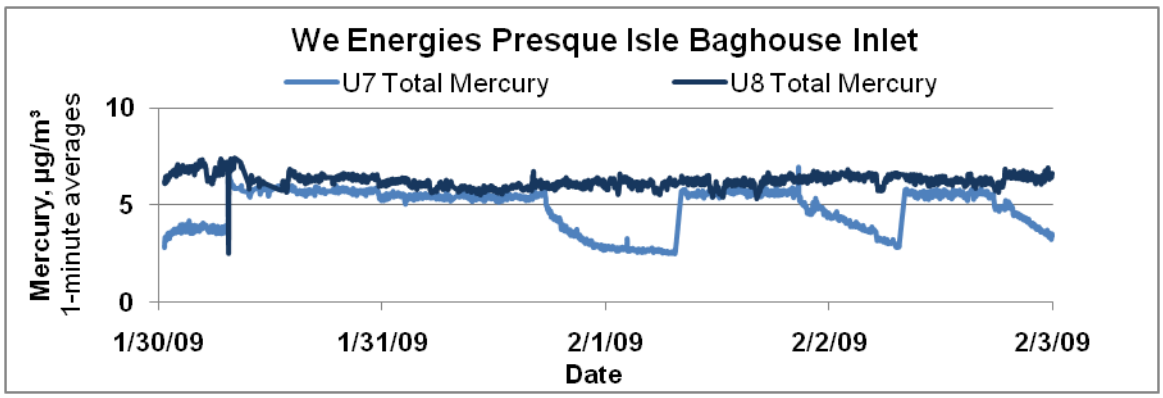


Figure 4-165. PIPP Units 7 and 8 Total Mercury Concentrations; January 30–February 2, 2009.

Since the Unit 7 probe concentrations recovered after a calibration check was initiated on the probe, it was decided to perform a calibration check every three hours to keep the Unit 7 mercury measuring correctly. This calibration routine change was programmed into the

analyzer software on February 3, 2009. This adjustment was effective in keeping the concentrations from the Unit 7 probe stable for the first few days of the change but the speed of the degradations continued to increase and the calibration routine every three hours was no longer effective in assuring correct mercury measurements. The mercury concentrations with the frequent calibration cycles can be found in Figure 4-166.

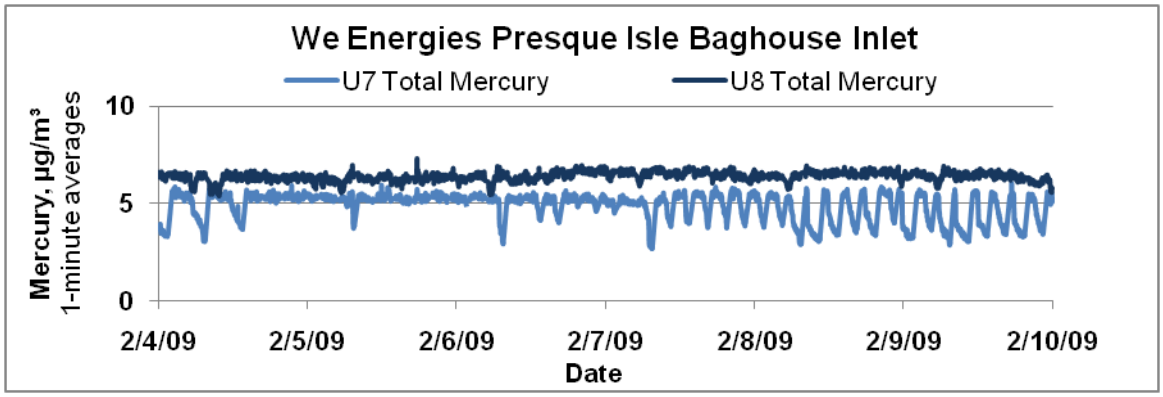


Figure 4-166. PIPP Units 7 and 8 Total Mercury Concentrations; February 4–9, 2009.

In order to correct for the problems in sampling mercury from the Unit 7 probe on the elemental channel an external software timer was developed to control the mercury analyzer and initiate a blowback on each of the three probes. This was done by using the MODBUS capabilities of the analyzer to receive commands from a computer or data logger. A program was developed by ADA-ES to send commands to the analyzer to switch to each of the three probe controllers and perform a blowback on the probe connected to the controller. The external timer software was programmed to switch to each of the three probes and perform a filter and stinger blowback routine on them every hour. This program was able to keep the Unit 7 mercury concentrations from degrading because of a dirty probe during the ash reburn tests on March 25–30, 2009. The mercury concentrations collected during the use of the external timer are shown in Figure 4-167. Unit 7 boiler went offline and the external timer was shut down after the ash re-burn tests were completed on March 30.

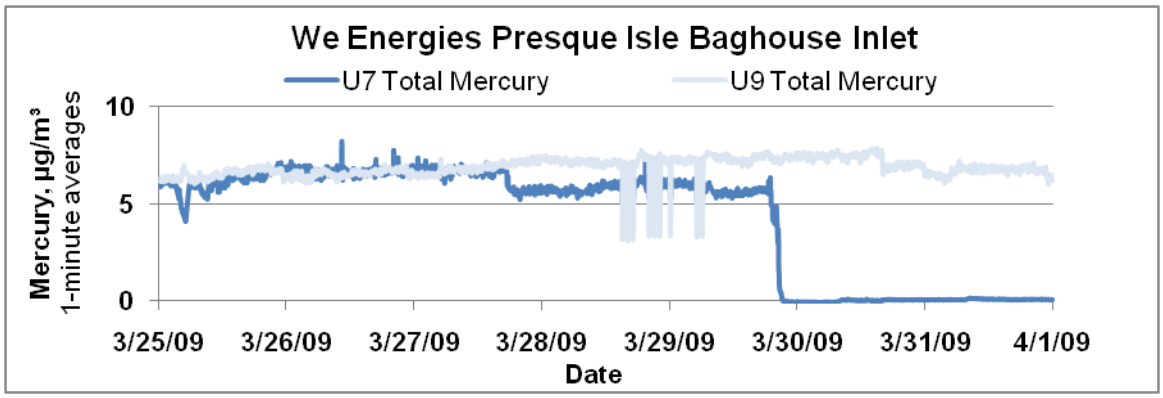


Figure 4-167. PIPP Units 7 and 9 Total Mercury Concentrations; March 25–30, 2009.

4.15.9.1.14 Baghouse Inlet – Second Quarter 2009

The mercury system collected data from all three of the probes during the second quarter of 2009. Sorbent screening tests interrupted stable mercury measurements from April 22–29. A couple of maintenance issues affected from which unit the mercury measurements were derived and analyzed. The mercury concentrations measured from the Unit 7 probe from June 10–30 were much less stable than the concentrations measured from the other probes and that indicated that the probe might require additional maintenance to improve performance.

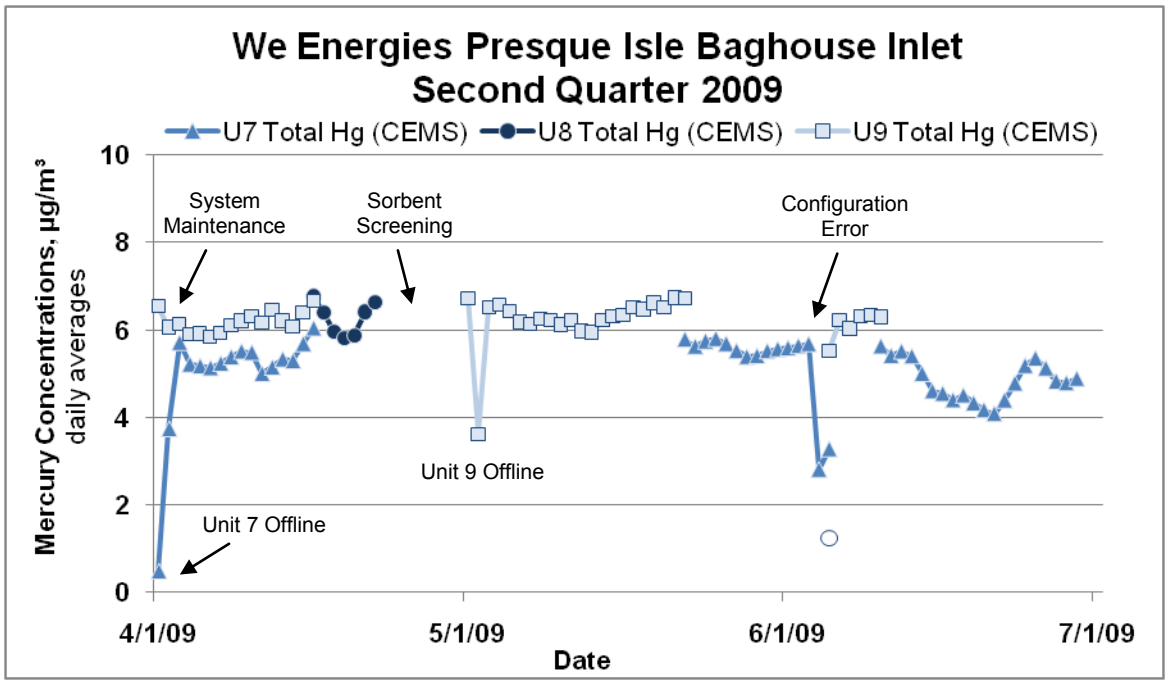


Figure 4-168. PIPP Units 7–9 Inlet Total Mercury Concentrations, 2Q09.

There was always one active unit and functional probe in which to sample mercury during the second quarter of 2009. Speciated mercury was collected from all three units at some point during the quarter. Total and elemental mercury concentrations were measured from the Unit 8 probe on April 16–22, Unit 7 probe on June 2–5, and Unit 9 from June 5–10. The list of the probe configurations for the quarter is shown in Table 4-68.

Table 4-68. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 2Q09.

Start Date	End Date	Total Channel	Elemental Channel
04/01/09 00:00	04/16/09 15:42	Unit 9 Total Hg	Unit 7 Total Hg
04/16/09 15:43	04/22/09 10:13	Unit 8 Total Hg	Unit 8 Elemental Hg
04/22/09 10:14	04/29/09 14:39	Sorbent Screening Tests	
04/29/09 14:40	05/01/09 14:52	Unit 8 Total Hg	Unit 8 Elemental Hg
05/01/09 14:53	05/22/09 15:01	Unit 9 Total Hg	None
05/22/09 15:02	06/02/09 16:33	Unit 7 Total Hg	None
06/02/09 16:34	06/05/09 13:53	Unit 7 Total Hg	Unit 7 Elemental Hg
06/05/09 15:39	06/10/09 12:06	Unit 9 Total Hg	Unit 9 Elemental Hg
06/10/09 12:07	06/30/09 23:59	Unit 7 Total Hg	None

The quarterly linearity check was performed on June 12, 2009. The responses of the system during the three-point linearity check are recorded in Table 4-69 and they satisfy the requirements of CAMR.

Table 4-69. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 2Q09.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	06/12/09	12:04	5.0	5.21	+0.21	+4.2%	PASS
1 M	06/12/09	12:14	11.0	11.41	+0.41	+3.7%	PASS
1 H	06/12/09	12:25	18.0	18.67	+0.67	+3.7%	PASS
2 L	06/12/09	12:36	5.0	5.05	+0.05	+1.0%	PASS
2 M	06/12/09	12:46	11.0	11.20	+0.20	+1.8%	PASS
2 H	06/12/09	12:56	18.0	18.33	+0.33	+1.8%	PASS
3 L	06/12/09	13:06	5.0	5.06	+0.06	+1.2%	PASS
3 M	06/12/09	13:17	11.0	11.24	+0.24	+2.2%	PASS
3 H	06/12/09	13:27	18.0	18.43	+0.43	+2.4%	PASS
Low-Level Average			5.0	5.11	+0.11	+2.2%	PASS
Mid-Level Average			11.0	11.28	+0.28	+2.5%	PASS
High-Level Average			18.0	18.48	+0.48	+2.7%	PASS

The calculation of the availability of the inlet mercury CEMS for the second quarter of 2009 can be found in Table 4-70. Sorbent screening tests were performed in April 2009 and this added 206 hours to the out-of-control period of the mercury system. The availability during May 2008 was the best calculated and was a result of the limited failed calibrations and no maintenance activities completed on the system during the month. However, an error with the calibrator and a couple of changes to sample probes decreased the availability for June 2008.

Table 4-70. PIPP Units 7–9 Inlet Mercury CEMS Availability, 2Q09.

Month	Operating Hours	Downtime Hours	Availability
April 2009	720 hours	301 hours	58.2%
May 2009	744 hours	21 hours	97.2%
June 2009	720 hours	95 hours	86.8%

The mercury lamp intensity inside the analyzer had decreased to an intensity level of less than 20,000 Hz on March 29, 2009. A replacement lamp was ordered, delivered, and installed in the analyzer on April 29. The failed experienced a longer life (19 weeks) than previous lamps. Regardless of the improvement in the lifetime of the lamp, Thermo sent a replacement lamp under warranty for the inlet analyzer because the lamp did not last for one full year as specified by the manufacturer. The mercury sample pump was also replaced on April 29, 2009. The chamber pressure inside the analyzer reflects the performance of the sample pump. The vacuum maintained by the pump decreases as the components inside the pump wear out. The chamber pressure recorded by the analyzer since the beginning of 2009 is shown in Figure 4-169.

The converter core located inside the Unit 9 probe was also replaced on April 29, 2009. The routine maintenance of replacing the converter cores in each of the probes was completed in the first four months of the year.

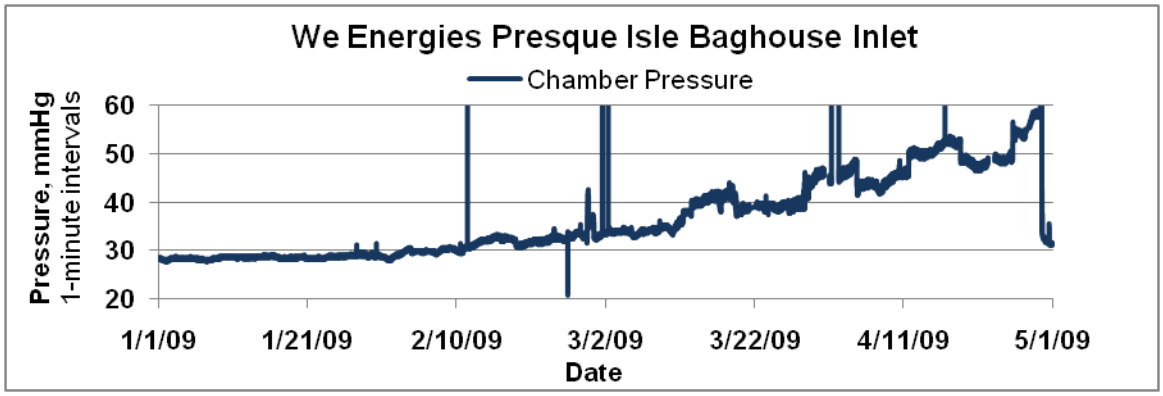


Figure 4-169. PIPP Units 7–9 Inlet Analyzer Chamber Pressure; January 1–April 30, 2009.

The electrical connection between the mercury reservoir and the interface board inside the calibrator was disconnected on June 3, 2009. The connection interfered with the stability of the span gas output concentration to the probe and caused the calibration checks to fail CAMR criteria on June 3 and June 4. The electrical connection to the interface board was reseated and the control was restored on June 5.

The procedure to switch sampling from one probe to another involves turning off the eductor from one probe, switching to another probe, and turning the eductor back on. This is to

ensure that the eductor is only being used on the probe that is currently being sampled and to limit the air use of the system. The eductor air going to the Unit 9 probe was left on when the system was switched to sample from the Unit 7 probe on June 10, 2008. The eductor air and the blowback air are supplied from the same air source for all probes. When the eductor from the non-sampled Unit 9 probe was turned off on June 23, the blowback air pressure for the Unit 7 probe increased. This demonstrated the relationship between the air pressures and the air supply to the mercury system.

4.15.9.1.15 Baghouse Inlet – Third Quarter 2009

The mercury system collected data from all three of the probes during the third quarter of 2009. The prototype Unit 8 probe, which was the original probe installed in June 2005, was replaced by a newer model mercury probe on July 13, 2009. While the new Unit 8 probe was installed, the probes installed on Unit 7 and Unit 9 were disassembled and thoroughly cleaned on July 13–16. After each of the probes was conditioned to the duct environment, they were sampled in turn to collect total mercury concentrations from each unit. The system was left to sample total and elemental mercury from the Unit 8 probe on August 28.

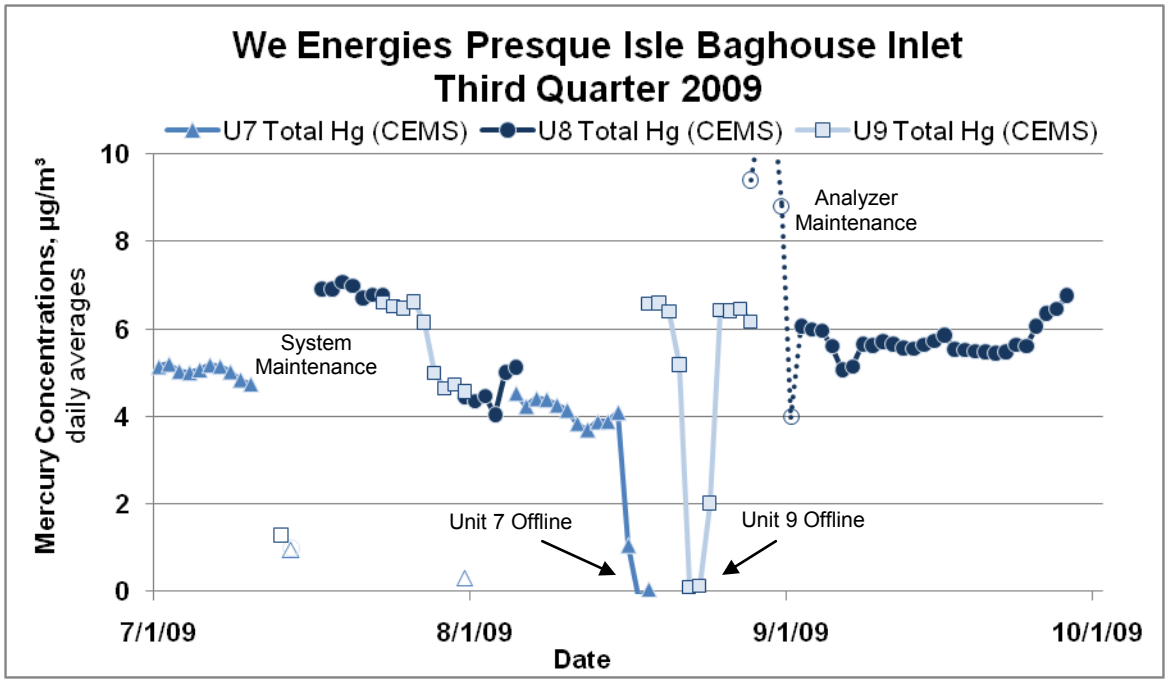


Figure 4-170. PIPP Units 7–9 Inlet Total Mercury Concentrations, 3Q09.

Each probe was configured to collect total mercury concentrations after the last round of maintenance was performed during the third quarter of 2009. Unit 8 inlet duct was sampled July 31–August 5, Unit 7 inlet duct was sampled August 5–18, and the Unit 9 inlet duct was sampled August 18–28. To facilitate transferring daily control and maintenance of the systems to plant personnel, ADA-ES set up the Unit 8 probe to sample total and elemental mercury for one full month from August 28 to the end of the project. The list of the probe configurations for the quarter is shown in Table 4-71.

Table 4-71. PIPP Units 7–9 Inlet Mercury CEMS Sampling Configuration, 3Q09.

Start Date	End Date	Total Channel	Elemental Channel
07/01/09 00:00	07/14/09 06:53	Unit 7 Total Hg	None
07/17/09 00:02	07/23/09 15:17	Unit 8 Total Hg	Unit 8 Elemental Hg
07/23/09 15:18	07/31/09 13:43	Unit 9 Total Hg	None
07/31/09 17:29	08/05/09 10:57	Unit 8 Total Hg	None
08/05/09 10:58	08/18/09 16:45	Unit 7 Total Hg	None
08/18/09 16:46	08/28/09 07:04	Unit 9 Total Hg	None
08/28/09 07:18	09/30/09 23:59	Unit 8 Total Hg	Unit 8 Elemental Hg

The quarterly linearity check was performed on September 16, 2009. The responses of the system during the three-point linearity check are given in Table 4-72. They satisfy the requirements of CAMR.

Table 4-72. PIPP Unit 9 Inlet Total Mercury System Linearity Check, 3Q09.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	09/16/09	11:32	5.0	4.99	-0.01	-0.2%	PASS
1 M	09/16/09	11:43	11.0	11.10	+0.10	+0.9%	PASS
1 H	09/16/09	11:53	18.0	18.14	+0.14	+0.8%	PASS
2 L	09/16/09	12:04	5.0	5.29	+0.29	+5.8%	PASS
2 M	09/16/09	12:14	11.0	11.26	+0.26	+2.4%	PASS
2 H	09/16/09	12:25	18.0	18.34	+0.34	+1.9%	PASS
3 L	09/16/09	12:35	5.0	5.34	+0.34	+6.8%	PASS
3 M	09/16/09	12:46	11.0	11.31	+0.31	+2.8%	PASS
3 H	09/16/09	12:57	18.0	18.19	+0.19	+1.1%	PASS
Low-Level Average			5.0	5.21	+0.21	+4.2%	PASS
Mid-Level Average			11.0	11.22	+0.22	+2.0%	PASS
High-Level Average			18.0	18.22	+0.22	+1.2%	PASS

The calculation of the availability of the inlet mercury CEMS for the third quarter of 2009 can be found in Table 4-73. A failed calibration check over the Independence Day holiday weekend prevented the system from being corrected in a timely manner and resulted in three days of out-of-control operation for July 2009. Several maintenance activities in July also added to the invalid data collected by the mercury system. Additional maintenance activities in August 2009 reduced the availability of the system as the lamp was replaced and the conditioning time over a weekend resulted in a large amount of invalid data. After the system was corrected for the new lamp installed in the analyzer, the system did not fail a single calibration check in September 2009 and this resulted in a very high availability for the system.

Table 4-73. PIPP Units 7–9 Inlet Mercury CEMS Availability, 3Q09.

Month	Operating Hours	Downtime Hours	Availability
July 2009	744 hours	181 hours	75.7%
August 2009	671 hours	84 hours	87.5%
September 2009	716 hours	14 hours	98.0%

While the mercury CEMS was collecting total mercury concentration data from the Unit 9 probe, the unit went offline from August 23–24, 2009. As demonstrated at various times during this project, the mercury system does not perform accurate calibrations when the unit is offline. The responses to the calibration check with calibration factor adjustments normalized to the response of August 19 can be found in Table 4-74. The responses to the calibration span gas appeared to shift at the same time that the unit was offline on August 22 and did not recovery quickly after the unit was back to full load on August 26. Analysis of the calibration responses could not continue past August 28 due to maintenance activities on the mercury analyzer.

Table 4-74. PIPP Unit 8 Inlet Total Mercury Calibration Responses; August 21–26, 2009.

Date	Time	Span	Level	Span Response		Unit 9 Load / Pct		Result
08/20/09	04:00	11.0	20.0	10.89	-0.5%	85 MW	100%	PASS
08/21/09	04:00	11.0	20.0	10.94	-0.3%	72 MW	85% ↓	PASS
08/22/09	04:00	11.0	20.0	11.96	+4.8%	0 MW	0%	PASS
08/23/09	04:00	11.0	20.0	12.07	+5.3%	0 MW	0%	FAIL
08/24/09	04:00	11.0	20.0	12.30	+6.5%	0 MW	0%	FAIL
08/25/09	04:00	11.0	20.0	11.48	+2.4%	73 MW	85% ↑	FAIL
08/26/09	04:00	11.0	20.0	11.55	+2.8%	85 MW	100%	PASS
08/27/09	04:00	11.0	20.0	11.73	+3.6%	85 MW	100%	PASS
08/28/09	04:00	11.0	20.0	11.48	+2.4%	85 MW	100%	PASS

The analyzer mercury lamp had degraded to maintenance levels and it was replaced on August 28, 2009. The new lamp required "burn-in" and the intensity to stabilize before being recalibrated with PMT voltage adjustment on August 31. Although the intensity of the new lamp experienced considerable degradation throughout the month, the calibration factors were regularly updated to correct for the drift and the system never failed a calibration check. The amount of zero drift, however, likely caused the slow increase in the total mercury measurements on the Unit 8 system during the last week of September.

4.15.9.2 Units 7–9 Baghouse Outlet Mercury CEMS

The Thermo iSeries Mercury CEMS was installed at the baghouse outlet location on December 19, 2005. The mercury analyzer, calibrator, probe control box, pump, and zero air supply were installed into the new CEMS shelter and equipment rack located in the baghouse enclosure.

A desktop computer was also installed into the contractor trailer to connect to the baghouse outlet system via serial cable and the iPort computer program. The iPort software was developed by Thermo and designed to communicate with all of the iSeries instruments to enable full control of the instruments by a remote device. This computer located in the trailer was set up to allow remote connection to the system through the Presque Isle Remote Access Portal.

There are several appendices in this report related to the performance of the baghouse outlet mercury CEMS. Appendix N is a record of the daily average mercury concentrations as measured by the mercury CEMS. Appendix O contains the complete calibration record from December 2005 to September 2009. Appendix P lists the monthly maintenance records and availability calculations from January 2008 to September 2009.

4.15.9.2.1 Baghouse Outlet – First Quarter 2006

The start of valid sample data was collected on December 20 with the passing of the first calibration check through the probe critical orifice. At this early stage of the project, valid data was defined as the measurement of stable and consistent mercury concentrations with several repeatable responses to calibration zero and span gas. The on-board data logger of

the analyzer was configured to record one-minute averaged data and routine collection of the data was performed by ADA-ES to determine the performance of the system with continuous analysis of the data.

The mercury analyzer and calibrator were set up with the typical operating conditions as recommended for the Thermo mercury CEMS. Although the recommended set points changed over the duration of the project and continued operation of the system, a table of the initial configuration of set points and alarms can be found in Table 4-36.

Table 4-75. PIPP Outlet Mercury CEMS Initial Set Point Configuration.

Setting	Minimum Alarm	Maximum Alarm	Set Point
Umbilical Temperature	135 °C	170 °C	150 °C
Probe Temperature	190 °C	230 °C	200 °C
Converter Temperature	750 °C	780 °C	760 °C
Dilution Pressure	40 psig	60 psig	45.4 psig
Blowback Pressure	40 psig	70 psig	55.8 psig
Eductor Pressure	10 psig	25 psig	18.6 psig
PMT Voltage	N/A	N/A	937.2 V

Unlike the inlet mercury CEMS, mercury concentrations measured by the outlet system are directly affected by the injection of PAC for mercury control. Figure 4-171 shows the clear changes in mercury concentrations measured by the outlet mercury CEMS for the first quarter of 2006.

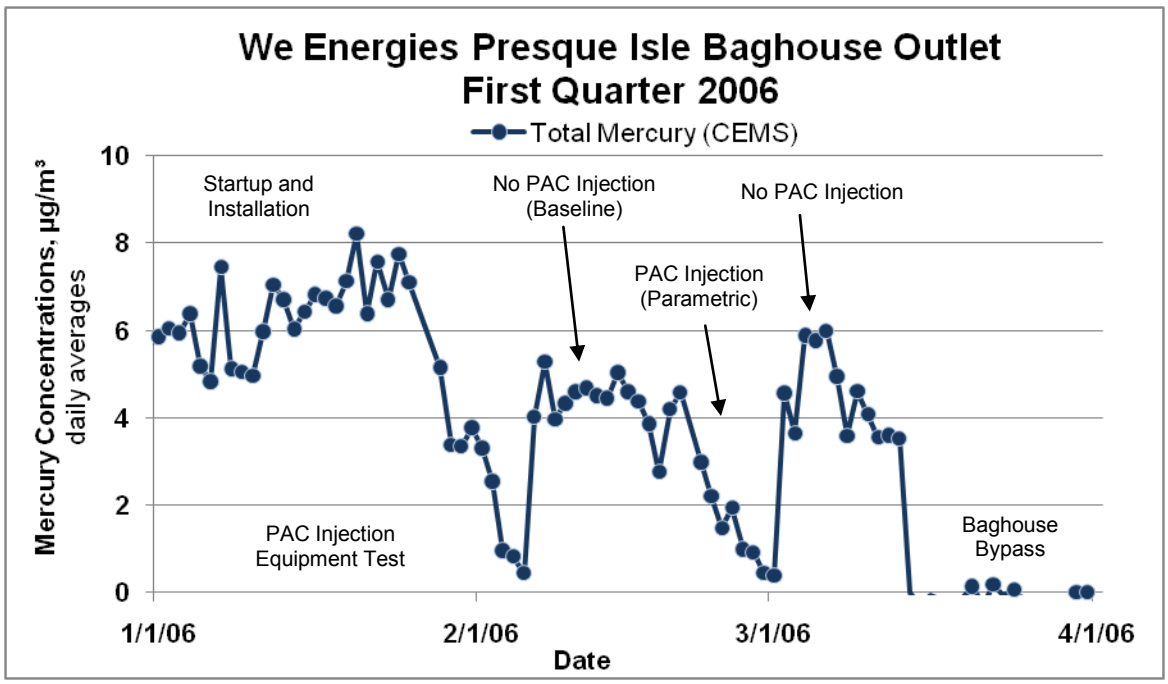


Figure 4-171. PIPP Outlet Total Mercury Concentrations, 1Q06.

The system was configured to perform daily calibration checks on December 23, 2005. The calibration routine was defined as a check of the zero and span responses directly to the analyzer followed by a check of the zero and span response of the system through the probe. The check of the system was performed by injecting calibration span gas with a concentration of 6.0 µg/m³ at the critical flow orifice upstream of the dilution module. The name of the type of calibration performed by injecting calibration gases upstream of the critical flow orifice is called an "orifice calibration." The zero gas phase of the daily calibration check is commonly called "orifice zero" gas mode and the calibration gas phase is called the "orifice span" gas mode.

The communication between the mercury system and the ESC data logger was completed on January 14 and the data logger was programmed to send a request to the mercury system to perform a calibration routine every morning at 7:35 AM. The software-initiated calibration routine would include the analyzer zero and span response check but the ESC-initiated calibration routine would only perform a 10-minute orifice zero check and a 10-minute orifice span response check. During this time, the software and the data logger would start their own calibration routine and two calibration checks were performed each day.

The software of the mercury analyzer was upgraded from version 00.04.52.088 to 00.04.65.101 on January 28, 2006. Unfortunately, the data stored in the analyzer was not downloaded immediately before the software upgrade and three days of data was lost when the data logger was reset. The software upgrade allowed more data content to be stored by the internal data logger for more thorough analysis of the data and operating conditions. Some of the new content recorded by the software included probe temperature, probe air pressures (dilution air, eductor, orifice, and venturi), sample flow rate, and calibration factors (backgrounds and coefficients). The new mercury system content was added to the list of data stored by the analyzer on February 3.

The baghouse outlet mercury system performed two calibration checks each day. One calibration check was initiated by the ESC data logger. A recalibration was automatically performed by the analyzer software shortly after the data logger-initiated check and was designed to update the calibration factors loaded into the analyzer based on the response of the calibration zero and span gases. This second calibration was designed to make sure that any drift observed by the analyzer was corrected on a daily basis. The original method of recalibrating the system involved changing the background factor based on the zero response and then adjusting the dilution ratio based on the span response. The coefficient factor was not changed. Based on the calibration responses and mercury measurements, there was a considerable amount of drift with the outlet analyzer. Table 4-37 contains the record of the first week of calibration checks performed after January 14 by the ESC data logger.

Table 4-76. PIPP Outlet Calibration Check Responses; January 14–20, 2006.

Date	Time	Level	Span	Zero Response		Cal Response		Result
01/14/06	07:36	6.0	10.0	-0.24	-2.4%	6.40	+4.0%	PASS
01/15/06	07:36	6.0	10.0	-0.35	-3.5%	6.35	+3.5%	PASS
01/16/06	07:36	6.0	10.0	0.03	+0.3%	6.99	+9.9%	PASS
01/17/06	07:36	6.0	10.0	-0.22	-2.2%	6.92	+9.2%	PASS
01/18/06	07:36	6.0	10.0	-0.33	-3.3%	7.04	+10.4%	FAIL
01/19/06	07:36	6.0	10.0	-0.72	-7.2%	5.81	-1.9%	PASS
01/20/06	07:36	6.0	10.0	0.60	+6.0%	6.74	+7.4%	PASS

The dilution air pressure set point was adjusted following the software upgrade. The dilution pressure was previously set to about 35 psig but changes to the air supply increased the dilution pressure to 45 psig, a more appropriate value for the dilution air pressure. While changes were made to the air source, the eductor pressure control valve to the probe was accidentally turned off and the eductor pressure was zero from January 29 to February 3, 2006. The increase in dilution pressure also caused the vacuum applied to the critical flow orifice to increase from 17.5 psig to greater than 21 psig. This increase in pressure produced a better vacuum assuring that the flow orifice in the probe is under the appropriate vacuum for critical flow.

The blowback pressure transducer failed on February 9, 2006. The blowback pressure maintained by the probe controller dropped from about 44 psig to 2 psig. A replacement transducer was not immediately available for the probe controller. As a temporary fix, blowback air was bypassed from the transducer and regulator inside the controller and routed through an external mechanical gauge to control the pressure to 60 psig.

The mercury concentrations measured by the outlet system are dependent on the operation and effectiveness of mercury capture by the injected PAC. The mercury system collected stable concentrations while it was conditioning after installation from January 8–28, 2006. The initial tests of the PAC injection system took place on January 28 to February 2 and the outlet mercury system was able to capture the data from the injection tests. After the injection tests were complete, the system returned to a baseline condition on February 6 (no injection of PAC). The mercury concentrations measured by the outlet CEMS are shown in Figure 4-172.

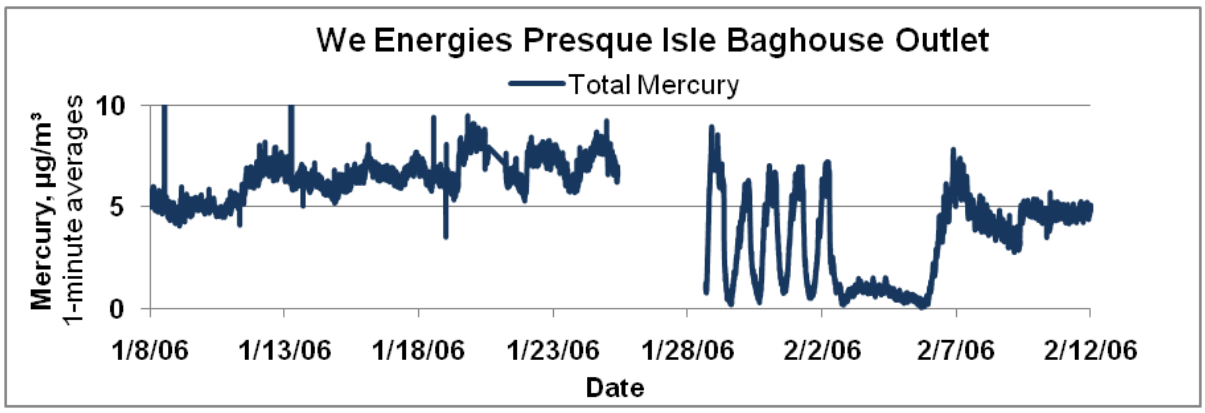


Figure 4-172. PIPP Outlet Total Mercury Concentrations; January 8–February 12, 2006.

Baseline tests for the TOXECON project were performed during the week of February 13, 2006. Baseline testing was done without PAC injection to get measurements of the mercury concentrations without mercury capture at the outlet of the baghouse. Samples of coal and ash were taken during the baseline period as well as mercury (Ontario Hydro and Method 324), halogen (Method 26A), and particulate testing (Method 5) on the flue gas into and out of the baghouse. The comparison of the total mercury collected by the mercury CEMS and the results of the Ontario Hydro samples are displayed in Figure 4-173 as collected and analyzed by GE Energy Management Services. The Ontario Hydro tests also indicated that the elemental portion of mercury at the outlet of the baghouse was 88% with the remainder in the oxidized form.

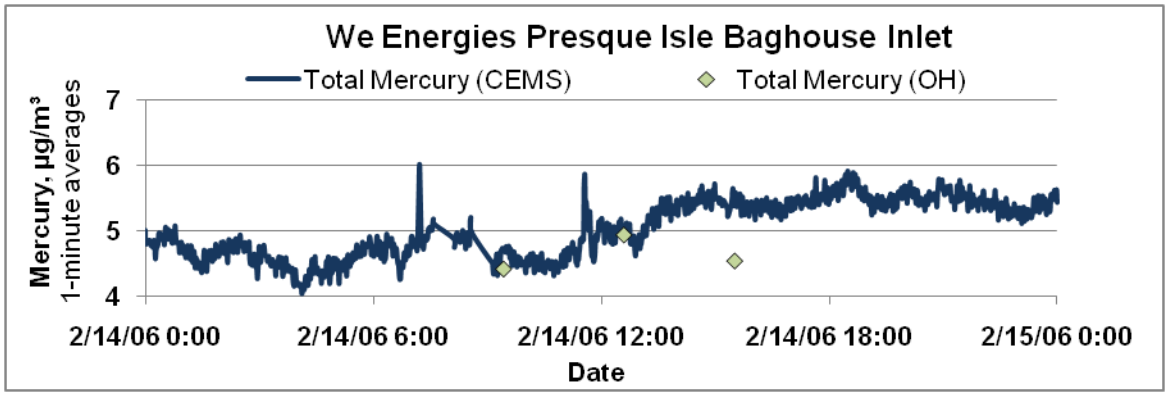


Figure 4-173. PIPP Outlet Total Mercury CEMS-Ontario Hydro; February 14, 2006.

For Ontario Hydro testing, twenty-four test points were sampled using six ports at the baghouse common inlet and outlet test locations. The speciated mercury sample trains met

all specifications required by the Ontario Hydro method. Triplicate tests were performed at the outlet to the baghouse location. The results are shown in Table 4-38 and show that the CEMS and the Ontario Hydro results differed by 9.9% and the error is well within the 20% agreement required by the EPA to pass the Relative Accuracy Test Audit (RATA).

Table 4-77. PIPP Outlet Ontario Hydro Test Results; February 14, 2006.

Date	Time	OH HgT µg/dscm	OH HgT µg/scm	CEMS HgT µg/scm	Differential	Result
02/14/06	09:25	4.96	4.41	4.63	5.0%	PASS
02/14/06	12:35	5.55	4.94	5.25	6.3%	PASS
02/14/06	15:30	5.10	4.54	5.39	18.7%	PASS
02/14/06	AVG	5.20	4.63	5.09	9.9%	PASS

Parametric tests of several different PAC injection rates were performed between February 20 and March 1, 2006. The overall goal of these tests was to establish a correlation between injection of DARCO Hg and mercury removal. The injection of activated carbon had a direct effect on the concentrations measured by the mercury CEMS at the baghouse outlet. Prior to parametric testing, the baghouse was put through one complete cleaning cycle to remove the residual cake off the bags. This was done by initiating a manual clean cycle six times to ensure every pipe in every compartment was pulsed. On February 20, the PAC injection was started and that decreased the mercury concentrations at the outlet to very close to zero. The results can be found in Figure 4-174.

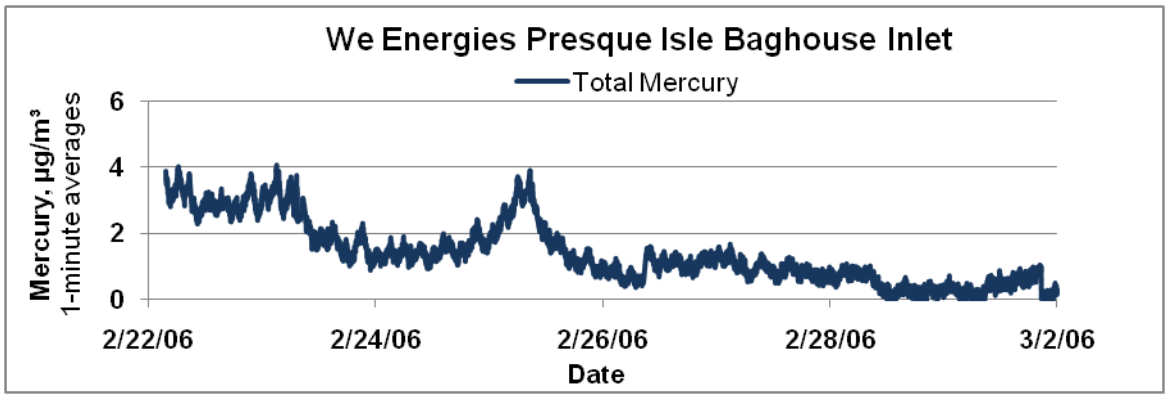


Figure 4-174. PIPP Outlet Total Mercury; February 20–March 2, 2006.

Before parametric testing was completed, the PAC injection was turned off after hot embers were discovered inside all of the baghouse hoppers on March 2, 2006. The baghouse was put into bypass mode and all compartments were isolated. The outlet mercury system was not exposed to any flue gas and it could not measure any mercury concentration during the bypass of the baghouse. The unit returned to service on March 3 and the mercury CEMS began to measure flue gas concentrations again. As the baghouse was inspected from March 13–24, it was placed back into a bypass mode and the mercury system did not record any mercury concentrations during this time. The flue gas was bypassed away from the baghouse for the remainder of the first quarter. While the baghouse was in bypass, no calibration checks were performed March 18–30. When calibration checks resumed on March 31, the output concentration of the calibrator was set to 5.0 µg/m³.

4.15.9.2.2 Baghouse Outlet – Second Quarter 2006

The baghouse outlet mercury CEMS was in sample mode during the second baghouse outage from March 13 to May 22, 2006. The mercury CEMS measured zero mercury during the time that the baghouse was bypassed as the probe was sampling only ambient air inside the duct. The baghouse was put back into service on May 22 and mercury concentrations increased quickly and slowly stabilized from May 22–30. The mercury concentrations measured at the outlet fluctuated from May 30 through the end of the quarter due to the restart of PAC injection parametric tests. The mercury concentrations recorded by the analyzer for the second quarter of 2006 are presented in Figure 4-175.

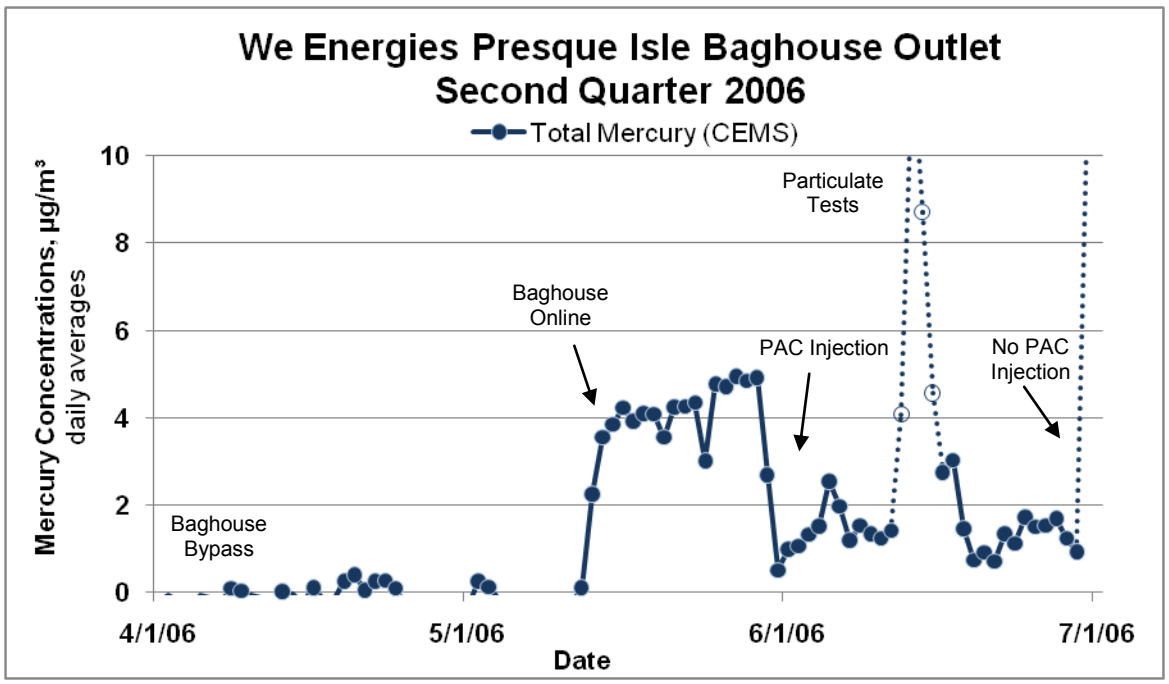


Figure 4-175. PIPP Outlet Total Mercury, 2Q06.

The baghouse returned to service with flue gas from Unit 7 on May 12, 2006. The mercury concentrations measured at the outlet during startup of the baghouse are shown in Figure 4-176. Mercury concentrations measured after the baghouse returned to service were comparable to those measured during baseline testing in February 2006.

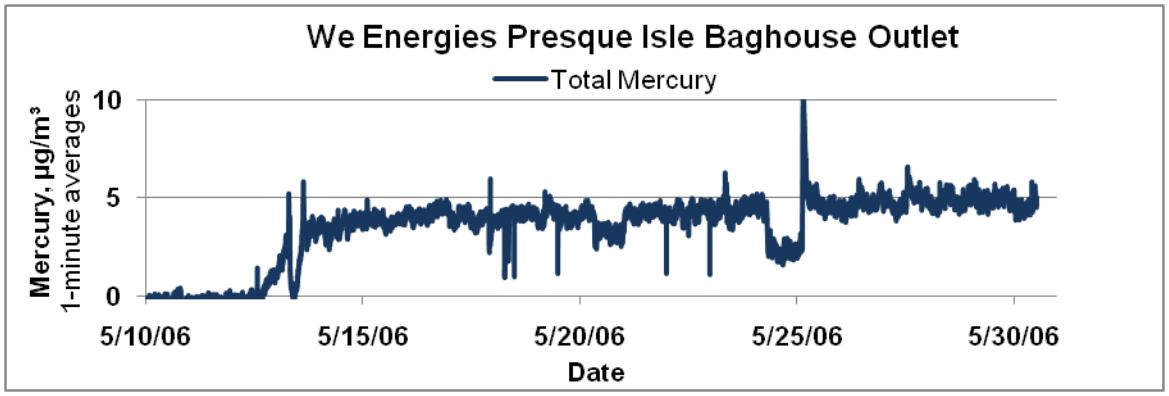


Figure 4-176. PIPP Outlet Total Mercury; May 10–30, 2006.

The daily calibration checks of the outlet system resumed on May 19, 2006. In the week leading up to the restart of the PAC injection parametric tests, it was important to ensure that the zero drift experienced by the outlet analyzer was diligently controlled. In addition to the daily calibration check initiated by the ESC data logger, the analyzer was programmed to

check the zero response of the instrument and correct for any changes in the drift. This check and adjustment of the system background factor was performed every four hours. The system would also be periodically recalibrated with a change of the dilution factor because of the response to the calibration gases. The updates to the calibration factors leading up to the start of the parametric tests are represented in Table 4-78. For the records indicated by "SET," the responses to the calibration gases represent the concentration measured prior to the update of the calibration factors during the calibration routine.

Table 4-78. PIPP Outlet Calibration Check and Recalibration; May 23–30, 2006.

Date	Time	Level	Span	Zero Response		Cal Response		Result
05/23/06	07:39	5.0	15	-0.05	-0.3%	4.60	-2.7%	PASS
05/23/06	16:46	5.0	15	-0.03	-0.2%	4.71	-1.9%	SET
05/24/06	07:39	5.0	15	-0.55	-3.7%	4.70	-2.0%	PASS
05/25/06	00:46	5.0	15	-0.24	-1.6%	4.92	-0.5%	SET
05/25/06	07:39	5.0	15	-0.27	-1.8%	5.04	+0.3%	PASS
05/26/06	07:39	5.0	15	-0.51	-3.4%	4.86	-0.9%	PASS
05/27/06	00:46	5.0	15	0.01	+0.1%	4.82	-1.2%	SET
05/27/06	07:39	5.0	15	-0.08	-0.5%	5.13	+0.9%	PASS
05/28/06	05:28	5.0	15	0.17	+1.1%	4.85	-1.0%	SET
05/28/06	07:39	5.0	15	-0.06	-0.4%	4.96	-0.3%	PASS
05/29/06	07:39	5.0	15	0.16	+1.1%	5.29	+1.9%	PASS
05/30/06	07:39	5.0	15	-0.11	-0.7%	5.26	+1.7%	PASS

Figure 4-177 shows that the mercury outlet reading responded quickly to the PAC injection, but the signal was very noisy compared to earlier parametric tests. This was explained by the outlet mercury value was affected by the flue gas. The temperature of the flue gas would continue to have an impact on the baghouse outlet mercury measurements and mercury removal calculations for the duration of the project.

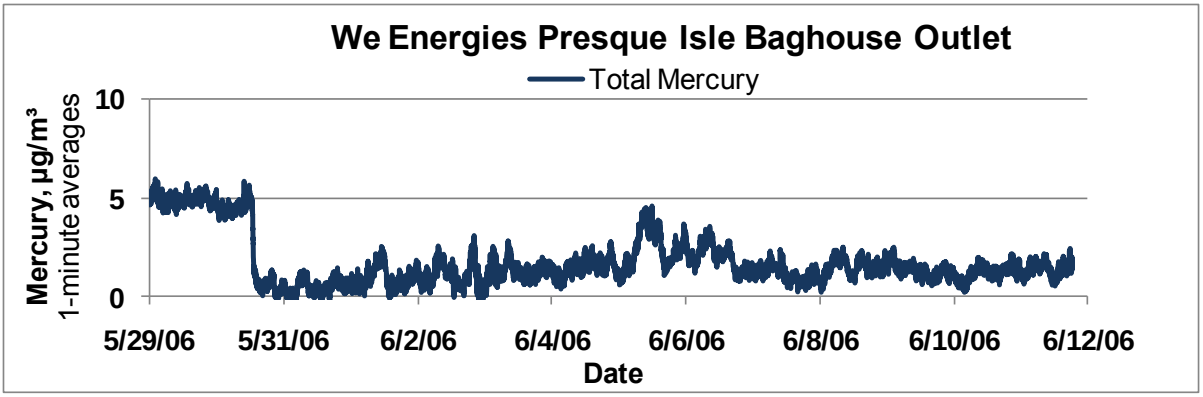


Figure 4-177. PIPP Outlet Total Mercury; May 29–June 11, 2006.

Activated carbon injection was temporarily stopped to conduct particulate testing from June 12–16, 2006. Parametric testing resumed when the particulate tests were complete and the analyzer responded immediately to the mercury control equipment. On June 29, plant personnel attempted to remove ash and PAC from the ash silo and encountered problems with excessive dusting. The injection of PAC was stopped on June 29 and the analyzer once again measured the increase of mercury at the baghouse outlet. A chart showing the responses of the mercury CEMS to the changes in activated carbon injection can be found in Figure 4-178.

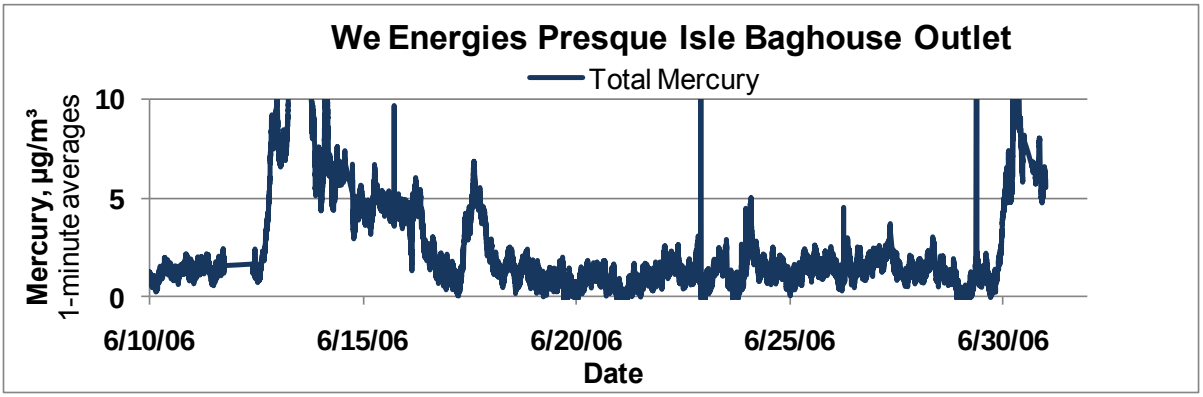


Figure 4-178. PIPP Outlet Total Mercury; June 11–30, 2006.

The outlet analyzer software was upgraded to version 00.04.86.122 on April 21, 2006. The software installed on the outlet analyzer was the same version as the software on the inlet analyzer. The new version of the software was installed to correct some of the problems with the alarms that were passed to the plant DCS and data logger but it did not correct the issue with the automatic recalibration routines initiated by the analyzer software. In addition to the

analyzer software upgrade, the DCS also was updated to allow several other alarms to be properly transmitted from the CEMS to the DCS.

The mercury CEMS continued to perform an ESC data logger-initiated calibration at 7:35 AM. Due to the differences between the data logger time and the analyzer time, the record of the calibration as collected in the analyzer data does not always match the data logger time. Small corrections were often made to the analyzer time to match the data logger data but the analyzer time occasionally differed from the data logger by up to five minutes.

The outlet mercury system failed to perform any of the daily calibration checks when the software was upgraded on April 21, 2006. Digital inputs were improperly set to default parameters and the analyzer did not receive the command from the data logger to check the calibration. The baghouse was not in service and the system was not sampling flue gas so the changes to the digital input configuration were not corrected until May 19.

The correct span gas concentration was questioned because of excessive fluctuations in mercury concentrations measured at the baghouse outlet during PAC injection. The calibrator output concentration was changed from 5.0 µg/m³ to 12.0 µg/m³ on June 14. This was changed back to 5.0 µg/m³ on June 27 but adjusted again to 10.0 µg/m³ on June 28.

The software update also changed several of the previously defined probe pressure set points saved by the analyzer. The dilution pressure changed from 44.0 to 40.5 psig and the eductor pressure was increased from 11.6 to 18.2 psig. The chamber pressure also decreased from 40.6 to 35.6 mmHg on April 20, 2006. Many of these involuntary changes were not corrected until June 2006 as the set point pressures were adjusted several times after the software upgrade. The dilution air was eventually set to 49.5 psig and the eductor pressure to 14.2 psig on June 13.

The probe temperature set point was increased from 190 °C to 200 °C on May 9, 2006. The increase in the probe heater temperature was to alleviate some of the concern of “cold spots” along the gas path inside the probe. Cold spots are important to control with the probe because mercury has a tendency to “stick” or “scrub” onto the surface of materials that are not kept at a proper temperature. In addition to the increase in probe temperature, the

umbilical temperature was increased from 150 °C to 160 °C on June 9 and again to 170 °C on June 13 to ensure that the transportation of mercury from the probe to the analyzer was not also subject to the "scrubbing" of mercury.

During the second quarter of 2006, the dilution ratio that was reset during the calibration span gas response increased from 20.00 to 33.00 by June 27. The increase in the dilution factor did not represent the change in the actual dilution ability of the probe but rather a change in the software in order to calibrate the system due to lamp degradation. As the lamp intensity decreases, the amount of mercury that the analyzer can detect decreases and this results in a corresponding multiplier (dilution ratio) increase. On June 28, the PMT voltage was increased from 930V to 983V to compensate for the decrease in lamp intensity. This change resulted in an overall decrease in the calculated dilution ratio to 22.18.

4.15.9.2.3 Baghouse Outlet – Third Quarter 2006

The intermittent injection of activated carbon for mercury control resulted in a large difference in the mercury concentrations measured at the baghouse outlet during the third quarter of 2006. The mercury concentrations collected during the quarter are presented in Figure 4-179. The injection of activated carbon was halted on June 29 due to excessive dusting when ash and PAC were unloaded from the ash silo. Injection resumed on August 18 and continued with transition and parametric testing of activated carbon on September 15–24. PAC injection was once again stopped on September 24 due to excessive dusting from the ash silo.

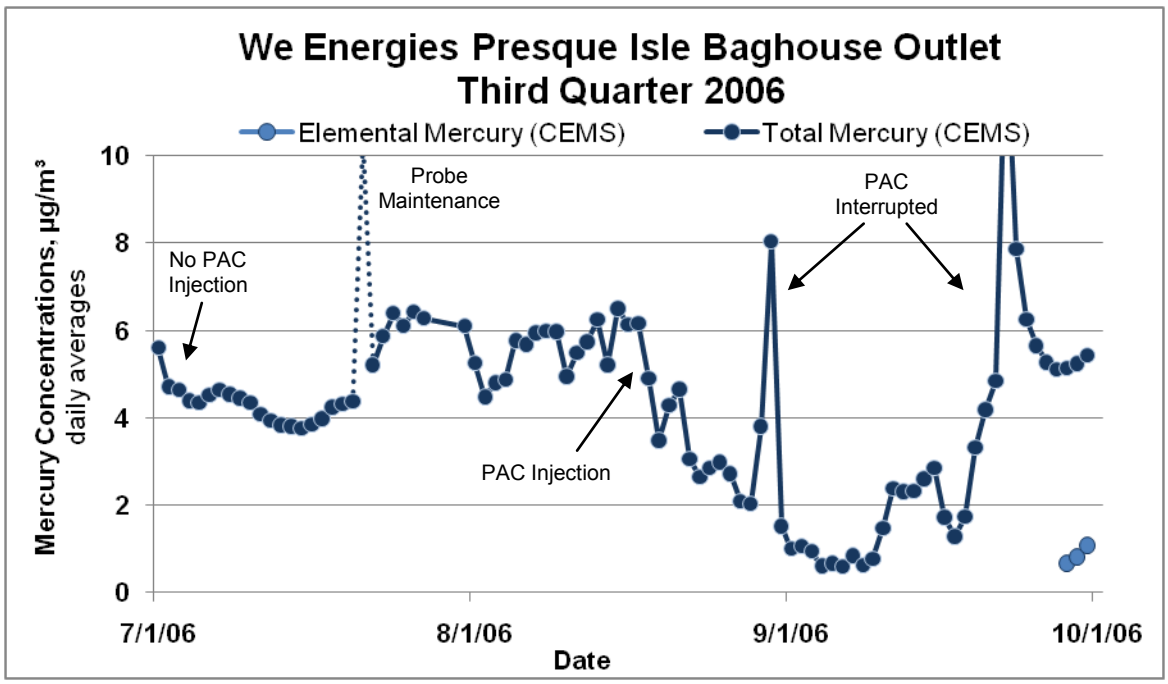


Figure 4-179. PIPP Outlet Total and Elemental Mercury, 3Q06.

During the week of July 18–23, 2006, the mercury extraction probe installed at the baghouse outlet location was modified to include an "actuator valve" mounted on the top of the probe. The addition of the actuator valve was a probe modification designed by Thermo to perform calibrations that are more acceptable to EPA regulations and requirements.

The actuator valve allows the probe to perform "filter" calibrations that are more compliant to EPA regulations and requirements than the "orifice" calibrations. During previous system calibration checks, the calibration zero and span gases would be injected to the probe downstream of the inertial filter and upstream of the critical orifice and dilution module. The modification was designed to inject the span gas directly into the fast loop upstream of the inertial filter in order to perform true calibrations through the entire flue gas path of the probe. The actuator valve located at the exhaust end of the fast loop will close during calibrations and force the span gas through one of the venturi pressure ports to flood the fast loop and would be sampled through the inertial filter.

When the probe is sampling flue gas, the actuator valve opens and the probe would function as previously designed. To test the new calibration routine, the first successful filter calibration check was performed on July 22, 2006. The software of the analyzer was set up

to call for a filter calibration at 10:03 and 22:03 every day. Unfortunately, these calibration routines were invalidated because the software was updating the calibration factors for each of the cycles and no valid hands-off calibration check was performed from July 22–31.

During the modifications to the probe, the two lines were accidentally switched at the mercury probe. This caused eductor air to be fed into the calibration valve at the probe and the calibration gas to be plumbed into the eductor assembly inside the probe. Because of the connections to the fast loop, this caused the filter span responses to be accurate but the orifice span measurements to be unresponsive. The corrections to the plumbing inside the probe were corrected on July 31, 2006.

The mercury calibrators were originally designed with a vacuum pump to keep the critical orifice in the probe from becoming over pressurized during an orifice zero or orifice span. The new design called for the installation of a check valve to improve the performance of the calibrator by not using a pump to regulate this increase in pressure.

The stability of the dilution air pressure was also upset during modifications to the outlet system in July 2006. The dilution pressure recorded during sample mode was greatly different from the dilution pressure during a calibration routine. When the probe was in normal sampling mode, the dilution pressure was reading 41.9 psig. The dilution pressure would increase to almost 60 psig when the system was placed into an orifice calibration or filter calibration gas mode. This led to incorrect system recalibrations because the calculation of an accurate dilution factor requires that the pressure is relatively close in all gas modes.

It was determined that when the pump was removed from the outlet calibrator and replaced with a check valve, one of the bulkhead fittings on valve #4 mounted to the back of the analyzer was loose. The valve connected to this bulkhead was tightened and accidentally rotated 180° from its correct position and the tubing was reconnected to the valve as if the valve was still in the original orientation. Once the valve was reinstalled in the correct orientation, the error with the dilution pressure was resolved.

Software was also upgraded on the mercury analyzer to version 00.05.15.139 and the software of the mercury calibrator was upgraded to version 00.04.35.038. This software was designed to fix the minimum and maximum alarm settings, provide more reliable automatic calibration routines, and record more measurement parameters to the internal data logger. The new version of the software accidentally disabled remote control of the instruments through the iPort program and another version of the analyzer software was released to upgrade the mercury CEMS to version 00.05.18.142. In an attempt to make sure that the mercury analyzer had the latest software with the newest improvements, the software was updated again to version 00.05.24.148 on September 7, 2006. This last upgrade of the software caused the calibration of the flow transducer inside the analyzer to reset and the measured flow rate of the system increased from 0.215 LPM to 0.535 LPM. This measurement does not affect any calculations performed by the analyzer to report mercury concentrations but rather only used as a monitoring and troubleshooting measurement.

In addition to the upgrade to the analyzer and calibrator software, the measurement interface board located inside the probe controller was also upgraded. The previous revision "A" of the interface board was replaced with revision "C" on July 31, 2006.

The first test of the speciation capabilities of the outlet mercury CEMS was at the end of the third quarter of 2006. The configuration of the system was adjusted to measure both total and elemental mercury concentrations from the outlet of the baghouse on September 28. The system was also set up to perform only filter calibration responses as initiated by the ESC data logger on September 28. The initial calibration checks while the system was in speciation mode resulted in very poor span gas responses on the elemental channel. Despite the poor responses, the system was not corrected to record accurate mercury on the elemental channel by the end of the quarter. The speciated mercury concentrations during a period of no PAC injection can be determined from Figure 4-180.

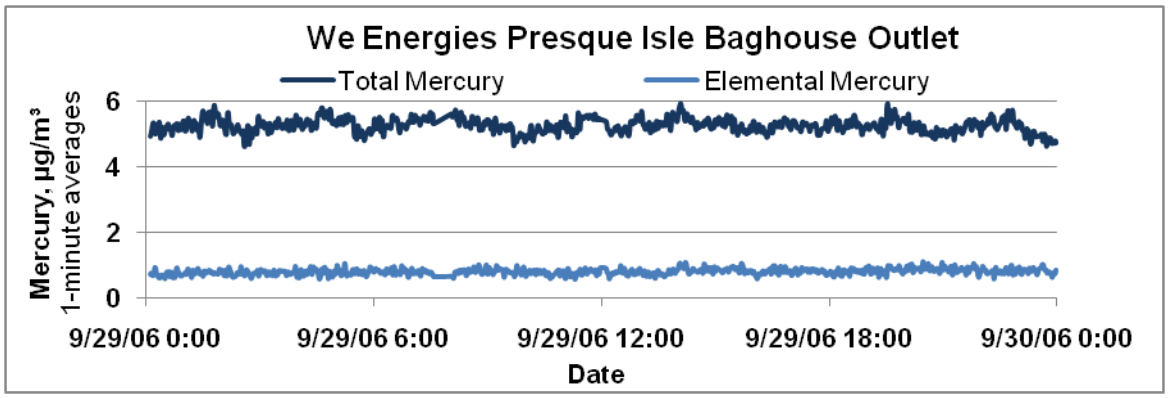


Figure 4-180. PIPP Outlet Total and Elemental Mercury; September 29–30, 2006.

The mercury detection chamber temperature measurements from inside the mercury analyzer at the baghouse outlet were null starting on June 30, 2006. The connection from the detection cell to the interface board was reconnected on July 10 but the temperature measured was equivalent to the ambient temperature inside the analyzer. Additional repairs on July 21 fixed the temperature of the optics bench.

4.15.9.2.4 Baghouse Outlet – Fourth Quarter 2006

The mercury CEMS installed at the outlet of the baghouse began the fourth quarter of 2006 measuring total and elemental mercury concentrations. The system was also configured to perform only filter calibrations as of September 28. Activated carbon injection parametric tests resumed on October 11 with long-term mercury control to achieve 90% removal starting on November 7 and continued through the rest of the quarter. The mercury concentrations collected by the analyzer are shown in Figure 4-181.

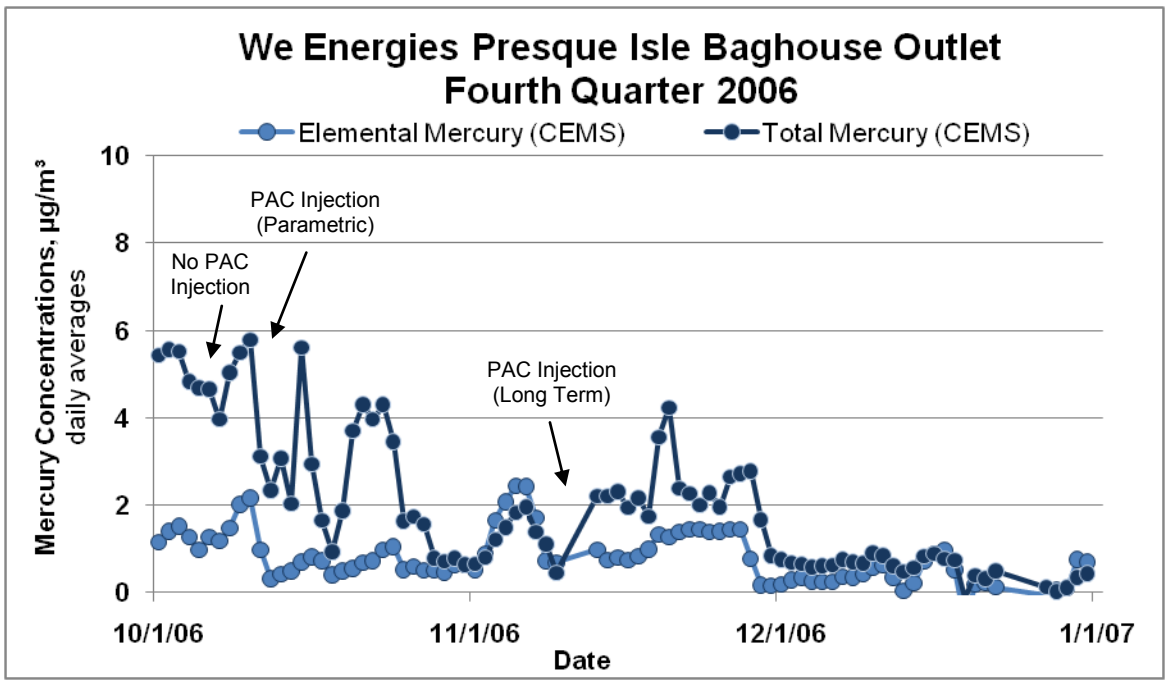


Figure 4-181. PIPP Outlet Total and Elemental Mercury, 4Q06.

When the analyzer was collecting data in speciation mode, the calibration gas responses were observed for the total and elemental channels independently. Although the criteria that the calibration check must satisfy are based only on the total mercury response to zero and span gas, it was important to record the elemental mercury responses while sampling in speciation mode. The calibrator was designed to output a known concentration of elemental mercury and therefore both the total and elemental channels should respond identically to the elemental calibration gas. The elemental and total calibration factors of the Thermo mercury analyzer are dependent on each other so both responses should be taken into consideration when performing recalibration or data correction activities.

The total mercury and elemental mercury channel responses to the zero and span gases were closely monitored and they satisfied all the requirements of the CAMR criteria. Example data of the total and elemental mercury calibration gas responses are recorded in Table 4-79. The elemental responses were more unstable than the total mercury responses between November 29 and December 12, 2009. Although the total mercury responses ranged from -4.8% to +2.7% over the two weeks, the elemental responses ranged from -11.2% to +2.5%

over the same period. The pass/fail results listed in Table 4-79 are only based on the response of the total channel.

Table 4-79. PIPP Outlet Mercury Calibration Responses; November 29–December 12, 2006.

Date	Time	Span	Level	Elemental Span Response		Total Span Response		Result
11/29/09	07:37	10.0	5.0	4.69	-3.1%	4.96	-0.4%	PASS
11/30/09	07:37	10.0	5.0	4.40	-6.0%	4.75	-2.5%	PASS
12/01/09	07:37	10.0	5.0	4.85	-1.5%	4.94	-0.6%	PASS
12/02/09	07:37	10.0	5.0	4.20	-8.0%	4.97	-0.3%	PASS
12/03/09	07:37	10.0	5.0	3.88	-11.2%	4.80	-2.0%	PASS
12/04/09	07:37	10.0	5.0	4.16	-8.4%	4.78	-2.2%	PASS
12/05/09	07:37	10.0	5.0	4.46	-5.4%	4.52	-4.8%	PASS
12/06/09	07:37	10.0	5.0	4.77	-2.3%	5.13	1.3%	PASS
12/07/09	07:37	10.0	5.0	4.81	-1.9%	4.84	-1.6%	PASS
12/08/09	07:37	10.0	5.0	4.62	-3.8%	4.88	-1.2%	PASS
12/09/09	07:37	10.0	5.0	4.42	-5.8%	5.27	2.7%	PASS
12/10/09	07:37	10.0	5.0	4.68	-3.2%	5.06	0.6%	PASS
12/11/09	07:37	10.0	5.0	5.25	2.5%	5.12	1.2%	PASS
12/12/09	07:37	10.0	5.0	4.76	-2.4%	4.60	-4.0%	PASS

Despite the occasional failures of the outlet mercury CEMS to pass each daily calibration check and automatically correct the calibration factors in the event of any failed calibration responses, the data was routinely analyzed and corrected manually by ADA-ES.

By calculating the background and coefficient factors that would result in a perfect calibration response, the mercury concentration data was corrected using the calculated calibration factors. This allowed the data to be corrected “instantaneously” in the data file based on any daily fluctuations in the calibration responses. The corrected mercury concentrations were used in all reported mercury data and removal calculations. An example

of the comparison between uncorrected data captured by the analyzer and the corrected data based on calibration factors can be found in Figure 4-182. The corrected data does not greatly differ from the uncorrected data due to the outlet system performing very well with respect to the daily calibration check responses and only minor correction of the data was necessary.

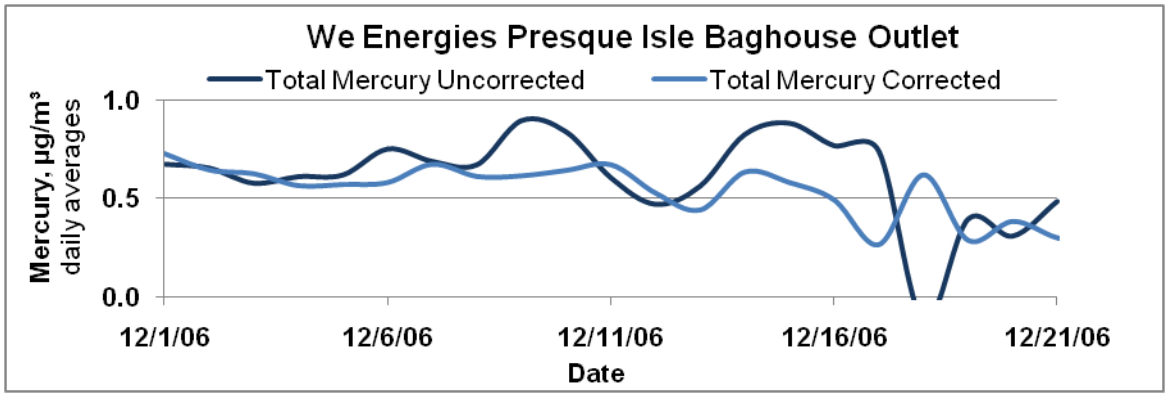


Figure 4-182. PIPP Outlet Total Mercury Corrected Concentrations; December 1–21, 2006.

Data was collected by the analyzer and downloaded daily by ADA-ES operating from an off-site computer. Based on the zero and span gas responses during a valid calibration check, the calibration factors were adjusted and applied to the mercury concentration data to provide the most accurate mercury measurements possible. The calibration factors saved in the analyzer software, however, were not always updated and resulted in several uncorrected calibration check failures.

4.15.9.2.5 Baghouse Outlet – First Quarter 2007

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation. The total and elemental concentrations collected by the analyzer are shown in Figure 4-183. The baghouse was offline from February 24–27 and the outlet system measured zero concentration of mercury during this time. An adjustment to the solar blind filter installed in the outlet analyzer also had significant changes to the mercury concentrations detected by the system.

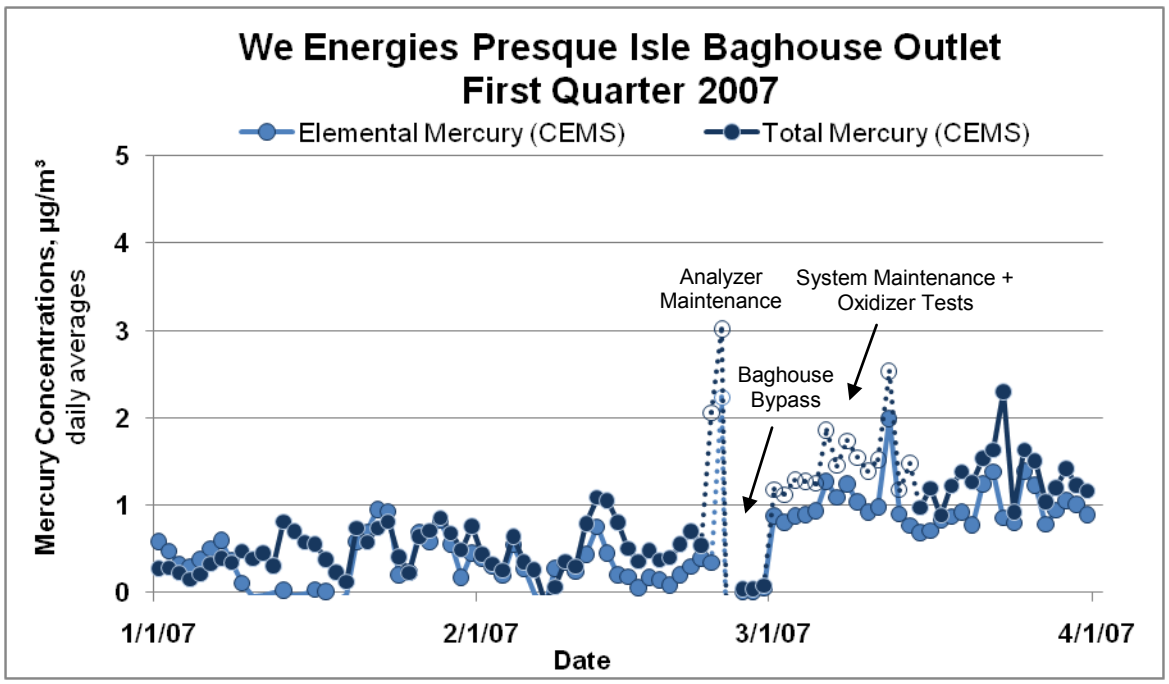


Figure 4-183. PIPP Outlet Total and Elemental Mercury, 1Q07.

The analyzer and calibrator software was upgraded on March 13, 2007. The new version of the analyzer software was 00.05.68.192 and the calibrator was upgraded to version 00.04.54.058. In previous versions of the software, the instrument calibration routine and the system calibration routine shared the same set of calibration factors. The only way to calibrate the system was to change the dilution ratio while sending calibration gas to the probe. This new version of the software created two sets of calibration factors (backgrounds and coefficients) so the instrument factors could be different from the system factors. This allowed the dilution ratio to remain constant while changing only the coefficients during a manual system recalibration. The new analyzer software also allowed for automatic calibration checks while in speciation mode and renamed the "filter" and "analyzer" calibration gas modes as "system" and "instrument" calibrations, respectively. The updated calibrator software allows six preset span concentrations to be stored in the calibrator and selected by the analyzer.

During the installation of the new software, all of the set points stored in the analyzer were lost in the upgrade therefore all of the operational parameters of the mercury system needed to be reset. This resulted in several changes to the operating conditions of the system,

including minor adjustments to the temperature and pressure settings. The probe bench temperature was increased to 240 °C before being reduced to 220 °C and the converter temperature increased to 800 °C before reset to 760 °C.

The analyzer software allows mercury measurements to be compensated based on the drift in lamp intensity and changes in temperature and pressure inside the analyzer. When the system was installed in 2006, the lamp compensation and temperature compensation were turned on. As the software development progressed, Thermo advised that only the lamp compensation should be turned on and the pressure and temperature compensations did not work correctly. Starting in February 2007, the system was configured to use only lamp compensation at all times.

The interface board inside the outlet probe controller was replaced on February 25, 2007. The new interface boards were designed to reduce the amount of signal noise of the probe controller temperatures being monitored through the probe controller. The probe was installed with a relatively short 40-foot umbilical and the thermal noise recorded was minimal. Unlike the improvement noticed on the mercury system installed at the inlet to the baghouse, the new probe controller interface boards did not have a noticeable impact on the probe temperatures monitored by the outlet mercury CEMS.

After the system was rebooted to install the new probe controller interface boards, the span gas concentration was accidentally changed from 5.0 µg/m3 to 10.0 µg/m³. This change affected the daily calibration checks from January 25 to February 1 although no calibration checks failed the required criteria during that time.

The lamp intensity inside the analyzer had decreased to 20,000 Hz by February 2006. The level in which Thermo recommends replacement of the mercury lamp is when the intensity is below 20,000 Hz so the lamp was replaced on February 24. Note that the unit of measure of the mercury lamp intensity is represented as a frequency in Hertz. The voltage associated with the light measured by the detector is converted to a frequency so the signal is transported to the interface board with less electronic interference. The effect of the new

lamp on the measured intensity is displayed in Figure 4-184. This was the first replacement of the mercury lamp inside the analyzer since installation in December 2005.

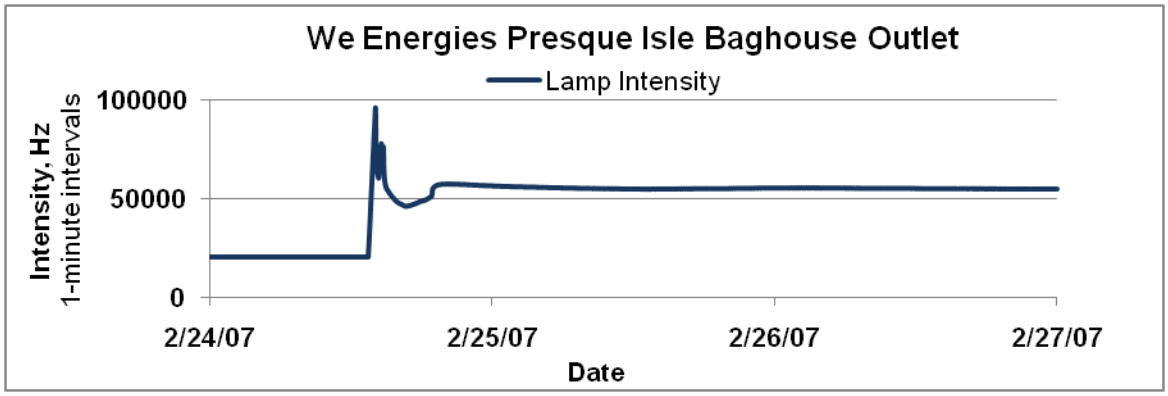


Figure 4-184. PIPP Outlet Mercury Analyzer Lamp Intensity; February 24–27, 2007.

The initial design of the analyzer optics bench called for a solar blind filter to be installed in front of the PMT; however, the newest model of PMT does not require this additional solar blind filter. The solar blind filter is designed to prevent any response of the PMT from visible light and improve the transmission of UV light but a redundant solar blind filter had the negative effect of causing the PMT voltage to be set very high in order to detect the fluorescence of mercury in the optics bench. A high PMT voltage also creates a fair amount of background noise and unstable detection of mercury and causes the measurement of mercury to contain a lot of noise. The redundant filter was removed from the outlet analyzer on February 24, 2007.

The PMT voltage was reduced from 953V to 725V because of the removal of the extra solar blind filter. Predictably, this resulted in a decrease in the instrument background calibration factor from 2.3 µg/m³ to 0.95 µg/m³ and stabilized the mercury measurements collected by the mercury analyzer. The contrast between the stability of the mercury measurements before and after the removal of the solar blind filter can be found in Figure 4-185.

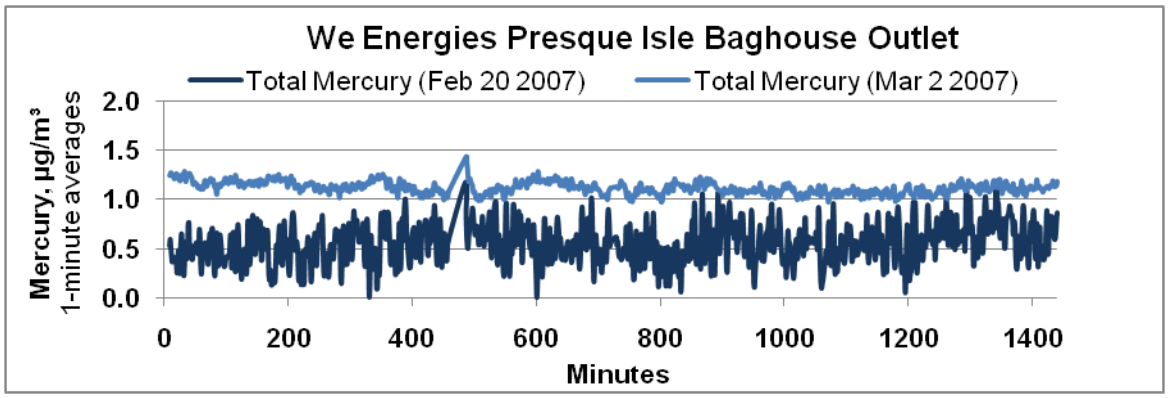


Figure 4-185. PIPP Outlet Total Mercury Measurements without Solar Blind Filter.

An unintended effect of removing the solar blind filter was that the average mercury concentrations increased by about 0.7 µg/m³ when compared to the concentrations measured with the solar blind filter installed. Several STM traps were collected at the baghouse outlet location to confirm if the analyzer was measuring the correct amount of mercury. Three sets of duplicate traps were run on March 29, 2007. Table 4-80 shows the results of the sorbent trap tests compared to the outlet mercury CEMS data and the calculated bias of 0.67–0.80 µg/m³. The data was later corrected based on the bias caused by the removal of the solar blind filter.

Table 4-80. PIPP Outlet Total Mercury CEMS-STM Comparison; March 29, 2007.

Date	Start	End	STM µg/dsm³	STM µg/wsm³	CEM µg/wm³	Differential µg/wm³
03/29/07	07:40	10:40	0.65	0.58	1.38	0.80
03/29/07	07:40	10:40	0.65	0.59	1.38	0.79
03/29/07	11:05	14:04	0.51	0.46	1.15	0.69
03/29/07	11:05	14:04	0.51	0.46	1.15	0.69
03/29/07	14:37	17:37	0.56	0.54	1.21	0.67
03/29/07	14:37	17:37	0.60	0.54	1.21	0.67

The baghouse outlet mercury probe was installed with prototype mercuric chloride generator ("oxidizer") components on March 12, 2007. The oxidizer is designed to mix the elemental mercury delivered to the probe from the calibrator with a mixture of chlorine gas in nitrogen

in order to produce mercuric chloride ($HgCl_2$). This oxidized form of mercury is then introduced into the fast loop of the mercury probe similar to normal elemental mercury system calibration checks. An oxidized mercury source is required in order to satisfy the requirements of the CAMR which stated that a system integrity test needs to be performed once a week while the unit is in operation.

The oxidizer components include a reaction chamber where the elemental span gas and the 900 ppm chlorine in nitrogen gas is introduced at approximately 400 °C in order to start the reaction into mercuric chloride gas. The reaction chamber is housed in an aluminum block enclosure that contains a heater and insulation to maintain a constant temperature. The mercuric chloride gas that is created in the reaction chamber is introduced into the venturi port of the fast loop in the same way as elemental calibration gas. The oxidized mercury then passes through new glass-coated stainless steel flow orifices and the converter core where it is converted back into elemental mercury for detection by the mercury analyzer. The mercury that does not pass through the converter core on the elemental channel does not get converted back to elemental mercury and the analyzer would not detect any mercury on that channel. In this way, the efficiency of the system to collect and analyze oxidized mercury is tested. A picture of the prototype oxidizer components installed in the outlet mercury probe is shown in Figure 4-186.

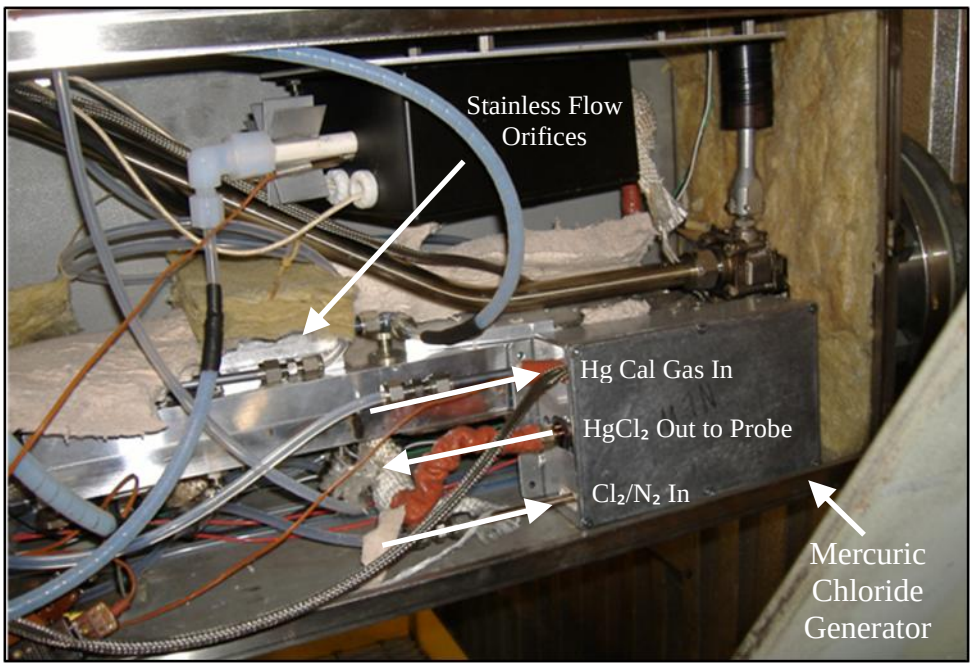


Figure 4-186. PIPP Outlet Prototype Mercuric Chloride Generator.

A research and development team from Thermo installed the prototype mercuric chloride generator in order to test under different conditions to determine what conditions would affect its operation. During the experiments, Thermo changed the probe temperatures and concentration of the calibration gas to analyze the performance of the oxidizer under different scenarios. The prototype mercuric chloride generator was removed when the tests were complete and the outlet mercury probe returned to its original condition.

Progress continued on the quality control procedures for the outlet mercury CEMS during the first quarter of 2007. ADA-ES started the process of connecting remotely to the on-site computer at Presque Isle to download the data collected by the analyzer each workday. The calibration responses would be analyzed based on the criteria published by the CAMR and the proper corrective action was discussed and performed. The accuracy of outlet mercury CEMS was of the highest importance in order to collect valid data that demonstrates 90% removal of mercury across the baghouse during PAC injection. The outlet system performed very well based on the responses to the daily calibration checks and stability of mercury measurements. Decisions to correct the calibration factors and perform extra data analysis were arbitrary.

4.15.9.2.6 Baghouse Outlet – Second Quarter 2007

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation while sampling both total and elemental mercury concentrations. PAC injection was halted from April 14–16 due to dusting problems with the ash silo filter separator. Significant changes to the outlet mercury CEMS also affected mercury measurements for the quarter, including the installation of a nitrogen generator, new lamp and optics mirror, calibration gas humidifier, and updated software. The mercury concentrations measured by the analyzer can be found in Figure 4-187.

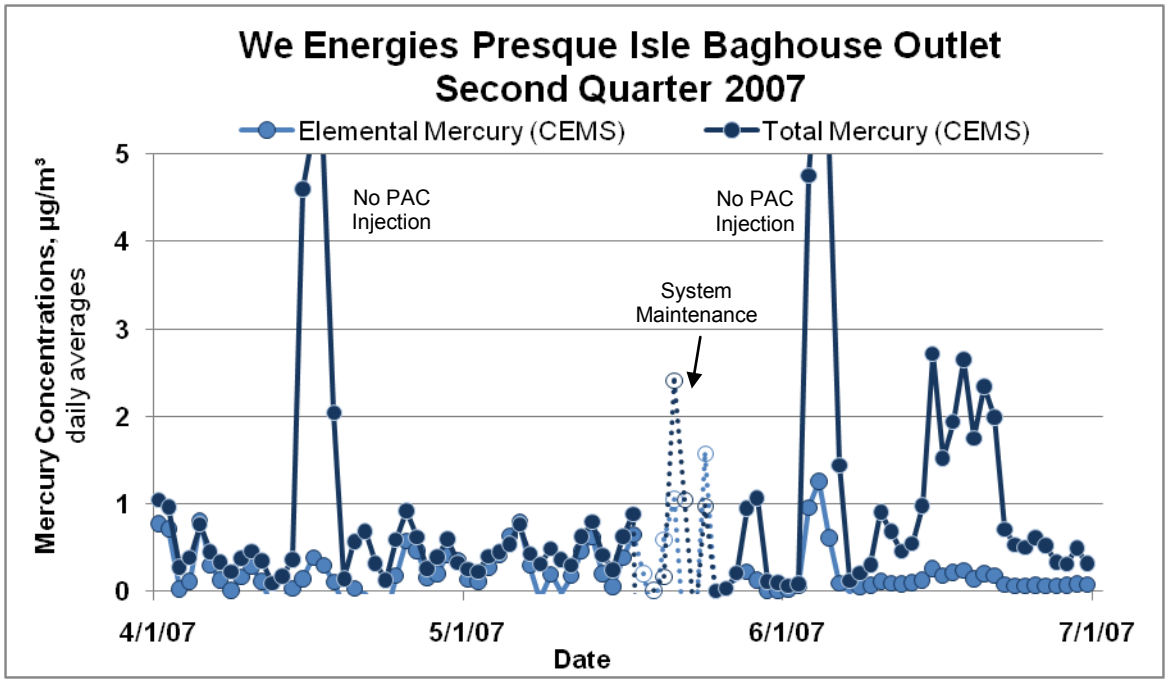


Figure 4-187. PIPP Outlet Total and Elemental Mercury, 2Q07.

The removal of the redundant solar blind filter in February 2007 caused a clear bias with the mercury detected by the analyzer. The injection rate of PAC was confirmed; the output concentration of the calibrator was checked, and the measurement was compared to STM traps all to confirm that the error originated with the removal of the solar blind filter. To ensure that the measurements of the outlet mercury CEMS was returned to the correct level, the solar blind filter was reinstalled into the optics bench of the analyzer on April 3. The comparison between the mercury concentrations measured before and after the solar blind filter installation is shown in Figure 4-188.

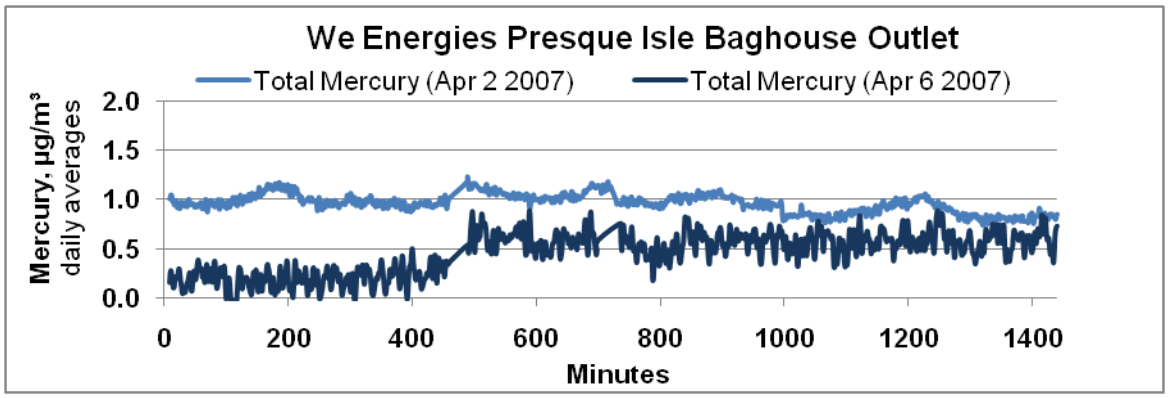


Figure 4-188. PIPP Outlet Total Mercury Measurements with Solar Blind Filter.

Major additions were made to the baghouse outlet mercury CEMS during the second quarter of 2007. All of the modifications greatly improved the ability of the system to measure stable concentrations of mercury. The components that were added to the mercury CEMS were a nitrogen generator, new lamp and mirror assembly for the optics bench, removal of the solar blind filter, and installation of a calibration gas hydrator.

The nitrogen generator was installed at the baghouse outlet on May 23, 2007, and had an immediate improvement on the operation of the mercury system. The nitrogen generator is designed to remove all of the oxygen from the air used for the dilution and calibration gases to improve the ability of the ultraviolet lamp to measure the mercury atoms in the detection chamber. Without the added interference from the oxygen fraction of compressed air, the PMT voltage was reduced from 920V to 528V on May 28. This also dropped the calibration background factor of the instrument from 0.66 µg/m³ to 0.13 µg/m³, which represents an improvement of over five times the signal clarity. The nitrogen generator installed on the outlet system can be found in Figure 4-189.

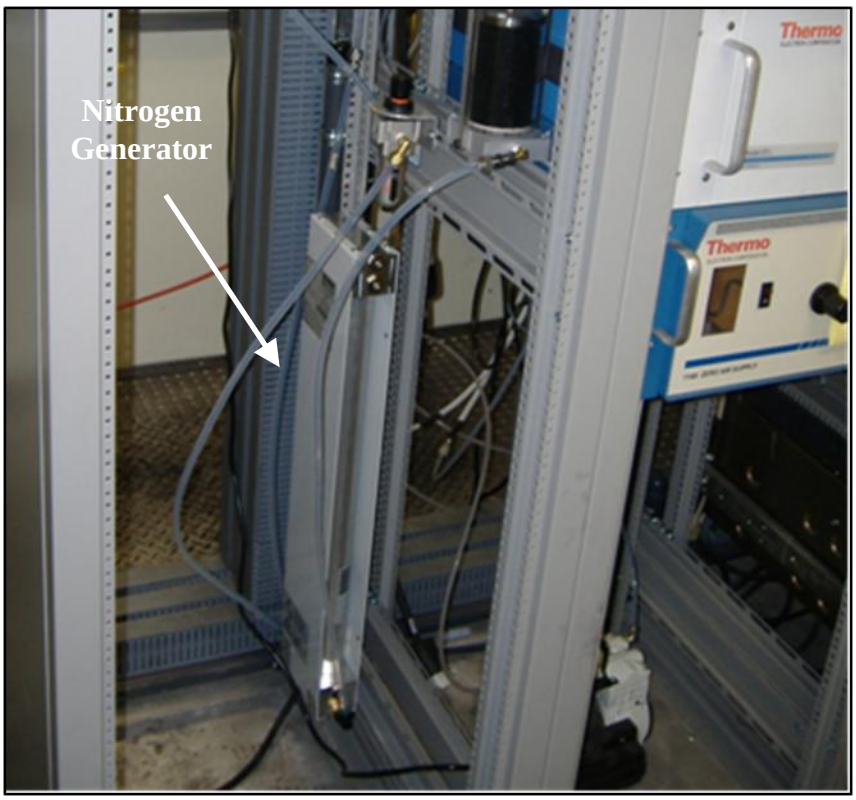


Figure 4-189. PIPP Outlet Mercury System Nitrogen Generator.

The improvements added to the outlet mercury CEMS produced a system that measured mercury with extreme precision and consistency. Figure 4-190 shows the improvement that the nitrogen generator had on the low mercury concentrations.

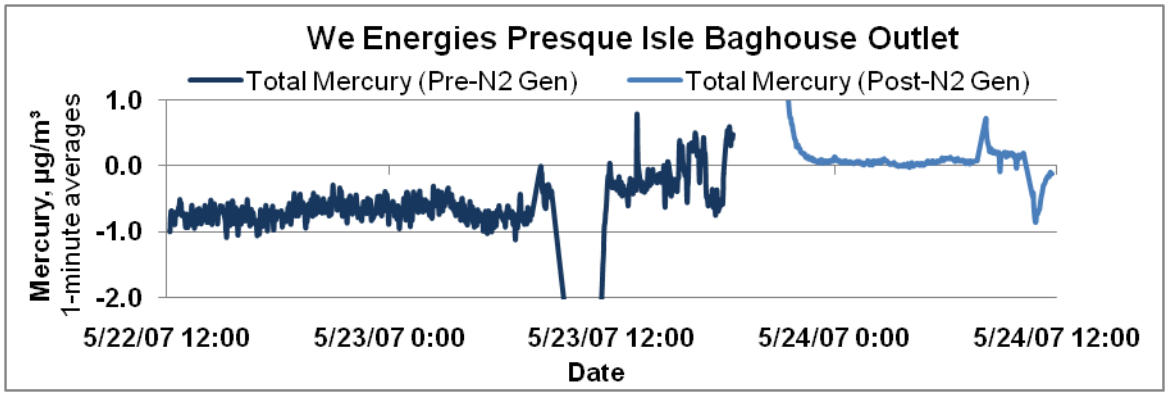


Figure 4-190. PIPP Outlet Total Mercury with Nitrogen Generator; May 22–24, 2007.

The redundant solar blind filter functioned as a bandpass filter by filtering out a wavelength that the reference cell would detect as mercury fluorescence. The use of the filter should be unnecessary since the lamp and mirrors should function in this capacity. Removing the solar

blind filter should not have caused mercury concentrations to increase in March 2007 and therefore the error was determined to be with the interaction between the old lamp and the defective mirror. Once a new lamp and mirror were installed, the extra solar blind filter could be removed to improve the ability of the analyzer to detect low quantities of mercury at the baghouse outlet. Figure 4-191 demonstrates continued improvements to the outlet system with the removal of the solar blind filter and the replacement of the old mercury lamp and optics.

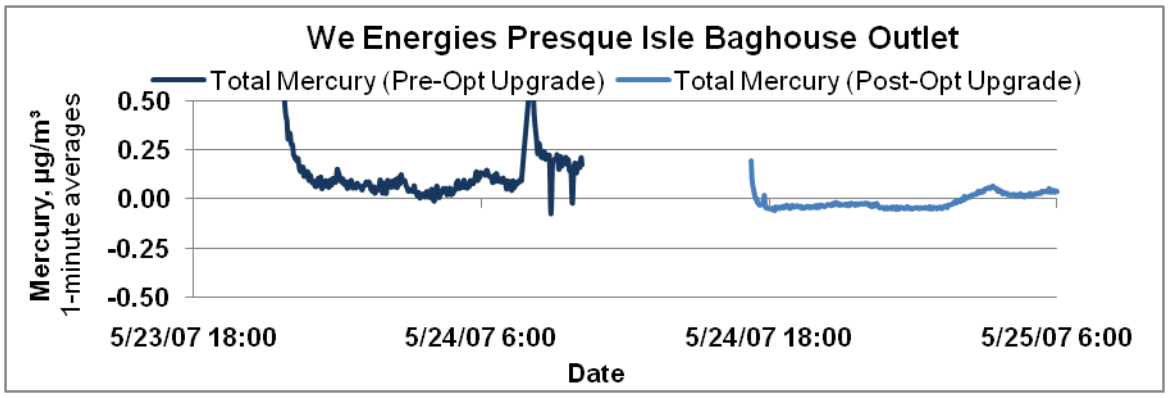


Figure 4-191. PIPP Outlet Total Mercury with Optical Upgrade; May 24–25, 2007.

A temporary hydrator was also installed on the outlet mercury CEMS on May 24, 2007. The calibrator was designed to use dry zero air as the source of the calibration zero and span gas. The temporary hydrator was plumbed into the path of the calibration zero and span gas to pick up moisture on the way to the probe. The Perma Pure ME™-Series moisture exchangers with Nafion® membrane tubing technology allow water to be transferred to a dry gas stream from a water-saturated environment. This process is commonly used to humidify calibration gases, which allows calibration of analyzers at humidity levels equal to those seen in samples and provides a more consistent calibration and sample baseline.

The purpose of the hydrator was to add a small amount of moisture to the calibration gas to eliminate the possibility of the inertial filter scrubbing or releasing captured mercury as the moisture characteristics of the filter change. Even though the inertial filter is coated, the surfaces of the filter become "wet" and the small pores of the inertial filter become saturated with moisture as it samples flue gas. When the sampled gas is switched from the wet flue gas to the dry zero or span gas, the moisture is released from the pores of the inertial filter

and the filter will instead capture mercury on the surface. The interference that could affect the accuracy of the mercury concentrations will be kept to a minimum by keeping the surface of the inertial filter wet in all sampling and calibration modes.

A mercury continuous emission monitoring relative accuracy test audit (RATA) was performed on the Flue 7 and Flue 9 stacks and compared to the total mercury concentrations measured by the baghouse outlet mercury CEMS. These tests were scheduled after the installation of the nitrogen generator, hydrator, and upgraded optics bench and performed on June 19–28, 2007. Table 4-81 summarizes the Method 30A Instrumental Reference Method, Method 30B Sorbent Trap and Ontario Hydro Mercury Speciation test results as collected and analyzed by Platt Environmental Services. Although the calculated relative accuracy exceeds the requirements of 40 CFR Part 75, the mean differences between the mean value of the monitor measurements and the reference method mean value does not exceed 1.0 µg/m³.

Table 4-81. PIPP Outlet Mercury RATA (M30A, M30B, Ontario Hydro), June 2007.

Test Dates	Method	RM Mean µg/wsm³	CEM Mean µg/wsm³	Mean Diff µg/wsm³	Relative Accuracy
06/18/07–06/19/07	M30A	1.41	1.34	0.07	8.6%
06/19/07–06/21/07	OH	1.58	2.16	-0.57	54.0%
06/19/07–06/21/07	M30B	2.42	2.13	0.29	18.2%
06/26/07–06/28/07	M30B	0.52	0.40	0.12	29.5%

4.15.9.2.7 Baghouse Outlet – Third Quarter 2007

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation. The total and elemental mercury concentrations are presented in Figure 4-192. The PAC injection was controlled on coal feed rate and the trim control was based on a mercury removal of 91%. The system performed under steady PAC injection for the entire month of July 2007. Trona injection, begun on August 1 and continued through August 10, influenced the mercury concentrations measured at the baghouse outlet. PAC injection was temporarily halted on September 11–15 due to problems with the ash handling system. At the time, only one unit was in operation.

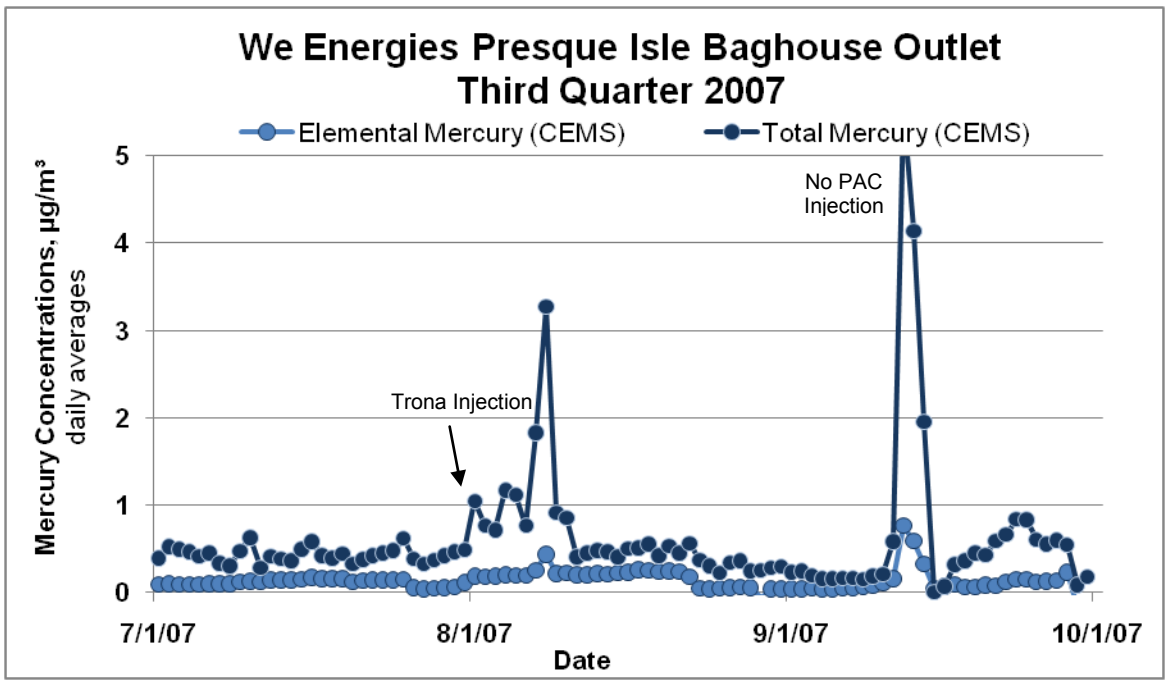


Figure 4-192. PIPP Outlet Total and Elemental Mercury, 3Q07.

With the completion of the RATA tests in June 2007, the remaining sections of the CAMR certification tests were performed in the third quarter. The certification tests include a seven-day drift test, a three-point linearity check, and a cycle time test.

A linearity check was performed on the baghouse outlet mercury CEMS on July 5, 2007. The results of the linearity check can be found in Table 4-49. Although the low-level average response of the system was greater than the 10.0% criteria required by the CAMR, the alternate specification of less than 1.0 µg/m³ absolute error was achieved.

Table 4-82. PIPP Outlet Total Mercury System Linearity Check, 3Q07.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	07/05/07	14:47	3.0	2.60	-0.40	-13.3%	PASS
1 M	07/05/07	15:03	6.0	6.12	+0.12	+2.0%	PASS
1 H	07/05/07	15:26	9.0	9.31	+0.31	+3.4%	PASS
2 L	07/05/07	15:41	3.0	2.57	-0.43	-14.3%	PASS
2 M	07/05/07	15:57	6.0	6.13	+0.13	+2.2%	PASS
2 H	07/05/07	16:12	9.0	9.21	+0.21	+2.3%	PASS
3 L	07/05/07	16:28	3.0	2.58	-0.42	-14.0%	PASS
3 M	07/05/07	16:44	6.0	6.12	+0.12	+2.0%	PASS
3 H	07/05/07	16:59	9.0	9.25	+0.25	+2.8%	PASS
Low-Level Average			3.0	2.58	-0.42	-14.0%	PASS
Mid-Level Average			6.0	6.12	+0.12	+2.0%	PASS
High-Level Average			9.0	9.25	+0.25	+2.8%	PASS

A seven-day drift check was performed on the outlet mercury CEMS from July 1–7, 2007. No adjustments were made to the system for the seven days and the system recorded no errors in the zero response above 0.3% and no error in the span gas response greater than 1.6%. The seven-day calibration error test can be found in Table 4-51.

Table 4-83. PIPP Outlet Total Mercury Seven-Day Calibration Drift, 3Q07.

Date	Time	Span	Level	Zero Response		Cal Response		Result
07/01/07	06:00	10.0	5.0	0.01	+0.1%	5.13	+1.3%	PASS
07/02/07	06:00	10.0	5.0	0.03	+0.3%	5.16	+1.6%	PASS
07/03/07	06:00	10.0	5.0	0.02	+0.2%	5.11	+1.1%	PASS
07/04/07	06:00	10.0	5.0	0.01	+0.1%	5.15	+1.5%	PASS
07/05/07	06:00	10.0	5.0	0.01	+0.1%	5.13	+1.3%	PASS
07/06/07	06:00	10.0	5.0	0.02	+0.2%	4.99	+0.1%	PASS
07/07/07	06:00	10.0	5.0	0.03	+0.3%	5.16	+1.6%	PASS

The cycle time test for the inlet mercury CEMS was not completed according to the procedures defined in Appendix A of Part 75. The downscale response was calculated using the profile of the zero response of the daily calibration check on July 6, 2007. The upscale value, which should be performed from a stable sample concentration, was instead calculated as the response time of the system from the stable zero gas response to the end of the span gas response on July 6. In both calculations, the response time of the system was much less than the 15-minute response time criteria. The calculations of the response time are shown in Table 4-50.

Table 4-84. PIPP Outlet Total Mercury System Cycle Time, 3Q07.

Scale	Date	Ref	Hg Start	Hg End	95% Time	Result
Downscale	07/06/07	0.0	0.10	0.06	4 minutes	PASS
Upscale	07/06/07	5.0	0.06	5.03	4 minutes	PASS

The analyzer software was upgraded to version 01.00.04.212 on July 19, 2007. This software was designed to correct some of the issues created with the previous version and mitigate the effects of lamp intensity drift on the measured mercury concentration.

The chamber pressure is an indication of the performance of the vacuum pump used to pull the sample from the probe to the analyzer through the umbilical. As the components of the vacuum pump wear out, the chamber pressure will slowly increase since the pump cannot maintain the low pressure required for steady operation of the mercury system. The chamber pressure started the third quarter at 50 mmHg. It is recommended that the sample pump be replaced or rebuilt when the chamber pressure increases to 50 mmHg as the ability of the pump to hold the low vacuum will quickly degrade. The chamber pressure continued to increase up to 100 mmHg during the quarter and the sample pump was replaced on September 18, 2007. After replacement, the chamber pressure decreased to 40 mmHg. Figure 4-193 shows the changes in the chamber pressure between July 1 and September 30.

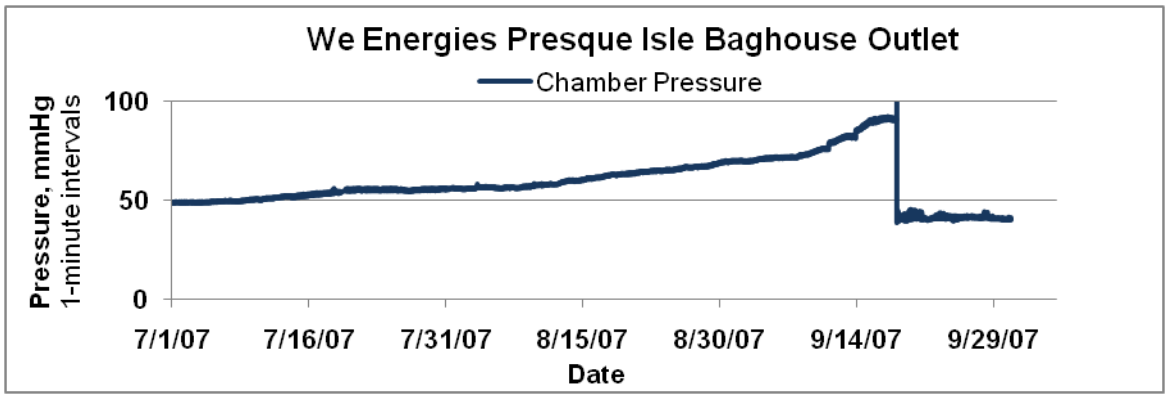


Figure 4-193. PIPP Outlet Mercury Analyzer Chamber Pressure, 3Q2007.

The mercury lamp had decreased to less than 22,000 Hz by the end of the quarter and required a replacement while personnel were on site. The lamp was replaced on September 28, 2007. This was the second lamp replaced in the baghouse outlet mercury analyzer since installation in December 2005. The lifetime of the mercury lamp was seven months as the last replacement was on February 24.

4.15.9.2.8 Baghouse Outlet – Fourth Quarter 2007

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation while sampling both total and elemental mercury concentrations as shown in Figure 4-194. The PAC injection was only controlled by coal feed rate and not trim control. The baghouse temperature changes as the total boiler load for Units 7–9 changes and that affects the ability of the PAC to capture mercury and therefore the stability of the outlet mercury concentrations. Concentrations recorded by the mercury analyzer for the fourth quarter of 2007 are given in Figure 4-194.

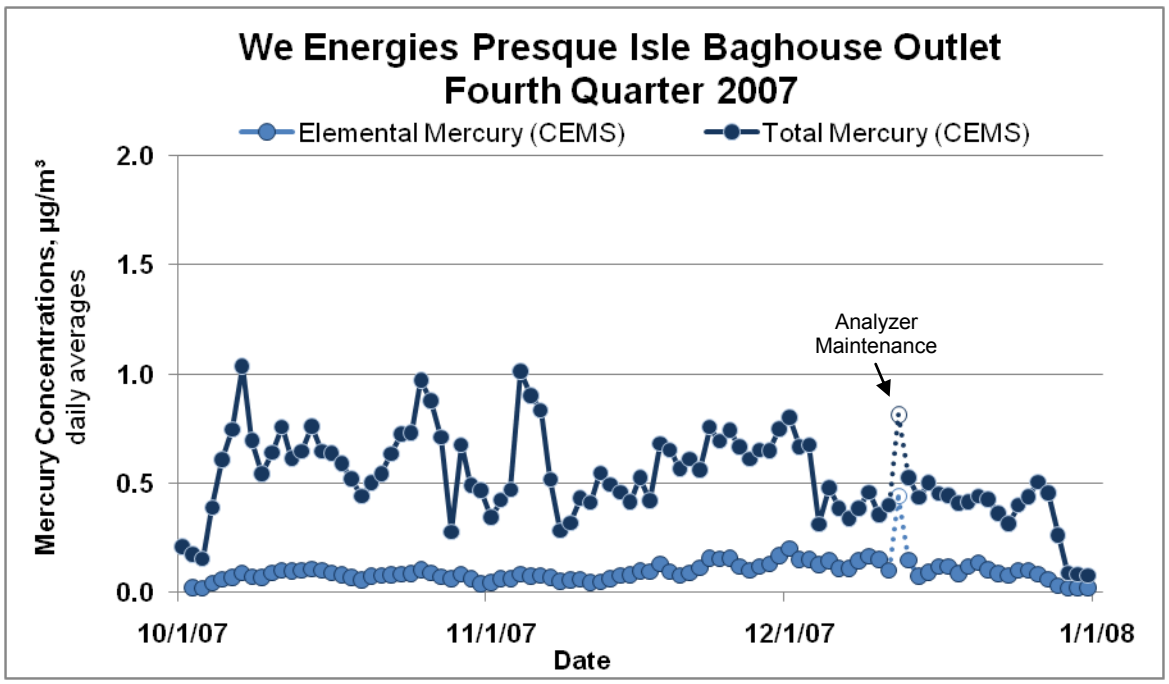


Figure 4-194. PIPP Outlet Total and Elemental Mercury, 4Q07.

In order to improve the stability of the system, Thermo released an upgrade kit that includes a mercury lamp heater assembly to maintain the temperature of the lamp at all times. There was concern that the temperatures measured inside the analyzer are affecting the ability of the system to measure stable mercury concentrations. As the internal temperature of the analyzer increased, the mercury observed by the analyzer decreased. This is due to the effect of the internal temperature on the stability of the lamp. With the addition of a heater around the lamp assembly, the temperature in which the lamp operates will remain constant and avoid unstable lamp performance due to ambient temperatures.

The lamp heater assembly was installed in the baghouse outlet mercury analyzer on December 12, 2007. The software had been previously updated to record the lamp temperature and the "open" temperature began to record valid temperature data for the lamp upon installation. Figure 4-195 shows the lamp temperature data recorded by the analyzer before and after installation. Although the lamp intensity had only decreased to 45,000 Hz by December 12, the mercury lamp was replaced as the lamp heater was delivered with a mercury lamp already installed inside the assembly. The system was completely recalibrated on December 13 with an adjustment to the PMT voltage and dilution ratio.

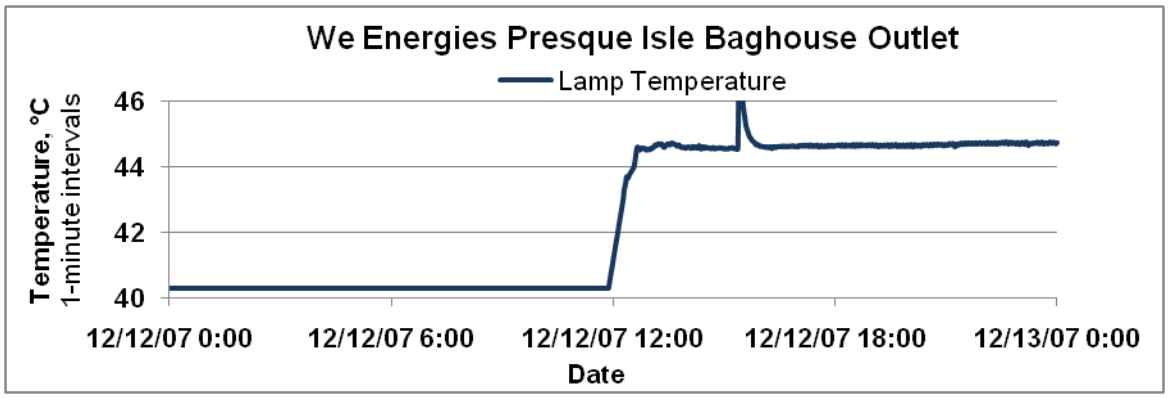


Figure 4-195. PIPP Outlet Mercury Analyzer Lamp Temperature; December 12, 2007.

The permanent hydrator for the calibration gas was installed on the outlet mercury CEMS on October 12, 2007. The hydrator is designed with two water reservoirs and a communication cable from the hydrator to the analyzer. The calibration zero and span gas is passed through the smaller water reservoir located at the bottom of the hydrator so that it can pick up an appropriate amount of moisture on its way to the probe. The larger reservoir holds a reserve amount of water. When the level in the small reservoir decreases, it triggers the larger reservoir to fill the smaller reservoir while the system is in a non-calibrating gas mode.

A prototype mercuric chloride generator was installed in the mercury probe at the baghouse outlet on October 13, 2007. The oxidizer components were installed in a similar way that Thermo had tested the oxidizer in April except that the extra solenoid valves for the oxidizer were not available. Only one extra valve was installed so the mercury calibration line was plumbed into the new valve while the chlorine/nitrogen gas mixture was plumbed into the orifice zero valve that was no longer being used. The outlet tubing from these two valves was plumbed into the inlet ports of the oxidizer. The outlet of the oxidizer was plumbed into the venturi. The installation of the oxidizer into the outlet mercury probe is shown in Figure 4-196. Although all of the physical components of the oxidizer were installed, the chlorine/nitrogen bottle was not connected to the probe and the components of the oxidizer were not heated.

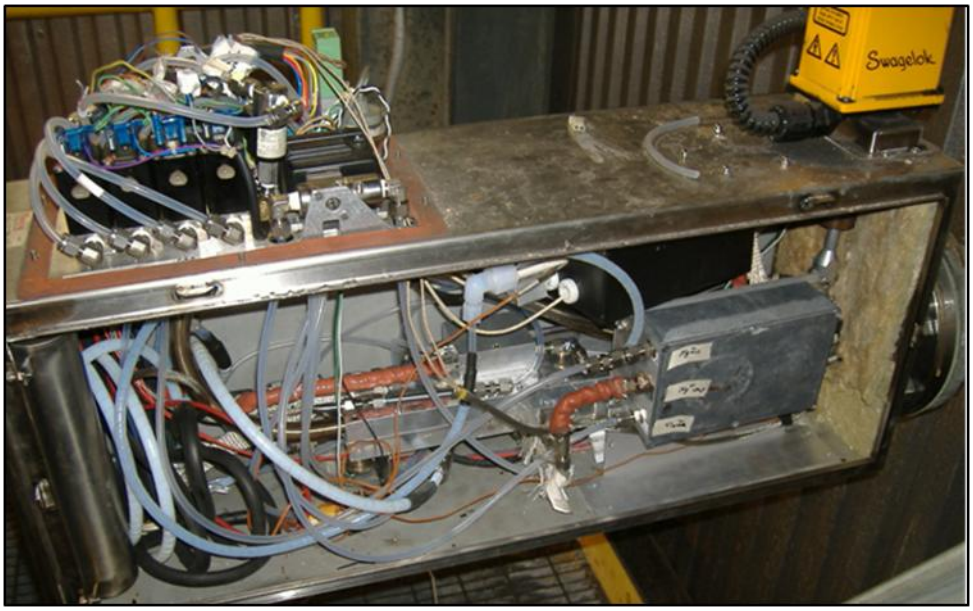


Figure 4-196. PIPP Outlet CEMS Probe Mercuric Chloride Generator; October 13, 2007.

The blowback pressure measurements had been invalid since January 2006. In order to repair the ability of the probe controller and analyzer to read the blowback pressure, several components inside the probe controller were replaced in December 2007. A new interface board was installed into the probe controller but the inability of the blowback pressure to register any pressure increase was not corrected. The blowback transducer and the blowback regulator assembly were also replaced but that also did not correct the error. Since the problem with the blowback pressure could not be corrected, the air was reconnected to the external pressure gauge in order to regulate the blowback pressure to the probe.

4.15.9.2.9 Baghouse Outlet – First Quarter 2008

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation while sampling both total and elemental mercury concentrations as shown in Figure 4-197. On January 29, the injection of PAC was halted in order to return the baghouse to baseline conditions prior to the alternative PAC test. Alternative sorbents were tested starting on February 6 and continued until March 24. Only minor adjustments and maintenance were performed on the baghouse outlet mercury CEMS, including a sample pump replacement, updated software alarms and settings, calibrating the sample flow transducer, and adjusting the umbilical temperature.

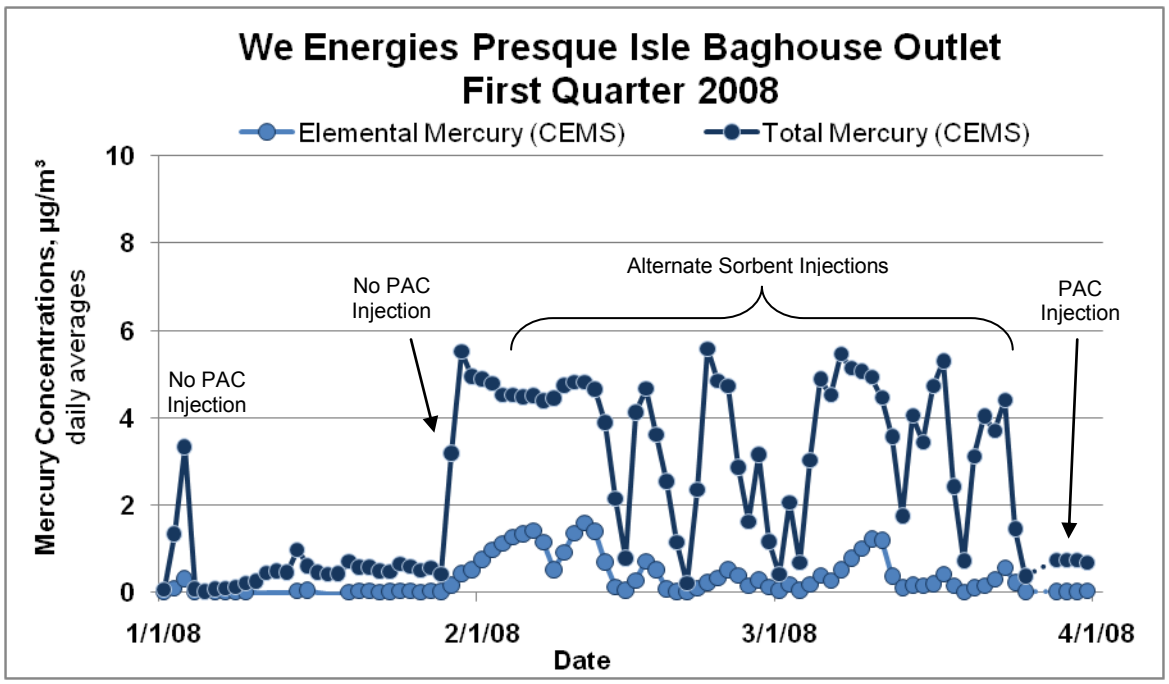


Figure 4-197. PIPP Outlet Total and Elemental Mercury, 1Q08.

The calculation of the availability of the outlet mercury CEMS for the first quarter of 2008 can be found in Table 4-54. The availability of the system in March 2008 was greatly affected by the loss of remote communications with the system. This resulted in the loss of data collected by the instrument and prevented the correction of failed daily calibration checks.

Table 4-85. PIPP Outlet Mercury CEMS Availability, 1Q08.

Month	Operating Hours	Downtime Hours	Availability
January 2008	744 hours	0 hours	100.0%
February 2008	696 hours	0 hours	100.0%
March 2008	744 hours	90 hours	87.9%

The availability calculated for the outlet mercury system is complicated by the ability of ADA-ES to download and analyze the data to ensure that the system is properly calibrated and functioning properly. The data was analyzed each workday and this allowed calibration failures that occurred on the weekend to be uncorrected until the next regularly scheduled

workday. This limitation occasionally leads to longer periods of invalid data than what would be expected from typical operation of mercury system. For ADA's analysis of the data, a failed calibration was one that did not pass the criteria on the total channel or the elemental channel. Most regulations only require the analysis of the total calibration response but this is unsuitable for the measurement of speciated mercury.

The installation of the oxidizer components for the system integrity checks were completed in January 2008. The chlorine bottle was installed and connected to the mercury probe on January 24. The power to the mercuric chloride generator was also turned on and the components were set to a temperature of 400 °C. After the components had been heated, the first system integrity check was performed on the system to confirm that the components were functioning properly.

Figure 4-198 shows the responses to each of the phases of the system integrity check for the total and elemental channels. The solid line represents the total mercury responses and the dashed line indicates the mercury responses of the elemental channel. The system integrity check was performed with a calibration span gas concentration of 10 µg/m³. The baseline responses were accurate for the total and elemental mercury, but the oxidized phase of the system integrity check indicated complete oxidation of mercury with zero value on the elemental channel but significant scrubbing of mercury through the converter as measured on the total channel. This was the only test of the oxidizer during the first quarter of 2008.

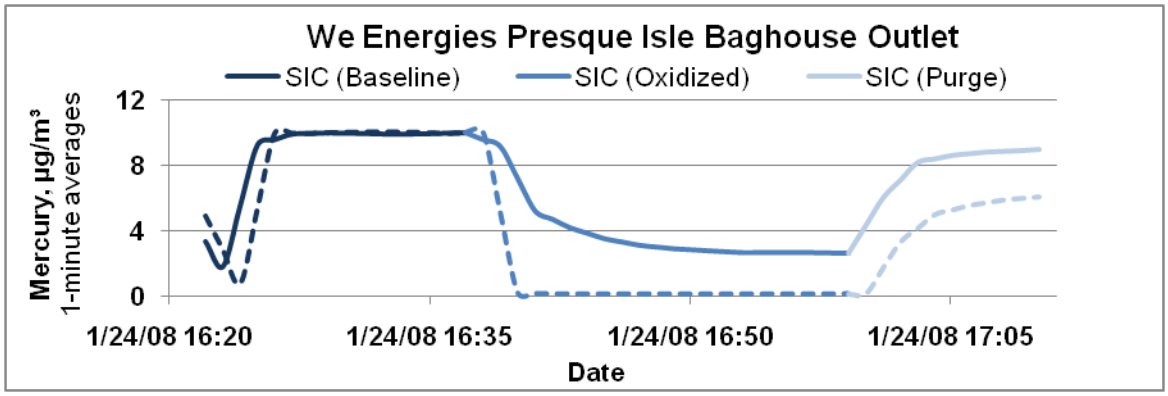


Figure 4-198. PIPP Outlet Mercury CEMS System Integrity Check; January 24, 2008.

The chamber pressure increased to above 60 mmHg in March 2008 and indicated that the sample pump required replacement with one that would be able to sustain a higher vacuum through the analyzer. The pump had been installed September 18, 2007, and was in service for almost six months before being replaced on March 11. Figure 4-199 displays the slow increase in chamber pressure from February 1 to March 11 and the decrease that resulted with replacement of the sample gas vacuum pump.

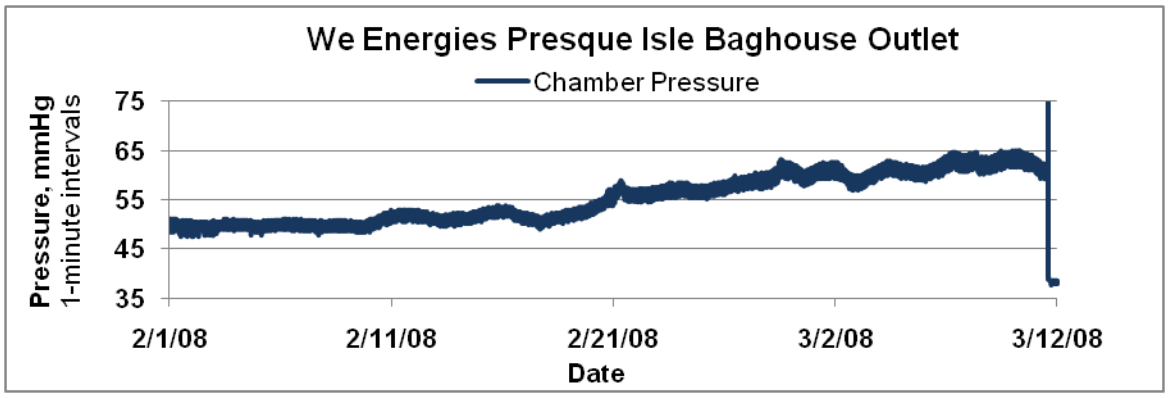


Figure 4-199. PIPP Outlet Mercury Analyzer Chamber Pressure, February–March 2008.

The sample flow rate of the outlet system had been reading higher than expected since installation of the system. The sampled calibration air flows through two glass orifices during an instrument calibration, one each for the zero and one for the span gas. The tolerances of the flow rate of the glass orifices inside the analyzer are very tight and should have a stable flow rate of 0.250 LPM. The flow rate measured through the glass orifices was 0.420 LPM and this indicated an improperly calibrated flow transducer as no leaks were found in the system.

Thermo reduced their recommendation of the umbilical temperature set point to 120 °C as they discovered that running the umbilical heaters at a lower temperature does not have a negative impact on the ability of the system to transport mercury from the probe to the analyzer. Lowering the temperature of the umbilical was also recommended to reduce the strain on the large umbilical heaters over time. The umbilical temperature set point was reduced to the recommended 120 °C on March 12, 2008.

The on-site computer used to connect to the mercury CEMS at Presque Isle was upgraded during the last week of March 2008. There were problems with establishing a remote connection to the system and data could not be collected until April 10. The analyzer had the ability to store up to five megabytes of data in the internal data logger. Due to the expanded data content programmed into the software for the analyzer to record, this electronic storage space limitation translates to about 13 days of data for the outlet system and records from March 25–28 were lost.

4.15.9.2.10 Baghouse Outlet – Second Quarter 2008

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation. The total and elemental mercury concentrations sampled by the analyzer can be found in Figure 4-200. Normal injection of PAC resumed on March 24 and continued until the baghouse went into an outage on May 17. PAC injection was restarted on May 30 and continued through the rest of the third quarter. Only minor maintenance items were performed with a software upgrade in April and a mercury lamp replacement in June.

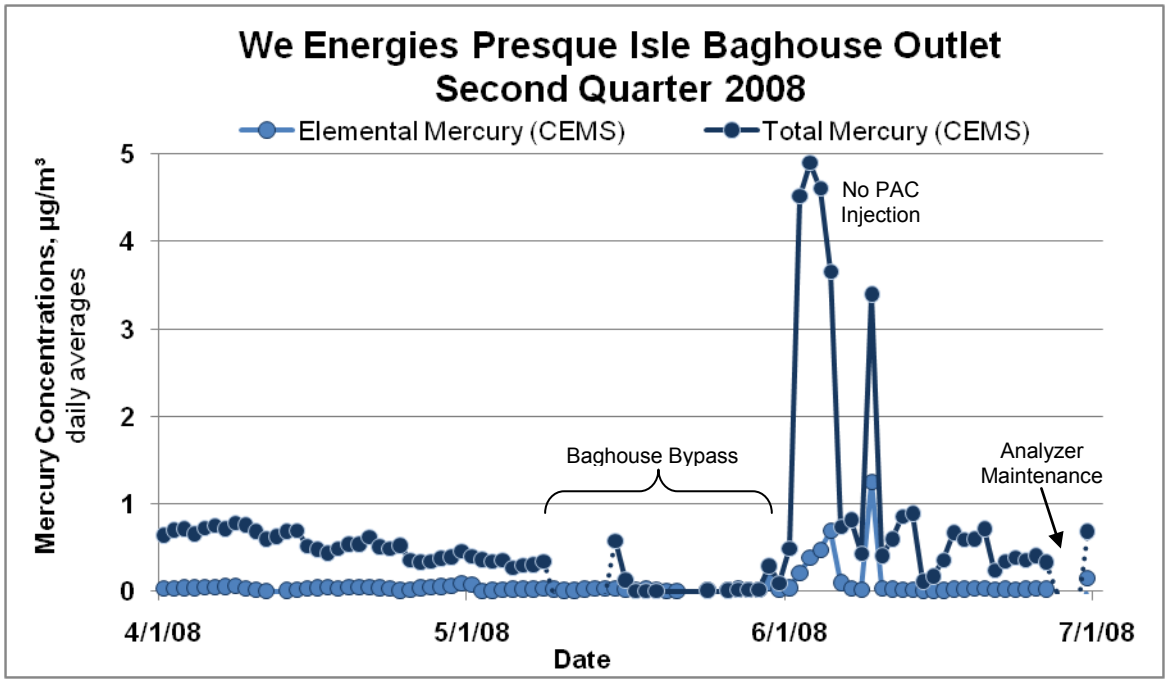


Figure 4-200. PIPP Outlet Total and Elemental Mercury, 2Q08.

The calculation of the availability of the outlet mercury CEMS for the second quarter of 2008 can be found in Table 4-86. The availability calculated for May 2008 was significantly

affected by corruption of a data file for 156 hours and reduced operating hours of the baghouse while it was bypassed from May 17–30.

Table 4-86. PIPP Outlet Mercury CEMS Availability, 2Q08.

Month	Operating Hours	Downtime Hours	Availability
April 2008	720 hours	25 hours	96.5%
May 2008	457 hours	158 hours	65.4%
June 2008	720 hours	75 hours	89.6%

A linearity check was performed on the baghouse outlet mercury CEMS on April 30, 2008. The results of the linearity check can be found in Table 4-87. This was the first of the regularly scheduled linearity checks performed each quarter between the second quarter of 2008 and the third quarter of 2009. A linearity check was not performed for the first quarter of 2008. The linearity check was performed with a mid-level span concentration of 6.0 µg/m³ instead of 5.0 µg/m³ but it was determined not to make a difference in the analysis of the linearity of the outlet mercury system.

Table 4-87. PIPP Outlet Total Mercury System Linearity Check, 2Q08.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	4/30/08	10:10	3.0	3.00	+0.00	0.0%	PASS
1 M	4/30/08	10:20	6.0	6.03	+0.03	+0.5%	PASS
1 H	4/30/08	10:30	9.0	9.07	+0.07	0.8%	PASS
2 L	4/30/08	10:41	3.0	2.93	-0.07	-2.3%	PASS
2 M	4/30/08	10:52	6.0	5.97	-0.03	-0.5%	PASS
2 H	4/30/08	11:02	9.0	8.97	-0.03	-0.3%	PASS
3 L	4/30/08	11:13	3.0	2.90	-0.10	-3.3%	PASS
3 M	4/30/08	11:24	6.0	5.92	-0.08	-1.3%	PASS
3 H	4/30/08	11:35	9.0	8.99	-0.01	-0.1%	PASS
Low-Level Average			3.0	2.94	-0.06	-2.0%	PASS
Mid-Level Average			6.0	5.97	-0.03	-0.5%	PASS
High-Level Average			9.0	9.01	+0.01	+0.1%	PASS

The analyzer software was upgraded to version 01.00.21.231 on April 30, 2008. The software was upgraded to take advantage of the new programmable functions of the analyzer to perform automatically scheduled system integrity checks. Before the new version of the software was installed, a system integrity check would have to be completed manually by selecting the appropriate gas mode (baseline span, chlorine span, and purge) at the correct time of the routine. The sequence of events used to perform a system integrity check would be handled by the analyzer automatically with the newest version of the software.

A test of the system integrity check was performed on June 10, 2008, and the results are presented in Figure 4-201. The solid line represents the total mercury responses and the dashed line indicates the mercury responses of the elemental channel. In this test, there was no observable oxidation of mercury during the system integrity check as witnessed by the failure of the elemental mercury concentration to decrease during the oxidized phase. Another system integrity check was performed on June 20 with the same results.

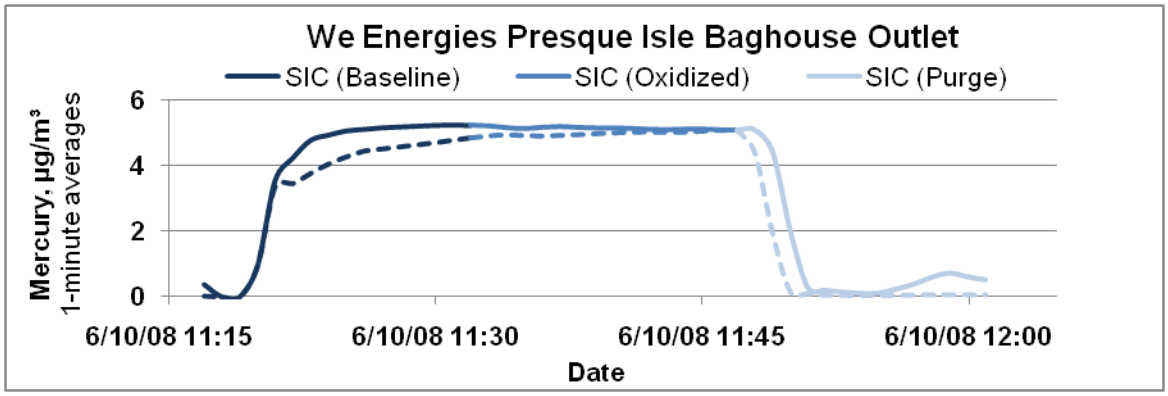


Figure 4-201. PIPP Outlet Mercury CEMS System Integrity Check; June 10, 2008.

The mercury lamp located inside the optics bench of the outlet analyzer had degraded to an intensity of 30,000 Hz in June 2008. The maintenance level of the mercury lamp used to be 30,000 Hz for regular scheduled maintenance with a critical limit of 20,000 Hz. As the lamp was approaching the maintenance limit, it was scheduled for replacement on June 27. The lamp that was replaced had been in use since it was installed with the lamp heater upgrade on December 12, 2007. The life of the mercury lamp should be up to one year instead of six months so it was determined that a maintenance limit of 30,000 Hz is too high as it May result in more frequent mercury lamp replacements. After the mercury lamp was

replaced, the maintenance limit of the lamp was set to 20,000 Hz and the critical intensity of the lamp was defined as 10,000 Hz.

4.15.9.2.11 Baghouse Outlet – Third Quarter 2008

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation and PAC injection in the third quarter of 2008 while sampling both total and elemental mercury concentrations. The mercury concentrations collected during the quarter are found in Figure 4-202.

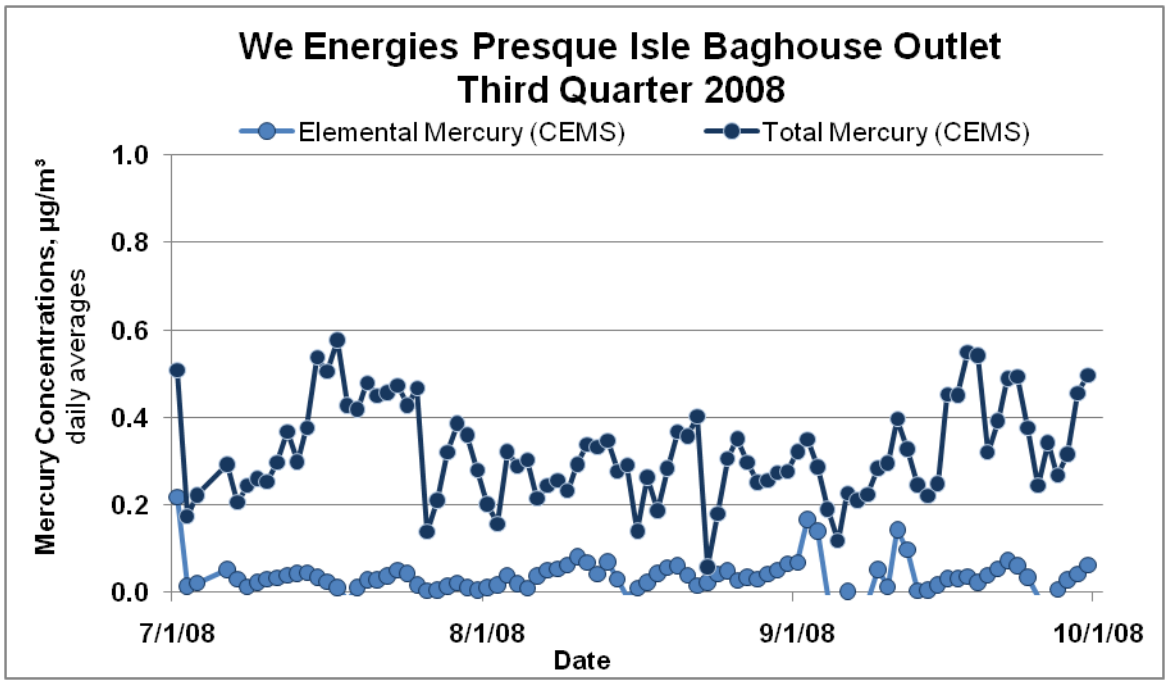


Figure 4-202. PIPP Outlet Total and Elemental Mercury, 3Q08.

The calculation of the availability of the outlet mercury CEMS for the third quarter of 2008 can be found in Table 4-88. The biggest reason for the poor availability for September was the out-of-control period between September 1 and September 12 that lasted for 272 hours. During that time, the eductor regulator inside the outlet probe controller was broken and not replaced until September 11. Although none of the daily calibration checks failed during the time the eductor valve was stuck in the closed position, the mercury CEMS was not functioning correctly and the data collected by the system was considered invalid.

Table 4-88. PIPP Outlet Mercury CEMS Availability, 3Q08.

Month	Operating Hours	Downtime Hours	Availability
July 2008	744 hours	6 hours	99.2%
August 2008	744 hours	3 hours	99.6%
September 2008	720 hours	272 hours	62.2%

A linearity check was performed on the baghouse outlet mercury CEMS on August 4, 2008. The results of the linearity check can be found in Table 4-89. The results of the linearity check satisfied all requirements for the 40 CFR Part 75.

Table 4-89. PIPP Outlet Total Mercury System Linearity Check, 3Q08.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	08/04/08	16:18	3.0	2.93	-0.07	-2.4%	PASS
1 M	08/04/08	16:29	5.0	4.90	-0.10	-2.0%	PASS
1 H	08/04/08	16:39	9.0	8.89	-0.11	-1.2%	PASS
2 L	08/04/08	16:49	3.0	2.90	-0.10	-3.4%	PASS
2 M	08/04/08	16:59	5.0	4.90	-0.10	-2.0%	PASS
2 H	08/04/08	17:09	9.0	8.87	-0.13	-1.5%	PASS
3 L	08/04/08	17:20	3.0	2.89	-0.11	-3.7%	PASS
3 M	08/04/08	17:30	5.0	4.84	-0.16	-3.3%	PASS
3 H	08/04/08	17:40	9.0	8.91	-0.09	-1.0%	PASS
Low-Level Average			3.0	2.90	-0.10	-3.2%	PASS
Mid-Level Average			5.0	4.88	-0.12	-2.4%	PASS
High-Level Average			9.0	8.90	-0.10	-1.2%	PASS

The mercury probe at the baghouse outlet was inspected to determine why the system integrity checks were not producing any oxidized mercury. The tubing that connects the chlorine/nitrogen gas mixture to the flow orifice had been disconnected and the regulator

opened to allow chlorine to be transported to the mercury probe. A system integrity check was performed after the repairs were completed on July 25, 2008. Figure 4-203 displays the response on the total and elemental channel for the three phases of the system integrity check. The solid line represents the total mercury responses and the dashed line indicates the mercury responses of the elemental channel.

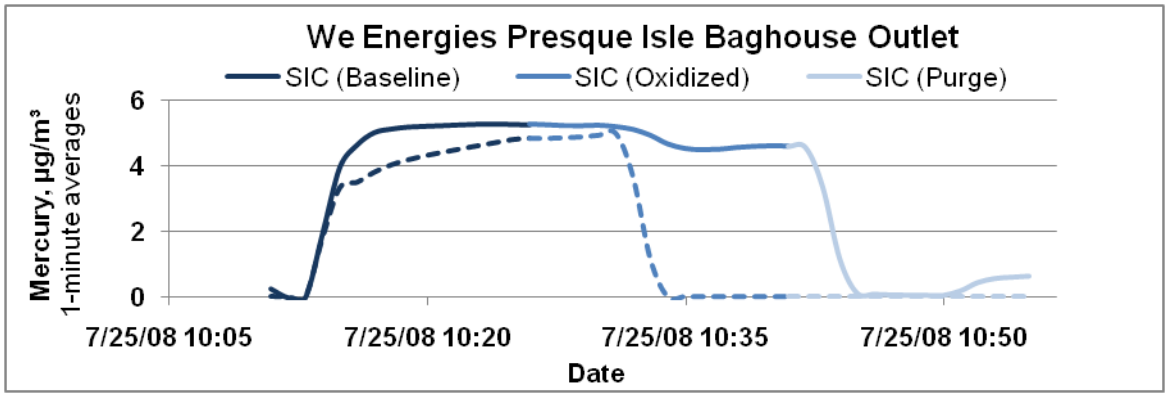


Figure 4-203. PIPP Outlet Mercury CEMS System Integrity Check; July 25, 2008.

During the introduction of the chlorine/nitrogen gas mixture into the oxidizer, the elemental span gas is diluted and the dilution must be accounted for accurate calculation of the responses of the system integrity check. Thermo recommends adjusting the elemental calibration response by the chlorine dilution factor to determine the adjusted oxidizer baseline response. The typical dilution calculated during the chlorine duration phase of the system integrity check is 4.0%. The adjusted baseline response is the adjustment (decrease) of the measured baseline response to account for the chlorine dilution.

There are several ways to interpret the response to the system integrity check. It is important to ensure that the proper amount of oxidized mercury is being created in the mercuric chloride generator. This calculation can only be performed while the instrument is measuring the system integrity check responses on the total and elemental channels. There were currently no performance specifications for the percentage of oxidized mercury required to perform a valid system integrity check. ADA-ES suggested that the oxidized fraction of the span gas used during the chlorine duration of the system integrity check should be at least 90% of the total mercury response. An oxidized fraction of less than 90% would not adequately test the ability of the system to transport and convert oxidized mercury.

Thermo recommends the calculation of "total efficiency" which shows how efficiently the probe transports oxidized mercury and converts the oxidized mercury into elemental mercury. The converter core in the mercury probe should convert all of the oxidized mercury back into elemental mercury. Thermo suggests that the total efficiency calculated during the system integrity check should be greater than 90%.

For error calculations of the system integrity check, Thermo had recommended that the absolute difference between the adjusted baseline response and the response recorded during chlorine duration should be less than 0.8 µg/m³. In addition, current regulations as defined by 40 CFR Part 75 also require that the system integrity check meet a performance specification of 5.0% of the span value.

Table 4-90 reports the responses of the system integrity checks performed in the third quarter of 2008. The total mercury baseline duration, adjusted baseline, and chlorine duration concentrations are calculated. Absolute error is calculated from the difference between the adjusted baseline total mercury response and the chlorine duration total response. The percent error is calculated based on the difference between the chlorine duration total response and the reference gas concentration of 5.0 µg/m³, calculated as an error of the span value of 10.0 µg/m³.

Table 4-90. PIPP Outlet Weekly System Integrity Checks (Converter 760 °C), 3Q08.

Date	Baseline Duration	Adjusted Baseline	Chlorine Duration	Pct Ox	Pct Eff	Abs Error	Pct Error	Result
07/25/08	5.24	5.04	4.59	100%	91%	0.45	2.2%	PASS
08/05/08	5.11	4.92	4.09	100%	83%	0.83	7.5%	FAIL
08/12/08	5.19	4.99	3.95	99%	79%	1.04	8.9%	FAIL
08/19/08	5.25	5.05	3.81	98%	75%	1.24	10.4%	FAIL
08/26/08	5.10	4.90	3.68	100%	75%	1.22	11.7%	FAIL

The system integrity check failed to meet any of the recommended performance specifications after the first check was performed and passed on July 25, 2008. Although the percentage of oxidized mercury created by the mercuric chloride generator was satisfactory,

the system was unable to meet the total efficiency recommendation of at least 90% conversion of the oxidized mercury into elemental mercury through the converter core. The problems with the system integrity check were discussed with Thermo and it was recommended that the converter core temperature be increased to facilitate the breakdown of mercuric chloride into elemental mercury. The converter core temperature was increased to 800 °C on September 12 and the system integrity check that followed passed all of the performance specifications. However, the system integrity check performed on September 16 depleted the remaining chlorine/nitrogen gas mixture and prevented oxidation of mercury in the mercuric chloride generator. The results of the system integrity tests after the converter core temperature increase are presented in Table 4-91.

Table 4-91. PIPP Outlet Weekly System Integrity Checks (Converter 800 °C), 3Q08.

Date	Baseline Duration	Adjusted Baseline	Chlorine Duration	Pct Ox	Pct Eff	Abs Error	Pct Error	Result
09/12/08	5.29	5.08	4.70	100%	93%	0.38	3.0%	PASS
09/16/08	5.27	5.06	5.19	3%	102%	0.40	4.0%	FAIL
09/23/08	5.22	5.02	5.10	2%	101%	0.30	3.0%	FAIL
09/30/08	5.19	4.99	5.12	1%	102%	0.32	3.2%	FAIL

The eductor transducer failed closed on August 31, 2008. When the eductor valve was closed, no air was delivered to the eductor in the probe to draw a steady sample of flue gas into the fast loop. The mercury system was still able to pull a sample of the flue gas through the inertial filter without an eductor and the mercury measurements collected between August 31 and September 12 May have been accurate but the concentrations cannot be completely trusted as the system was not functioning correctly. The daily calibration check responses continued to pass during the time that the eductor valve was stuck in a closed position because the eductor is normally turned off during the calibration routine. The eductor transducer and electronic regulator were replaced on September 12 and the system was returned to the correct operating condition. A chart of the change of the eductor pressure is shown in Figure 4-204.

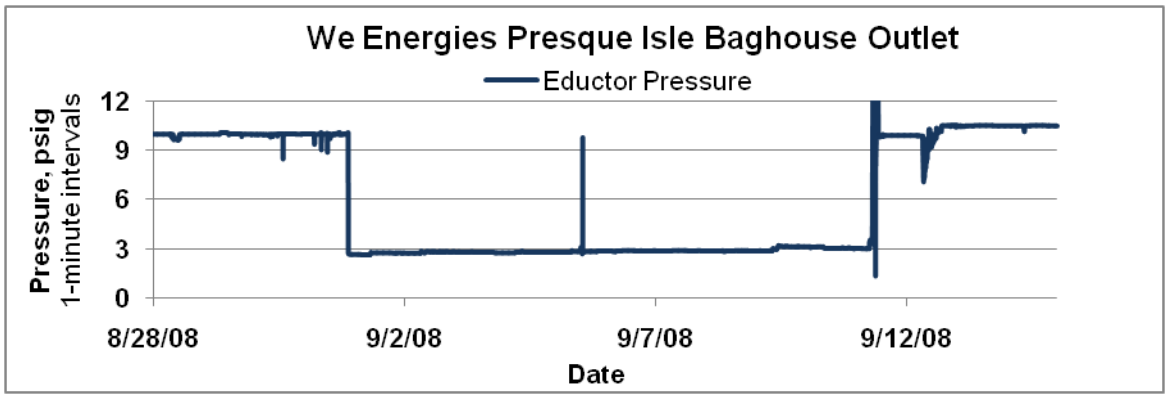


Figure 4-204. PIPP Outlet Mercury System Eductor Pressure, August–September 2008.

The mercury lamp located inside the optics bench of the outlet analyzer had degraded to an intensity of 20,000 Hz in September 2008. The previous mercury lamp was installed on June 27 and was only in service for nine weeks before reaching the maintenance limit for mercury lamps. This was a very short lifespan of the mercury lamps and they should last up to one year before requiring replacement.

4.15.9.2.12 Baghouse Outlet – Fourth Quarter 2008

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation in the fourth quarter of 2008 while sampling both total and elemental mercury concentrations. The mercury concentrations collected and recorded by the analyzer are presented in Figure 4-205.

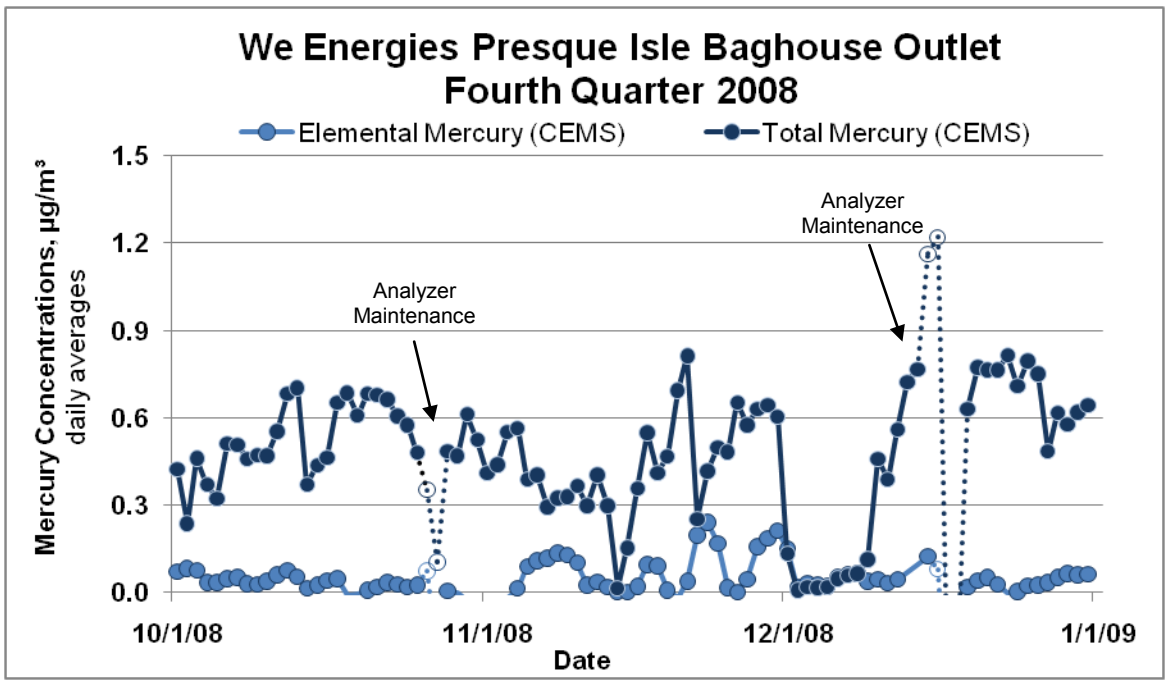


Figure 4-205. PIPP Outlet Total and Elemental Mercury, 4Q08.

The calculation of the availability of the outlet mercury CEMS for the first quarter of 2008 can be found in Table 4-92. The only out-of-control times for the mercury CEMS for the third quarter were due to the replacement of the mercury lamp and recalibration of the system in October and December 2008.

Table 4-92. PIPP Outlet Mercury CEMS Availability, 4Q08.

Month	Operating Hours	Downtime Hours	Availability
October 2008	744 hours	2 hours	99.7%
November 2008	720 hours	0 hours	100.0%
December 2008	744 hours	25 hours	96.6%

A linearity check was performed on the baghouse outlet mercury CEMS on November 20, 2008. The results of the linearity check can be found in Table 4-93. The results of the linearity check satisfied all requirements for the 40 CFR Part 75.

Table 4-93. PIPP Outlet Total Mercury System Linearity Check, 4Q08.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	11/20/08	14:40	3.0	3.04	+0.04	+1.3%	PASS
1 M	11/20/08	14:51	5.0	5.17	+0.17	+3.4%	PASS
1 H	11/20/08	15:04	9.0	9.45	+0.45	+5.0%	PASS
2 L	11/20/08	15:14	3.0	3.00	0.00	0.0%	PASS
2 M	11/20/08	15:24	5.0	5.11	+0.11	+2.2%	PASS
2 H	11/20/08	15:35	9.0	9.44	+0.44	+4.9%	PASS
3 L	11/20/08	15:46	3.0	3.01	+0.01	+0.3%	PASS
3 M	11/20/08	15:56	5.0	5.09	+0.09	+1.8%	PASS
3 H	11/20/08	16:06	9.0	9.44	+0.44	+4.9%	PASS
Low-Level Average			3.0	3.02	+0.02	+0.7%	PASS
Mid-Level Average			5.0	5.12	+0.12	+2.4%	PASS
High-Level Average			9.0	9.44	+0.44	+4.9%	PASS

A mercury continuous emission monitoring relative accuracy test audit (RATA) was performed at the stack and compared to the total mercury concentrations measured by the baghouse outlet mercury CEMS. These tests performed on November 4–6, 2008. Table 4-94 summarizes the Method 30B Sorbent Trap test results as collected and analyzed by Platt Environmental Services. Although the calculated relative accuracy exceeds the requirements of 40 CFR Part 75, the mean differences between the mean value of the monitor measurements and the reference method mean value does not exceed 1.0 µg/m³.

Table 4-94. PIPP Outlet Mercury RATA (M30B), June 2008.

Test Dates	Method	RM Mean µg/wsm³	CEM Mean µg/wsm³	Mean Diff µg/wsm³	Relative Accuracy
11/04/08–11/06/08	M30B	0.457	0.379	0.078	21.9%

The chlorine in nitrogen gas mixture bottle was replaced on October 21, 2008. A system integrity check was immediately performed and others were scheduled every week for the

rest of the quarter. The results of the system integrity checks for the fourth quarter of 2008 can be found in Table 4-95. The percent of oxidized mercury created in the mercuric chloride generator was very high for all system integrity checks but the conversion of oxidized mercury to elemental mercury in the converter core was often lower than acceptable based on the performance specifications of the system. The converter core in the mercury probe was scheduled for a replacement in January 2009 in order to improve the ability of the mercury system to convert the oxidized mercury.

Table 4-95. PIPP Outlet Weekly System Integrity Checks, 4Q08.

Date	Baseline Duration	Adjusted Baseline	Chlorine Duration	Pct Ox	Pct Eff	Abs Error	Pct Error	Result
10/21/08	5.22	5.02	4.39	99%	88%	0.63	6.1%	FAIL
10/28/08	5.21	5.01	4.37	99%	87%	0.64	6.3%	FAIL
11/04/08	5.07	4.87	4.22	99%	87%	0.65	7.8%	FAIL
11/11/08	5.23	5.03	4.05	99%	81%	0.98	9.5%	FAIL
11/18/08	5.29	5.09	4.06	94%	80%	1.03	9.4%	FAIL
11/25/08	5.17	4.97	3.90	99%	79%	1.07	11.0%	FAIL
12/02/08	5.11	4.92	4.38	98%	89%	0.54	6.2%	FAIL
12/09/08	5.18	4.98	4.66	99%	94%	0.32	3.4%	PASS
12/16/08	5.29	5.08	3.82	97%	75%	1.26	11.8%	FAIL
12/23/08	5.20	5.00	3.64	99%	73%	1.36	13.6%	FAIL
12/30/08	5.08	4.89	3.50	98%	72%	1.39	15.0%	FAIL

The probe bench temperature indication became unstable and decreased to zero on December 31, 2008. As the probe bench temperature reading decreased below the failsafe temperature of 157 °C, the mercury CEMS automatically shut off the dilution air and eductor air to the probe and put the system into a blowback mode in order to protect the components in the probe from contamination while sampling at a lower than acceptable temperature. It was suspected that the error was caused by the thermocouple measurement of the probe bench. The temperature measurements recovered without any repair activities performed on

the system. Figure 4-206 shows the unstable probe bench temperatures recorded from December 29–31.

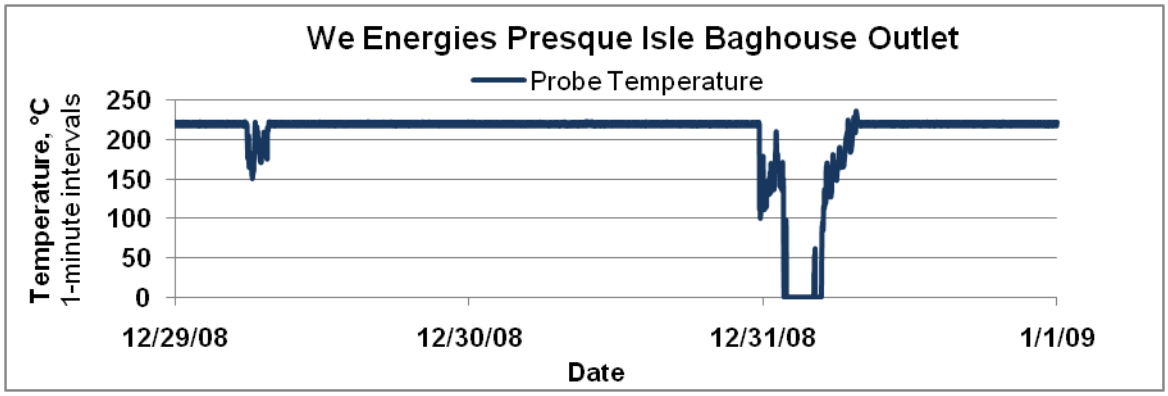


Figure 4-206. PIPP Outlet Mercury Probe Temperature; December 31, 2008.

Continuing problems with the mercury lamp led to two replacements during the fourth quarter of 2008. One replacement occurred on October 26 and the second replacement took place on December 17. The combination of low beginning lamp intensity and rapid degradation causes the lamps to reach maintenance level very quickly. The lifespan of the mercury lamps is very short and inadequate to ensure stable operation of the mercury system as excessive rates of degradation causes large amounts of drift in the mercury concentrations. Thermo was aware of the problems with the lamps and had agreed to replace them under warranty as they continue to investigate the problems with the mercury lamps.

4.15.9.2.13 Baghouse Outlet – First Quarter 2009

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation in the first quarter of 2009 while sampling both total and elemental mercury concentrations. Outlet mercury levels were impacted from February 10 to March 2, 2009 by activities associated with alternative PAC testing. The mercury measurements collected by the analyzer during the quarter are shown in Figure 4-207.

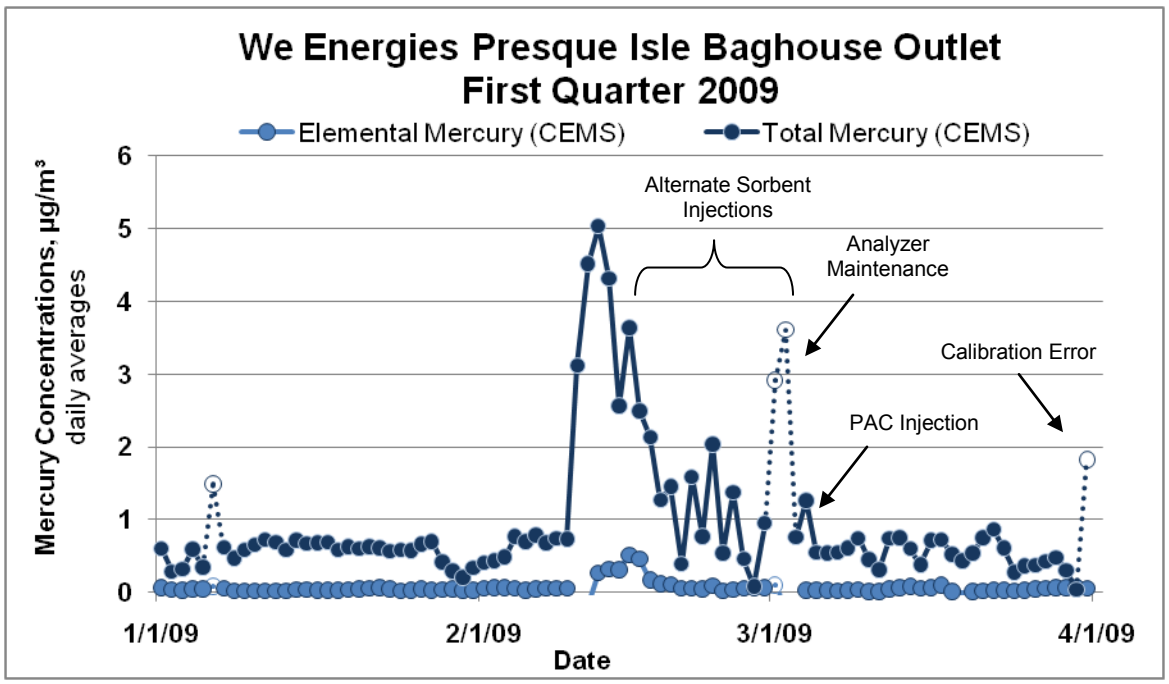


Figure 4-207. PIPP Outlet Total and Elemental Mercury, 1Q09.

The calculation of the availability of the outlet mercury CEMS for the first quarter of 2008 can be found in Table 4-96. Very brief maintenance activities and an error with the calibrator output concentration led to a lower availability calculated for March 2008.

Table 4-96. PIPP Outlet Mercury CEMS Availability, 1Q09.

Month	Operating Hours	Downtime Hours	Availability
January 2009	744 hours	54 hours	92.7%
February 2009	720 hours	41 hours	94.3%
March 2009	744 hours	87 hours	88.3%

A linearity check was performed on the baghouse outlet mercury CEMS on March 13, 2009. The results of the linearity check can be found in Table 4-97. The results of the linearity check satisfied all requirements for the 40 CFR Part 75.

Table 4-97. PIPP Outlet Total Mercury System Linearity Check, 1Q09.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	03/13/09	14:15	3.0	2.71	-0.29	-9.7%	PASS
1 M	03/13/09	14:25	5.0	4.99	-0.01	-0.2%	PASS
1 H	03/13/09	14:37	9.0	9.32	+0.32	+3.6%	PASS
2 L	03/13/09	14:47	3.0	2.98	-0.02	-0.7%	PASS
2 M	03/13/09	14:57	5.0	5.12	+0.12	+2.4%	PASS
2 H	03/13/09	15:07	9.0	9.37	+0.37	+4.1%	PASS
3 L	03/13/09	15:20	3.0	3.08	+0.08	+2.7%	PASS
3 M	03/13/09	15:29	5.0	5.01	+0.01	+0.2%	PASS
3 H	03/13/09	15:39	9.0	9.42	+0.42	+4.7%	PASS
Low-Level Average			3.0	2.92	-0.08	-2.7%	PASS
Mid-Level Average			5.0	5.04	+0.04	+0.8%	PASS
High-Level Average			9.0	9.37	+0.37	+4.1%	PASS

The converter core in the baghouse outlet mercury probe was replaced on January 6, 2009. Thermo recommends that the converter core be replaced every six months of continuous use and the converter at the outlet had never been replaced. There is very little oxidized mercury at the outlet to convert into elemental mercury for detection by the analyzer and the replacement of the converter core did not have any noticeable change on the concentrations measured at the baghouse outlet. Figure 4-208 shows the comparison between the total mercury concentrations measured before and after the converter core replacement.

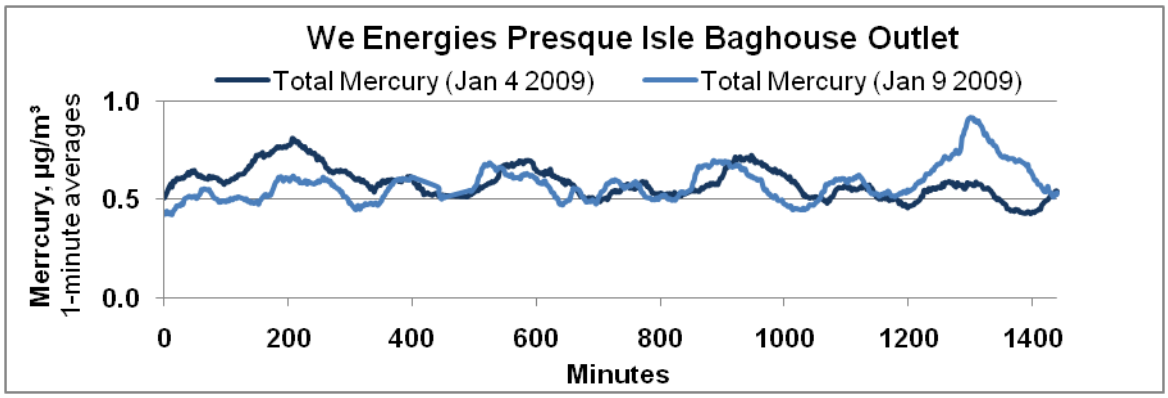


Figure 4-208. PIPP Outlet Mercury Probe Converter Core Replacement, January 2009.

A system integrity check was performed on January 14, 2009, after the replacement of the mercury probe converter core. The check was unsuccessful as the chlorine in nitrogen gas mixture bottle became empty in the middle of the chlorine duration phase of the test. The system integrity checks were automatically scheduled for each week and continued through February 17 before the oxidizer schedule was disabled. Each system integrity check performed during the first quarter of 2009 resulted in no oxidation of the elemental mercury in the mercuric chloride generator.

The probe bench temperature measurements became unstable on January 15, 2009, as shown in Figure 4-209. This thermocouple problem also occurred in December 2008. The system automatically engaged the failsafe conditions as the dilution air and eductor air valves closed and the system was set into a blowback mode. Because of the failsafe condition being met, the system was in blowback mode during the morning calibration routine and the daily calibration check was not performed. The thermocouple connection for the probe bench heaters was inspected during on-site activities on January 28 and the thermocouple connection secured.

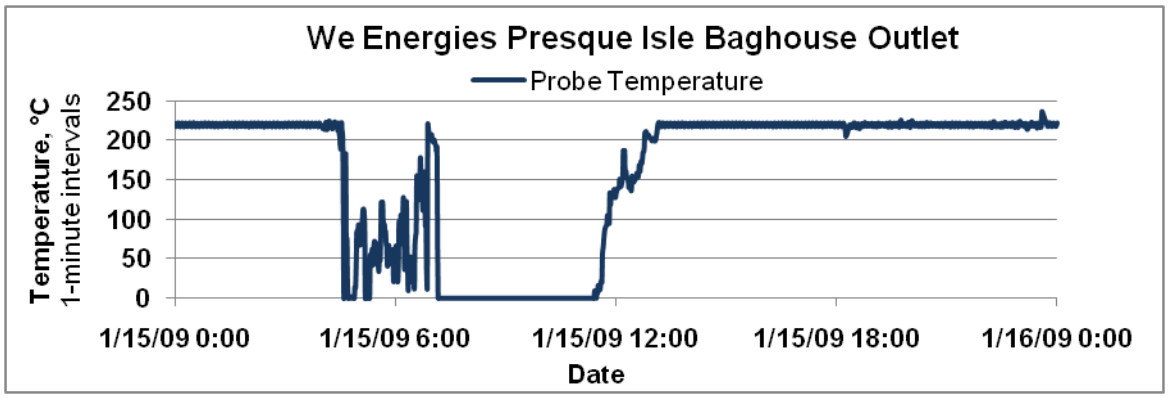


Figure 4-209. PIPP Outlet Mercury Probe Temperature Error; January 15, 2009.

The eductor air was accidentally turned off on February 10, 2009. There was a potential of the ash to build up on the filter while the eductor is turned off due to the dilution eductor still able to pull flue gas through the filter and to the dilution module. If the eductor air were off, the opportunity for the perpendicular flow across the filter to keep it clean would not be there. The eductor air was turned back on February 11. The eductor pressure was then temporarily increased to a maximum pressure on February 12 to create a large volume of air to pass across the filter to ensure that there was no build up inside the fast loop.

The lamp degraded to maintenance levels of less than 20,000 Hz within ten weeks of being installed in December 2008. A replacement mercury lamp was delivered and installed on March 2. The lamps that were installed in October and December 2008 started at an intensity of less than 50,000 Hz right after installation. The lamp replaced in March 2009 started at an intensity above 75,000 Hz and was predicted to have a longer lifespan that the previous lamps.

The communication between the analyzer and calibrator was interrupted on March 9, 2009. During the time that the analyzer could not communicate with the calibrator, the daily calibration checks failed to meet the criteria established in the CAMR on March 10–11 because the calibrator would not output the zero or span gas at the request of the analyzer. The communication problems were corrected on March 11 and the calibration checks passed again on March 12.

4.15.9.2.14 Baghouse Outlet – Second Quarter 2009

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation. The total and elemental mercury concentrations collected during the second quarter of 2009 are presented in Figure 4-210.

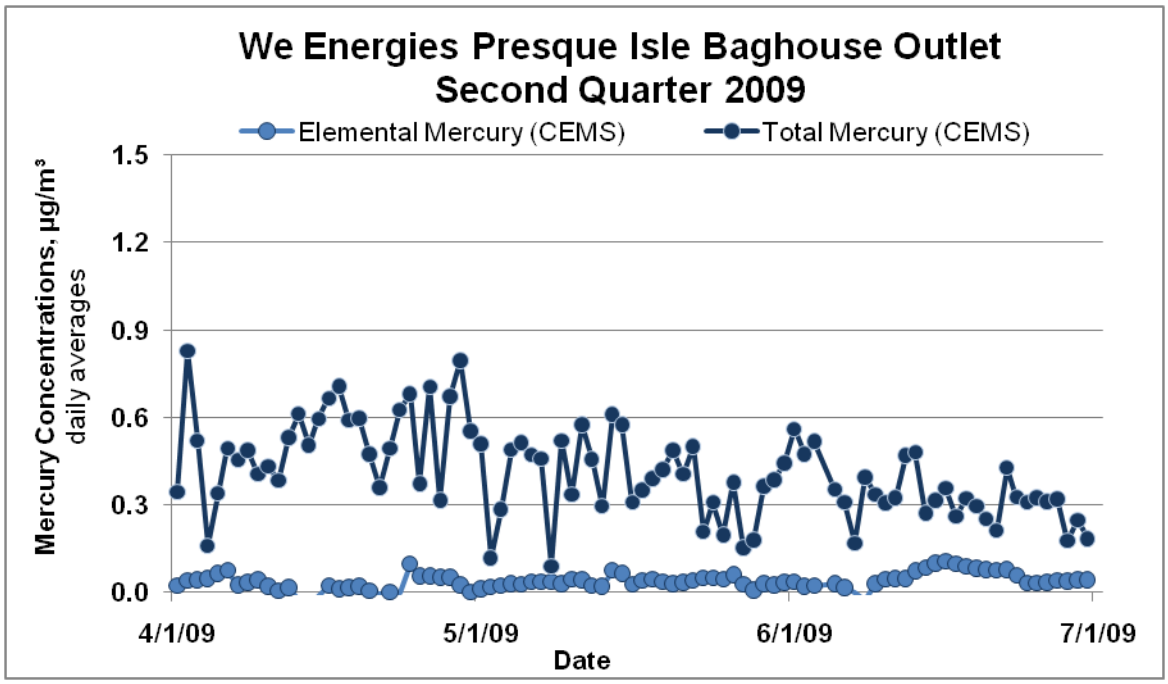


Figure 4-210. PIPP Outlet Total and Elemental Mercury Concentrations, 2Q09.

The calculation of the availability of the outlet mercury CEMS for the second quarter of 2009 can be found in Table 4-98. There was very little downtime recorded for the mercury CEMS and the availability for the quarter was calculated to be the highest recorded for this system.

Table 4-98. PIPP Outlet Mercury CEMS Availability, 2Q09.

Month	Operating Hours	Downtime Hours	Availability
April 2009	720 hours	5 hours	99.3%
May 2009	744 hours	0 hours	100.0%
June 2009	720 hours	0 hours	100.0%

A linearity check was performed on the baghouse outlet mercury CEMS on June 12, 2009. The results of the linearity check can be found in Table 4-99. The results of the linearity check satisfied all requirements for the 40 CFR Part 75 but they appear to be biased high on all three levels of span gas.

Table 4-99. PIPP Outlet Total Mercury System Linearity Check, 2Q09.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	06/12/09	12:01	3.0	3.11	+0.11	+3.7%	PASS
1 M	06/12/09	12:11	5.0	5.43	+0.43	+8.6%	PASS
1 H	06/12/09	12:21	9.0	9.56	+0.56	+6.2%	PASS
2 L	06/12/09	12:32	3.0	3.31	+0.31	+10.3%	PASS
2 M	06/12/09	12:42	5.0	5.35	+0.35	+7.0%	PASS
2 H	06/12/09	12:53	9.0	9.68	+0.68	+7.6%	PASS
3 L	06/12/09	13:03	3.0	3.26	+0.26	+8.7%	PASS
3 M	06/12/09	13:13	5.0	5.41	+0.41	+8.2%	PASS
3 H	06/12/09	13:24	9.0	9.70	+0.70	+7.8%	PASS
Low-Level Average			3.0	3.23	+0.23	+7.7%	PASS
Mid-Level Average			5.0	5.40	+0.40	+8.0%	PASS
High-Level Average			9.0	9.65	+0.65	+7.2%	PASS

The chlorine in nitrogen bottle for the system integrity check was replaced on April 2, 2009. The regular weekly system integrity checks began on April 2 and they were performed through the rest of the quarter. Although the chlorine/nitrogen bottle was replaced on April 2, an error with the regulator valve on the bottle was not repaired until the week of April 20. The small chlorine/nitrogen bottle did not last through to the end of the quarter before being emptied in the middle of the system integrity check on June 9. A replacement bottle for the system integrity check was never ordered so the last functional system integrity check performed on the baghouse outlet mercury system was June 2. The record of the system integrity check responses from April 2 to June 16 can be found in Table 4-100. None of the tests completed in the second quarter of 2009 was able to meet the specifications of

converting over 90% of the oxidized mercury into elemental mercury. When there was sufficient exposure to oxidized mercury, the converter core was only able to convert 83–86% of the mercuric chloride into elemental mercury. The system integrity checks continued to be performed according to the schedule programmed into the software until August 4 when the schedule was disabled.

Table 4-100. PIPP Outlet Weekly System Integrity Checks, 2Q09.

Date	Baseline Duration	Adjusted Baseline	Chlorine Duration	Pct Ox	Pct Eff	Abs Error	Pct Error	Result
04/02/09	5.57	5.36	5.51	9%	103%	0.14	5.1%	FAIL
04/07/09	5.29	5.08	5.26	6%	104%	0.18	2.6%	FAIL
04/14/09	5.15	4.95	5.16	6%	104%	0.21	1.6%	FAIL
04/21/09	5.23	5.03	5.20	3%	103%	0.17	2.0%	FAIL
04/27/09	5.45	5.24	4.44	99%	85%	0.80	5.6%	FAIL
05/05/09	5.38	5.17	4.29	99%	83%	0.88	7.1%	FAIL
05/12/09	5.32	5.11	4.31	100%	84%	0.80	6.9%	FAIL
05/19/09	5.53	5.32	4.52	99%	85%	0.80	4.8%	FAIL
05/26/09	5.49	5.28	4.52	99%	86%	0.76	4.8%	FAIL
06/02/09	5.45	5.24	4.35	100%	83%	0.89	6.5%	FAIL
06/09/09	5.54	5.32	3.01	64%	57%	2.31	19.9%	FAIL
06/16/09	5.42	5.21	5.50	12%	106%	0.29	5.0%	FAIL

As the lamp intensity drifts over time, the multiplier applied to the mercury detected in the analyzer increases. This is reflected as an increasing elemental coefficient that is calculated during normal recalibration procedures. When the elemental coefficient gets too high, the multiplier on the mercury signal has more of an impact on the calculated mercury concentration and causes more noise in the measurements. To reduce the elemental coefficient, the PMT voltage is routinely increased during an instrument calibration gas mode. The PMT voltage was adjusted on April 16, 2009. When the PMT was increased from 465V to 500V, the elemental coefficient was reduced from 1.44 to 1.01.

The weekly system integrity checks have not been producing any oxidized mercury in the mercuric chloride generator assembly. The mercury probe at the outlet was inspected and a loose wire connection for the oxidizer was replaced on April 21, 2009. The pressure on the regulator for the chlorine in nitrogen gas cylinder was also increased to get the proper flow to the oxidizer components. The pressure increase was recorded as from 18 PSI to 25 PSI, although it should be noted that there are suspicions that the gauge on the regulator is incorrect. Once these repairs were made, a system integrity check with a proper amount of mercury oxidation was performed on April 27. The probe bench and oxidizer heater set point temperatures were increased on May 12 to improve the conversion of oxidized mercury to elemental mercury.

4.15.9.2.15 Baghouse Outlet – Third Quarter 2009

The mercury CEMS installed at the outlet of the baghouse continued to be monitored during long-term operation in the third quarter of 2009 while sampling both total and elemental mercury concentrations. The mercury concentrations measured by the outlet mercury system can be found in Figure 4-211.

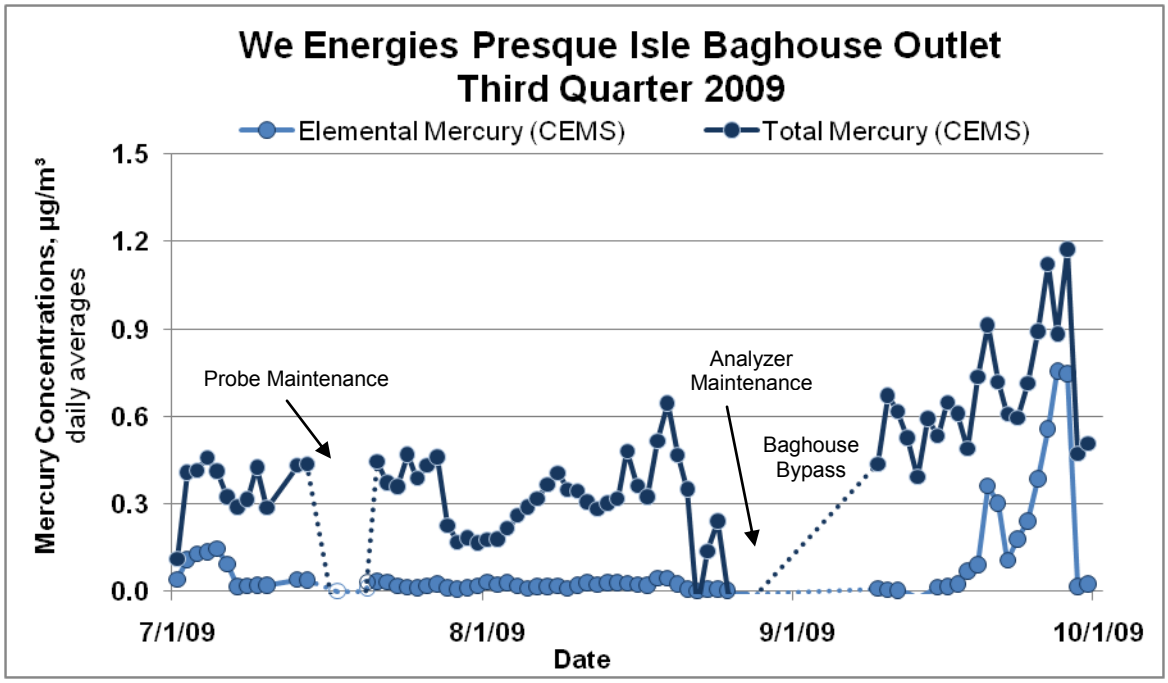


Figure 4-211. PIPP Outlet Total Mercury Concentrations, 3Q09.

The availability of the outlet mercury CEMS for the third quarter of 2009 can be found in Table 4-101. Probe maintenance activities negatively affected the availability of the system to collect valid mercury in July. A brief period of mercury analyzer maintenance to replace the detection lamp contributed briefly to the downtime of the CEMS in September.

Table 4-101. PIPP Outlet Mercury CEMS Availability, 2Q09.

Month	Operating Hours	Downtime Hours	Availability
July 2009	744 hours	98 hours	86.8%
August 2009	577 hours	0 hours	100.0%
September 2009	574 hours	49 hours	91.5%

A linearity check was performed on the baghouse outlet mercury CEMS on September 16, 2009. The results of the linearity check can be found in Table 4-102. The results of the linearity check satisfied all requirements for the 40 CFR Part 75.

Table 4-102. PIPP Outlet Total Mercury System Linearity Check, 3Q09.

Run	Date	Time	Ref	CEMS	Abs Error	Pct Error	Result
1 L	09/16/09	11:31	3.0	2.98	-0.03	-1.0%	PASS
1 M	09/16/09	11:41	5.0	5.12	+0.12	+2.4%	PASS
1 H	09/16/09	11:51	9.0	9.37	+0.37	+4.1%	PASS
2 L	09/16/09	12:02	3.0	3.40	+0.40	+13.0%	PASS
2 M	09/16/09	12:13	5.0	5.27	+0.27	+5.4%	PASS
2 H	09/16/09	12:23	9.0	9.87	+0.87	+9.6%	PASS
3 L	09/16/09	12:33	3.0	3.38	+0.38	+12.6%	PASS
3 M	09/16/09	12:45	5.0	5.51	+0.51	+10.2%	PASS
3 H	09/16/09	12:55	9.0	9.86	+0.86	+9.5%	PASS
Low-Level Average			3.0	3.25	+0.25	+8.3%	PASS
Mid-Level Average			5.0	5.30	+0.30	+6.0%	PASS
High-Level Average			9.0	9.70	+0.70	+7.8%	PASS

The probe and umbilical installed at the baghouse outlet were taken out of service on July 13, 2009. The probe and the umbilical were disassembled and cleaned on July 14. The system was returned to service and allowed to condition on July 15.

After cleaning of the probe and umbilical, a complete recalibration was performed on the outlet system. The PMT voltage was adjusted from 500V to 526V and the system passed the first hands-off calibration check on July 16.

The mercury lamp required another replacement on August 28, 2009. The PMT voltage was decreased from 526V to 474V after the replacement and during the complete recalibration of the system. The baghouse was being bypassed after the installation of the lamp and a system recalibration was not performed over concerns that the system would not respond correctly to the zero and span gas if the filter was not exposed to the moisture of flue gas. The baghouse returned to service on September 7 but the system did not start sampling flue gas and recalibrate until September 9.

4.15.9.3 QA/QC of Mercury CEMS Data

ADA-ES had developed an extensive internal Mercury CEMS Quality Assurance and Quality Control (QA/QC) Program that was implemented as a guideline during the on-going operation of the two Thermo mercury CEMS at the Presque Isle Power Plant.

Given the conditions of installation and monitoring of the mercury systems during testing events, strict adherence to promulgated quality assurance standards were not always possible. As such, latitude was taken internally when applying the quality assurance standards to the data collected, and experience and judgment were employed when interpreting data.

In order to have confidence in the individual measurements and the conclusions based on those measurements, a set of quality assurance checks were developed during the test phase. Many of the quality control requirements were performed according to the procedures defined in Appendix A and Appendix B of Part 75. While these QA/QC checks were generally observed, they were only guidelines. ADA-ES had significant experience and

expertise in designing and conducting test programs of this nature and in conducting the subsequent analysis.

4.15.9.3.1 U.S. EPA Clean Air Mercury Rule

The U.S. EPA published the Clean Air Mercury Rule (CAMR) on March 15, 2005, to permanently cap and reduce mercury emissions from coal-fired power plants. CAMR provided for operation and maintenance requirements, specifications and test procedures, and quality assurance and quality control procedures for continuous mercury emission monitoring systems to be included in 40 CFR Part 75.

The procedures that were followed for the mercury systems are outlined in 40 CFR Part 75.20 and 75.21. Appendix A of Part 75 details the certification requirements for the installation of a mercury monitor and Appendix B outlines the on-going quality assurance and quality control (QA/QC) procedures that need to be followed for accurate collection of data. Many of the certification tests were performed on an on-going basis as part of the QA/QC requirements. While the tests performed were the same, the success criteria for certification can be tighter than what was required for the on-going QA/QC activities. The 40 CFR Part 75 document is presented in Appendix Q.

For the mercury CEMS to complete initial performance specifications, a series of tests and evaluations were performed and the criteria passed. The CEMS must have passed a seven-day calibration error test with elemental mercury, a three-level linearity check with elemental mercury, a cycle time test, and a RATA (bias) test. If the mercury CEMS used a converter to measure total mercury, then the system must also have passed the criteria of a three-level system integrity check with oxidized ($HgCl_2$) mercury. The certification tests and criteria are outlined in Table 4-103.

Table 4-103. CAMR 40 CFR Part §75.20 Mercury CEMS Certification Tests.

Performance Test	Test Specifications	Criteria	CAMR Reference
Seven-day Calibration Error Test	Two-pt calibration check (zero and upscale) for seven consecutive days.	< 5.0% of span (or ≤1.0 µg/m³ if span is 10 µg/m³)	Part 75 Appendix A Section 6.3
Linearity Check	Challenge monitor three times with each reference gas (low, mid, high).	< 10% (or < 1.0 µg/m³) of reference gas value	Part 75 Appendix A Section 6.2
Cycle Time Test	Zero and upscale.	< 15 minutes to 95%	Part 75 Appendix A Section 6.4
System Integrity Check	Three-point converter efficiency test.	< 5.0% of span	Part 75 Appendix A Section 6.2
Relative Accuracy Test Audit (RATA) and Bias Test	One set of 12 test runs.	< 20% difference (or < 1.0 µg/m³ for low emitters)	Part 75 Appendix A Section 6.5

After certification was completed, the mercury CEMS must also have satisfied the requirements of on-going quality assurance and quality control checks. The mercury CEMS calibration needed to be checked daily with elemental or oxidized mercury. A one-level system integrity check was performed weekly if the system uses a mercury converter. A 3-level, 3-run linearity check was also performed quarterly, and a RATA and bias test needed be completed annually. The on-going quality control requirements are outlined in Table 4-104.

Table 4-104. CAMR 40 CFR Part §75.21 Mercury CEMS On-going QA/QC Tests.

Performance Test	Test Specifications	Criteria	CAMR Reference
Daily Calibration Error Test	Two-point calibration check (zero and upscale).	< 5.0% of span (or ≤1.0 µg/m³ if span is 10 µg/m³)	Part 75 Appendix B Section 2.1.1
Weekly System Integrity Check	Single-point converter efficiency test.	< 5.0% of span	Part 75 Appendix B Section 2.6
Quarterly Linearity Check	Challenge monitor three times with each reference gas (low, mid, high).	< 10% (or < 1.0 µg/m³) of reference gas value	Part 75 Appendix B Section 2.2.1
Relative Accuracy Test Audit (RATA) and Bias Test	One set of 12 test runs.	< 20% difference (or < 1.0 µg/m³ for low emitters)	Part 75 Appendix B 2.3.1

On February 8, 2008, the D.C. Circuit Court of Appeals vacated the EPA's rule that removed power plants from the Clean Air Act list of sources of hazardous air pollutants and likewise vacated the entire CAMR. Because the CAMR was vacated, it was in the opinion of the EPA's Office of General Council that the provisions that regulated quality control and quality assurance were also vacated.

Despite the removal of the EPA protocols, ADA-ES continued to use the procedures originally established by 40 CFR Part 75 Appendix A and Appendix B to ensure proper quality control and quality assurance of data collected by the Hg CEMS. In cases where Part 75 was lacking in quality control specifications, ADA-ES added criteria that may be more restrictive than those found in CAMR.

4.15.9.3.2 We Energies Consent Decree

In conjunction with We Energies, the mercury systems installed at Presque Isle were to come under the same performance requirements as the mercury CEMS installed at their Oak Creek

and Pleasant Prairie Power Plants. As part of the consent decree between We Energies and the U.S. Government, the installation and certification plan for the Oak Creek and Pleasant Prairie mercury CEMS was clearly defined to be in accordance to the revisions and requirements of 40 CFR 75, promulgated in the Federal Register, Volume 70, Number 95, on May 18, 2005. We Energies supplied ADA-ES with a preliminary document of the performance requirements for certification and on-going operations of the mercury CEMS on August 5, 2006. This document can be found in Appendix R.

Presque Isle Power Plant burned a subbituminous coal from the Powder River Basin. According to Appendix A of Part 75, the maximum potential concentration (MPC) of mercury in the flue gas resulting from combustion of a subbituminous coal is 10 µg/m³. Since the MPC is defined as 10 µg/m³, the span value of the mercury CEMS is defined as 20 µg/m³, which is the next highest multiple of the MPC. The appropriate gas level concentrations to be used with the inlet mercury system as defined by We Energies are listed in Table 4-105. The selected concentration to use with daily calibrations of the inlet system is defined by the mid-level gas concentration of 11.0 µg/m³.

Table 4-105. PIPP Inlet Mercury Span and Calibration Level Concentrations.

Gas Level	Allowable Range	Selected Percent	Selected Concentration
Zero Concentration	0–20% of span	0%	0.0 ug/m3
Low Concentration	20–30% of span	25%	5.0 ug/m3
Mid Concentration	50–60% of span	55%	11.0 ug/m3
High Concentration	80–100% of span	90%	18.0 ug/m3

However, the flue gas sampled at the baghouse outlet location is affected by mercury emissions control equipment and required the maximum expected concentration (MEC) to be defined. The goal of the project is to maintain 90% capture of the mercury across the baghouse and therefore the MEC was defined as 1.0 µg/m³. Since the MEC was defined as 1.0 µg/m³, the span value of the mercury CEMS was defined as 10 µg/m³, which is the next highest multiple of the MEC. The appropriate gas level concentrations to be used with the

outlet mercury system as defined by We Energies are listed in Table 4-106. The selected concentration to use with daily calibrations of the outlet system is defined by the mid-level gas concentration of 5.0 µg/m³.

Table 4-106. PIPP Outlet Mercury Span and Calibration Level Concentrations.

Gas Level	Allowable Range	Selected Percent	Selected Concentration
Zero Concentration	0–20% of span	0%	0.0 ug/m3
Low Concentration	20–30% of span	25%	5.0 ug/m3
Mid Concentration	50–60% of span	55%	11.0 ug/m3
High Concentration	80–100% of span	90%	18.0 ug/m3

4.15.9.3.3 ADA-ES Quality Control Program Development

ADA-ES was designated to handle all of the responsibilities of checking the daily calibration responses and performing maintenance on the system to continue the collection of valid data. It was determined that all efforts should be made to ensure that the data collected by the analyzer and passed to the ESC data logger was as accurate as possible. Although the data was being adjusted based on calibration responses in a reporting spreadsheet, it was of the best interest to operate the systems as closely to the regulations of the CAMR to make sure that the analyzer was measuring and recording the correct mercury concentrations at all times. This quality control procedure was still being implemented by the end of 2006.

Progress continued on the quality control procedures for the mercury CEMS during the first quarter of 2007. ADA-ES started the process of connecting remotely to the on-site computer at Presque Isle to download the data collected by the analyzer each workday. The calibration responses were analyzed based on the criteria published by the CAMR and the proper corrective action was discussed and performed. Unfortunately, concerns about the stability of the calibration responses of the analyzer led to questions about what the proper corrective action would be required for a failed calibration. Most of the corrections, if any, were still performed in a separate data analysis spreadsheet and reported as the mercury concentrations. It was determined that the best course of action would be to focus on correcting the stability

of the mercury CEMS and solve the problem of calibration checks not being repeatable from one day to the next.

The quality control and quality assurance program for the data collected by the baghouse inlet mercury CEMS was further defined by April 2007. The CAMR requires that the daily system calibration checks with zero air and elemental mercury pass criteria of less than 5.0% error of the span value on the total channel. The ±5.0% error imposed on the inlet mercury CEMS translates to an allowable absolute error of ±1.0 µg/m³ with a span value of 20.0 µg/m³. ADA-ES determined that these specifications were not satisfactory to ensure that the mercury concentrations measured by the CEMS and the removal calculations of the carbon injection system were as accurate as possible.

In addition to the requirements listed in Part 75, ADA-ES implemented a series of maintenance levels for the daily calibration error check in which the calibration settings of the instrument were adjusted without failing the criteria established by CAMR. A summary of these maintenance limits can be found in Table 4-107. Adjustments were made to the calibration factors of the mercury system based on the previous calibration response were performed without an additional manual recalibration as permitted by Appendix B of Part 75, Section 2.1.3(b). ADA-ES reserved the right to perform changes to the calibration factors at any time to achieve maximum integrity of the data collected, regardless of the guidelines specified in Table 4-107.

Table 4-107. ADA-ES Daily Calibration Error Test Maintenance Limits.

Maintenance Level	Specifications	Criteria	Corrective Action
Low Maintenance Limit	Zero Response, first day. Span Response, second day	>0.5% of span (or >0.1 µg/m³ if span is 10 µg/m³)	Update calibration factors.
High Maintenance Limit	Zero or Span Response, first day.	>2.5% of span (or >0.5 µg/m³ if span is 10 µg/m³)	Update calibration factors.

The table of corrective action based on calibration response defines the different levels used at ADA-ES to analyze the performance of the mercury system. If the zero and span response to the calibration check is less than 0.1 µg/m³ absolute error and less than 0.5% error, then the system does not requires any corrective action. If the error is greater than 0.1 µg/m³ or 0.5%, then there are several degrees of corrective action depending on if it is the first occurrence at this response error level and on what phase (zero or span) the error occurred. An error above 0.5 µg/m³ or 2.5% will identify that the system requires a calibration factor update.

4.15.9.3.4 Daily Calibration Error Test

The daily calibration checks were modeled after the regulations defined by Appendix B of Part 75, Section 2.1.1 and 2.1.2. The calibration checks were automatically initiated by the analyzer software or external data logger/timer each day and the responses compared to the criteria to see if the result of the calibration check passed or failed.

The daily calibration check began by challenging the system with zero gas. The zero gas was introduced to the mercury probe and it was pulled through the inertial filter and down to the analyzer. The response was allowed to stabilize for at least ten minutes to get an accurate measurement of the zero gas. The calibrator also challenged the system with span gas of a specific concentration in the same way as the zero gas. The responses to the zero and span gases constitute the daily system calibration check and they were analyzed to determine if they satisfy the regulations of CAMR. The typical profile of a daily calibration check is shown in Figure 4-212

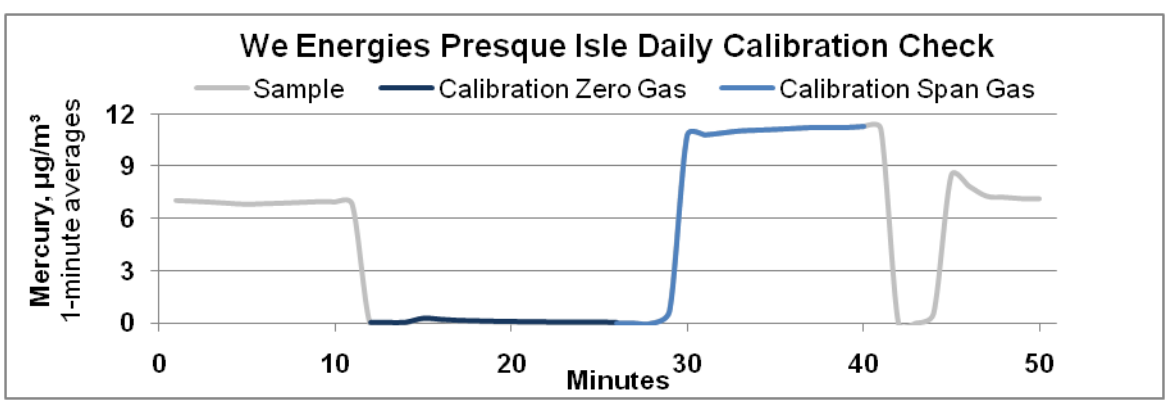


Figure 4-212. Daily System Calibration Zero and Span Check Profile.

The monitor is requires to meet a performance specification of 5.0% of span or an alternate specification of 1.0 µg/m³ absolute difference between the reference gas and the analyzer response for span values less than 10 µg/m³.

Whenever a daily calibration error test failed or whenever a monitoring system returned to service following repair or corrective maintenance, data from the monitor was considered invalid until the required additional calibration error test had been successfully completed.

Routine calibration adjustments of a monitor were permitted after any successful calibration error test. These adjustments were made to bring the monitor readings close to a perfect calibration response. These adjustments were made by manual calculations of the calibration factors. However, an additional calibration test was required if a manual recalibration is performed on the system through the functions of the analyzer program or if physical adjustments were made to the system.

In order to maximize the availability of the instrument and to keep recalibration procedures to a minimum, ADA-ES developed an extensive quality control and quality assurance program to analyze the daily calibration check responses to a greater level than provided by federal and state regulations. This analysis held the performance of the mercury system to greater standard to allow measurement of more precise concentrations.

4.15.9.3.5 Weekly System Integrity Check

System integrity checks were performed to assess the response of the system with the low-, mid-, and high-level oxidized reference gases injected at the filter. The Thermo mercury probe May be installed with a Mercuric Chloride Generator (MCG) that converts the elemental mercury into an oxidized form of mercury by exposing the span gas to chlorine under high temperature. If the system was not equipped with an MCG, the requirements of this test were not considered.

The system integrity check procedure recommended by Thermo with their mercuric chloride generator was comprised of three distinct phases. The first phase is a “baseline duration” where the system was challenged with calibration span gas of a known concentration. This

was performed to record the baseline response with elemental mercury from the calibrator. The baseline phase was very similar to the daily calibration checks except that the gas was being passed through the oxidizer. This procedure was programmed by the analyzer to take place for 15 minutes.

The second phase was the "chlorine duration" where the 900 ppm of chlorine in nitrogen gas mixture was introduced to the elemental span gas that was passing through the oxidizer at a very high temperature. During this phase, the mercury exiting the mercuric chloride generator should be completely oxidized into mercuric chloride and introduced into the fast loop. The oxidized mercury was then sampled through the inertial filter and dilution module before it was pulled through the converter core. The converter core reduces the mercury back to the elemental form to be measured by the analyzer. In this way, the total channel should observe the same response as recorded during the baseline phase. The elemental channel should be reduced to measure zero mercury as the mercuric chloride should not be converted back to elemental mercury and the analyzer should not be able to detect it. This phase is also typically configured to have a duration of 15 minutes.

The final phase of the system integrity check was the "post condition" or "purge" phase. The valve that controls the chlorine/nitrogen gas mixture was closed to allow only elemental mercury or zero gas to pass through the oxidizer. This step was designed to clean out the mercuric chloride generator from any residual chlorine that May be present inside the oxidizer components and tubing.

The baseline, chlorine, and purge phases of the system integrity check are presented in Figure 4-213. The solid line represents the total mercury responses and the dashed line indicates the mercury responses of the elemental channel. The regulations do not specify that the elemental channel be monitored to determine the oxidation percentage of the system integrity check but it is recommended as the ability of the mercuric chloride generator to produce mercuric chloride should be determined as part of the test.

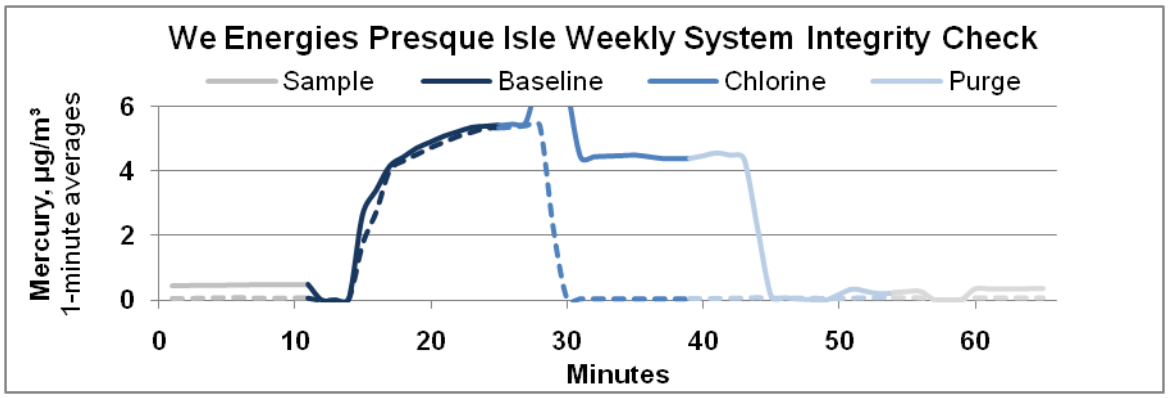


Figure 4-213. Weekly System Integrity Check with Mercuric Chloride Generator.

ADA-ES uses several criteria to determine the validity of the system integrity check. According to Part 75, the monitor must not differ from the reference by more than 5.0% of span value at any of the three gas levels. Another criteria defined by Thermo was a recovery efficiency of the oxidized mercury greater than 90%. A third criteria was for the response of the test not to differ from the span by more than 10% of the span value. The percentage of elemental mercury that was converted to oxidized mercury must also be above 50% in order to challenge the ability of the mercury converter.

4.15.9.3.6 Quarterly Linearity Check

Linearity checks were performed to access the response of the system with the low-, mid-, and high-level reference gases injected at the filter in non-repetitive triplicate. The three runs of the linearity check were performed consecutively without regard for collecting valid sample data within the operating hour of the system. Figure 4-214 represents a typical system linearity check as performed on the inlet and outlet systems at Presque Isle.

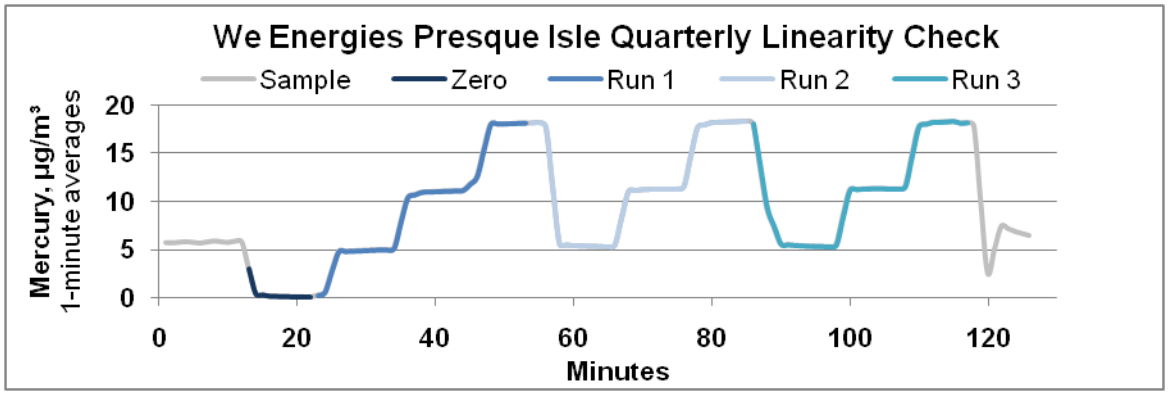


Figure 4-214. Monthly System Linearity Check.

The linearity check was performed manually by changing the span concentration output of the calibrator during the test. The daily calibration check should have passed the requirement before starting a linearity check to ensure that the system is properly calibrated before the check. Linearity checks were required once each QA quarter and at least 30 days apart. The complete linearity error test must complete within 24 unit-operating hours.

The monitor was required to meet a performance specification of 10.0% of reference or an alternate specification of 1.0 µg/m³ absolute difference, whichever is less restrictive. Stoppage of a linearity test because of monitor problems results in a failed linearity check for the monitor. If a linearity test was stopped for reasons other than monitor problems (unit offline), the linearity test should be resumed as soon as reasonably possible when the normal operating conditions are re-established.

If adjustments are necessary, this constituted an aborted linearity check and thereby forced the monitor into an out-of-control period back to the time the linearity test began. For a linearity check to be successful, no adjustments should be made to a monitor between or while gas is flowing. The linearity check should be repeated of a coincident calibration error test fails.

4.15.9.3.7 Relative Accuracy Test Audit

A Relative Accuracy Test Audit (RATA) is required to compare data from the mercury CEMS to data collected from an independent Reference Method. A RATA test involves installation of sampling probes into the flue gas stream close to the location of the mercury probes. There were two reference methods used to validate the performance of the mercury CEMS at the baghouse inlet and outlet locations. The sorbent trap collection method (Method 30B) and the Ontario Hydro reference method (ASTM D6784-02) are typically used as a quality assurance check against the mercury CEMS in order to provide assurance and quality control of the concentrations collected by the CEMS.

The Ontario Hydro test method is the measurement of the particle-bound, oxidized, elemental, and total mercury in coal-fired stationary sources. The flue gas passes through a filter to capture the particle-bound mercury component. After the filter, the sample is drawn

through an impinger that contain an aqueous potassium chloride solution to capture the oxidized mercury and several impingers of aqueous hydrogen peroxide and potassium permanganate solutions capture the elemental mercury. The samples are then recovered, digested, and analyzed for the elemental and oxidized mercury. The method is applicable to mercury concentrations between 0.5 µg/m³ and 100 µg/m³.

The sorbent trap method had been used since the early 1990s, and was formally validated against the Ontario Hydro Method in 2003. In 2004, EPA published a version of the method as Draft Method 324. With the release of the Clean Air Mercury Rule, EPA abandoned the "Method 324" nomenclature and now refers to the method as 40 CFR Part 75 App K. In late 2007, EPA published a new form of the sorbent trap method for use in CEM relative accuracy audits. This new form was designated Method 30B. While the sampling methodology itself is largely consistent with previous versions of the method, Method 30B stipulates additional quality control features, including the use of a field recovery test on previously spiked sorbent traps. Method 30B shall be used for all formal compliance testing, but an abbreviated form was used for general quality control throughout the testing phase.

For a RATA test, a minimum of nine valid runs using the Ontario Hydro method or Method 30B should be completed for mercury analysis. Each of the test runs must be two hours in duration. The relative accuracy of the test must not exceed 20% in order for the test to be considered valid. Alternatively for units where the average of the reference method measurements are less than 5.0 µg/m³, the test results will be considered acceptable if the difference between the mean value of the CEMS measurements and the reference method mean value does not exceed 1.0 µg/m³ in cases where the relative accuracy specification of 20% is not achieved. The paired runs of the RATA test must also meet a self-consistency criterion. The relative accuracy between the paired samples must be less than 10%.

4.15.9.3.8 Availability and Maintenance Reports

A monthly mercury CEMS performance report was also created starting in January 2008 to record all maintenance activities and unavailable times of invalid data collected by the system. The availability of the mercury CEMS was determined by analyzing the daily

calibration checks and determining when the system is no longer in compliance and the time that elapses before the system passes another daily calibration check.

The calculations for system data availability was based on Appendix B of Part 75 which defined the quality assurance and quality control procedures with respect to the daily, weekly, and quarterly assessments and maintenance activities of the mercury CEMS. The most common event for the invalidation of mercury data was the failure of the daily calibration check according to the criteria defined by the CAMR. The system entered an out-of-control period and the data collected by the system cannot be validated when it experienced a calibration response that exceeds the limit defined by the regulations. The data collected by the mercury CEMS remained in an out-of-control period until a hands-off calibration check could be completed and pass the criteria.

In addition to the daily assessments, the system must have collected at least one valid data point in each of the four 15-minute quadrants of the hour or else the system was considered out-of-control for that hour. If other required quality assurance or maintenance activities are performed, the hour was considered valid as long as there were two data points in two or more of the 15-minute quadrants of that hour. This specification includes hours in which a calibration check was performed and therefore only two data points were necessary for that hour to be considered valid.

Calculating the availability of the inlet system is complicated by the use of three different sampling probes with one mercury system and the number of combinations and unique configuration changes performed during operation of the mercury CEMS. The inlet mercury system was not designed as a compliance system due to the atypical installation of the mercury CEMS but quality control checks were performed liberally to ensure that the system was functioning properly and recording valid mercury concentrations.

4.15.9.3.9 Data Analysis and Performance Reports

The data collected from each mercury system was regularly collected and analyzed to ensure quality system performance and operation. Performance reports are typically created on a weekly basis to check the operating conditions and trends of the system (temperatures,

pressures, calibration responses and other quality assurance activities) in order to ensure that the system is collecting the most reliable and accurate mercury concentrations. The performance reports were generated starting in February 2008 and continued through September 2009.

4.15.9.4 Mercury CEMS Training Program

The training program provided by ADA-ES was an intensive, 8-hr program based on four years of operating experience and designed to provide CEM operators with the knowledge to successfully operate and monitor a Thermo Scientific Mercury Freedom System. Operators are given the opportunity to explore and operate all of the major components of the system on a fully functioning demonstration model provided by ADA-ES.

The training program was designed in three sections. The first section included an introduction to operators in order to give them the necessary background information to understand what mercury is and how the design and operation of a power plant effects mercury emissions and performance of the mercury system. The second section expanded on the operation of the mercury system and the operators would be given detailed descriptions of the make-up and function of the major system components. The third section was designed to cover detailed instructions to the important operating and monitoring functions of the system. This section would include hands-on training with a fully functional and integrated mercury system.

The on-site training program was completed for the operators at the Presque Isle Power Plant on June 3–4, 2008. A presentation was given to the trainees on the components of the system and basic operations. The training did not include instructions on how to perform repairs or maintenance activities as they are designed for more advanced parts of the training program.

The first section of the training program was a one-hour presentation that included an introduction to mercury and summarized the sources and hazards of mercury, different measurements techniques of mercury, and how the concentrations are typically calculated to present emission rates. This section also provided an overview of the CAMR and the requirements of a power plant to monitor and report mercury emissions.

The second section was a three-hour overview of the Thermo Mercury Freedom System. The overview included an introduction to the different instruments that make up the mercury CEMS, including the analyzer, calibrator, probe controller, and extraction probe. Other major components like the Hydra valve box, mercuric chloride generator, mercury umbilical and other ancillary equipment were also introduced to the trainees. The power and air requirements for a properly functioning mercury CEMS was also explained during the training session.

The third section was a four-hour introduction to the operation of the mercury CEMS. This section provided for the details on typical system operation and control of the instruments through the software loaded onto the analyzer and calibrator. Also included in the session were basic troubleshooting techniques and maintenance activities. The most common maintenance items were covered including replacement of the mercury lamp and sample vacuum pump. The troubleshooting guide instructed trainees on how to check if the mercury CEMS is functioning properly by inspecting the system for leaks, plugs, or incorrect settings.

4.15.9.5 Mercury CEMS Instrument Reference Method 30A

A Thermo Mercury Freedom System had been configured for Instrumental Reference Method (IRM) testing. A photo of the unit as installed and demonstrated at the Presque Isle Power Plant in June 2007 is shown in Figure 4-215. The unit consisted of a standard Model 80i mercury analyzer and Model 81i mercury calibrator installed in a temperature-controlled enclosure. Probe control (temperature, flow, pressure) is achieved through analog controls installed in the environmental enclosure. A standard Model 83i mercury extraction probe had been modified by removing the mantel and stinger, connecting calibration gas to a port upstream of the sampling filter, and adding additional pressure monitoring capabilities to the flow measurement venturi. A modified mantel/stinger portion of the probe had been fabricated to facilitate traversing. The mantel/stinger will be coupled to the other probe components by a 25-foot long heated umbilical.

Figure 4-215. Thermo Mercury CEMS for Instrumental Reference Method.

The demonstration completed at the Presque Isle Power Plant indicated that Method 30A and Method 30B are viable methods that can be successfully achieved according to the certification criteria under the CAMR. The complete report on the testing with the Mercury Instrumental Reference Method can be found in Appendix S.

4.15.10 Baghouse Performance

4.15.10.1 Emission Testing

4.15.10.1.1 Background

Emission testing from the Presque Isle TOXECON™ baghouse was conducted in 2006, 2007, 2008, and 2009. Primary areas of interest were particulates, halogens, hydrogen halides, and mercury. Other tests were conducted for metals in 2008 and SO_3 in 2009. Coal and fly ash samples were also analyzed in order to produce a mass balance for the coal constituent levels versus the fly ash and flue gas levels. Detailed descriptions of the tests methods referred to herein can be found at http://www.epa.gov/ttn/emc/promgate.html. Figure 4-216 below is a simplified diagram of test locations used for all four years of testing.

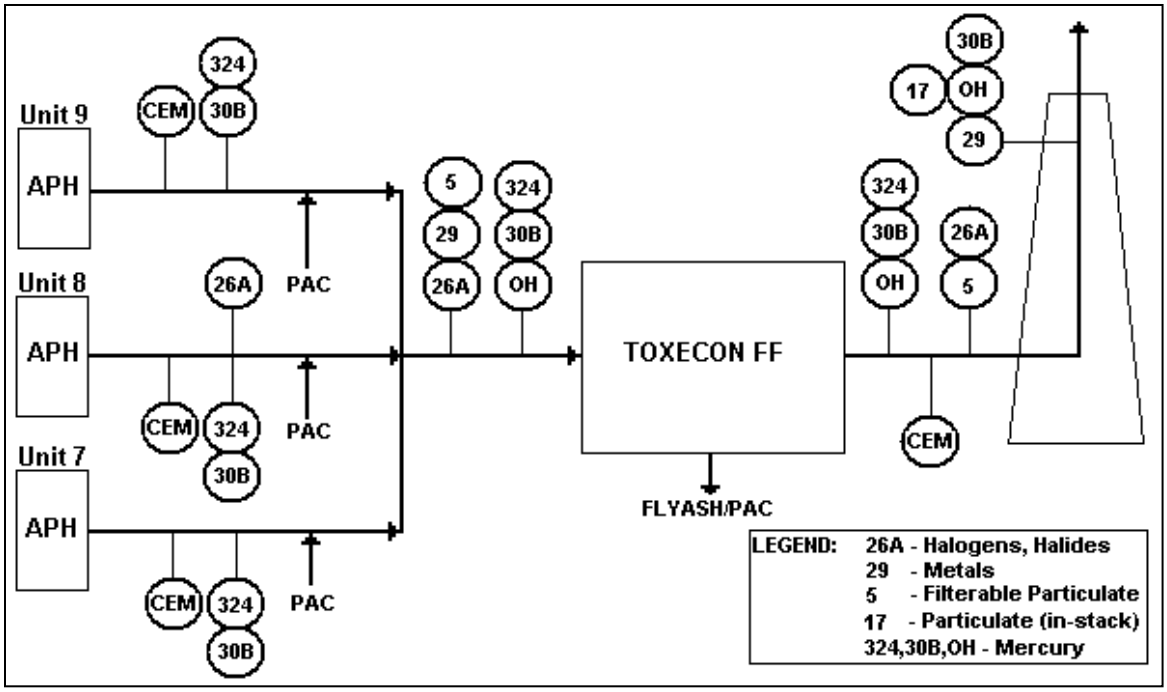


Figure 4-216. Emission Sampling Locations.

4.15.10.1.2 2006 Tests

GE Energy Management Services, Inc. performed Method 5 (M5) for particulate, Method 324 (M324) for mercury, and Ontario-Hydro (OH) for mercury at the TOXECON™ common inlet and outlet. Additionally, Method 26A (M26A) for halogens and hydrogen halides was performed at the TOXECON™ common outlet. The 2006 test dates were February 14–16, 2006. Powdered activated carbon (PAC) injection had been intermittent prior to this testing but was turned off during the 2006 tests to establish a baseline before parametric testing. The report from GE Energy is in Appendix G.

4.15.10.1.3 2007 Tests

In 2007, Platt Environmental Services, Inc. (PES) performed M5 particulate tests at the common inlet and outlet ducts of the baghouse. Additionally, M26A for halogens and halides was performed at the baghouse common outlet. The report from PES is in Appendix T. PES also conducted a mercury continuous emission monitoring relative accuracy test audit (RATA) on Flue 7 and Flue 9 stacks from June 19 through June 8, 2007. The RATA testing employed M30B sorbent traps for total mercury measurements. Ontario Hydro (OH) tests for total and speciated mercury were also performed at the stack for

compliance and to confirm the RATA results. ADA-ES performed a RATA using the Instrumental Reference Method (IRM) with a Thermo CEM during the time PES was performing the M30B and OH RATAs. PAC was injected during the 2007 test period. The report from PES covering the RATA testing is in Appendix U.

4.15.10.1.4 2008 Tests

On November 4–6, 2008, PES conducted a series of mercury, particulate, halogen, and trace metals tests. Mercury CEMS RATAs on the Unit 9 duct upstream of PAC injection and baghouse outlet common duct were performed using M30B. For the M30B mercury tests, paired sorbent traps were used at each location. Ontario Hydro (OH) tests for total and speciated mercury were also performed at the TOXECON™ inlet and outlet to confirm the RATA results. Previous tests on the three inlet flues showed that the mercury concentration between the three units was comparable. PAC was injected during the 2008 test period. The M26A tests were performed at the Unit 8 TOXECON™ inlet upstream of carbon injection, as well as at the common baghouse inlet and outlet. M5 particulate measurements were also taken at the common inlet and outlet of the baghouse. M29 metals were taken at the common baghouse inlet and at the Unit 8 stack. The two reports covering these tests are in Appendix V and Appendix W.

4.15.10.1.5 2009 Tests

On June 5, 2009, PES performed Consol Controlled Condensate Sulfuric Acid Mist Method tests at the common outlet duct to test for SO_3 emissions. PAC was injected during this test period. The report from PES covering these tests is in Appendix X.

4.15.10.1.6 Results and Comparisons

4.15.10.1.6.1 Particulate Matter

Particulate Matter (PM) measurements for each of the three year's tests are presented in Table 4-108. The quantities shown are the min/max range of the triplicate test runs as well as the average of triplicates performed during each period of testing. The measurements were taken at the common inlet to the baghouse downstream of PAC injection. PAC was injected during the 2007 and 2008 test periods but not during the 2006 measurements.

Table 4-108. Method 5/17, Particulate Matter.

M5/17	Year	Method	TOXECON™ Inlet (lb/hr)	TOXECON™ Outlet (lb/hr)	Baghouse Efficiency %
Filterable PM	2006	Range	84.9–141.2	0. 6–4.2	
		Average	110.1	1.7	98
	2007	Range	70.1–162.0	16. 7–20.0	
		Average	114.0	17.8	84
	2008	Range	259.9–608.9	11.9–27.4	
		Average	413.8	17.0	96
	2008	Inlet PM using Baghouse Fly Ash LOI%	137.5	17.0	88

The filterable outlet PM for 2006 was much lower than successive years. This was measured after startup testing of the PAC injection system but before long-term injection of PAC. Outlet emissions for 2007 and 2008 were consistent with an average of about 17 lb/hr. This would indicate that the bags were maintaining integrity throughout that period.

Inlet PM measurements were not as consistent. The 2007 inlet was not significantly higher than 2006 even though about 90 lb/hr PAC was being injected in 2007. The 2008 inlet PM measurement increased by nearly 400% over the previous years. The triplicate measurements for 2008 were 260, 372, and 609 lb/hr. Even if the last measurement is considered an outlier the difference in PM from 2007 to 2008 was still about 200 lb/hr higher. Possible explanations may include measurement error, stratification at measurement location, and ESP operational differences.

During the 2008 measurements PAC was injected into Units 7, 8, 9 at a rate of 81 lb/hr (for 1,100 Kacfm stack flow, 1.2 lb/MMacf PAC concentration). Knowing the PAC injection rate and the LOI % of the PAC, TOXECON™ fly ash and 7–9 ESP fly ash, the theoretical inlet PM for 2008 was calculated. Table 4-109 displays the LOI % of the different TOXECON fly ash components from the 2008 testing period. Using the equations below,

the inlet PM was calculated to be 137.5 lb/hr. This value is more consistent with previous years.

$$M_{Tox} = M_{PAC} + M_{ESP} \qquad \text{Eqn 1}$$

$$(M_{Tox} * LOI_{Tox}\,[\%]) = (M_{PAC} * LOI_{PAC}\,[\%]) + (M_{ESP} * LOI_{ESP}\,[\%]) \qquad \text{Eqn 2}$$

$$M_{ESP} = (M_{PAC} * (LOI_{PAC}\,[\%] - LOI_{Tox}\,[\%])) / (LOI_{Tox}\,[\%] - LOI_{ESP}\,[\%]) \qquad \text{Combine Eqns 1 and 2}$$

Table 4-109. LOI % of each TOXECON Fly Ash Component.

Sample	Date	Location	LOI %
TOXECON™ Fly Ash	11/4–6/08	Composite from Compartments 1, 5, 6, & 10	41.2
PAC, DARCO® Hg-LH	11/08	PAC Silo	69.0
7 01509 ESP Fly Ash	11/4–5/08	ESP Composite	1.2

4.15.10.1.6.2 Halogens and Hydrogen Halides

Three years of halogen and halide measurements are presented in Table 4-110. All quantities shown except for the Unit 8 inlet HBr and all results for Br_2, are the average of the triplicate test runs performed during each period of testing. The Unit 8 inlet HBr and all Br_2 measurements were below the detection limit; therefore the quantities presented are the range of emissions from zero to the detection limit.

Table 4-110. Halogens and Hydrogen Halides.

M26 Item	Year	Unit 8 Inlet, Upstream of PAC	TOXECON™ Inlet	TOXECON™ Outlet	TOXECON™ Outlet
		[lb/MMBtu]	[lb/MMBtu]	[lb/MMBtu]	[avg, lb/hr]
HBr	2006	-	-	0.00045	1.4
	2007	-	-	0.00070	2.0
	2008	0.0 – 0.0277*	0.00044	0.00023	0.6
Br_2	2006	-	-	-	-
	2007	-	-	-	-
	2008	0.0 – 0.0277*	0.0 – 0.00003*	0.0 – 0.00003*	0.0 – 0.8*
HCl	2006		-	0.00490	15.0
	2007		-	0.00040	1.2
	2008	0.00172	0.00130	0.00120	3.2
Cl_2	2006	-	-	-	-
	2007	-	-	0.00120	3.7
	2008	0.00007	0.00008	0.00005	0. 2
HF	2006	-	-	-	-
	2007	-	-	-	-
	2008	0.00084	0.00050	0.00074	2.0

*ND – Non detected, detection limits were used in the emission calculations

The 2006 outlet HCl level of 15.0 lb/hr was much higher than successive years. This correlates reasonably well with coal chlorine content. The coal chlorine in 2006 averaged 68 μg/g. In 2007 and 2008 the coal chlorine averaged 25 μg/g. Additionally, there was no PAC injection during the 2006 M26A run. PAC tends to adsorb halogens. HCl quantities measured in the flue gas increased from 2007 to 2008, but coal chlorine content was the same. This may be attributed to the higher PM loading at the baghouse common inlet in 2008.

HBr vapor emissions decreased from 2007 to 2008. Brominated PAC injection was essentially equal for the two periods, so some other factor may be responsible. 2007 measurements were taken in summer, while 2008 measurements were taken in winter with lower ambient and flue gas temperatures.

Hydrogen fluoride levels upstream of PAC injection were similar to stack levels, so HF was likely created during combustion and passed through the TOXECON™ baghouse and then out the stack.

Table 4-111 shows the results from the 2008 halogen and halide testing using M26A. These tests were performed at three locations to understand the effects of PAC injection on halogens regarding both scrubbing of native species or emissions of halogens originating in the PAC. The first location was upstream of PAC injection to determine what would be emitted without PAC injection and a baghouse. The second location was in the common inlet duct to the baghouse. This data gave an indication of scrubbing of native species by the PAC in-flight. The third location was the common outlet duct. This gave the true emissions to the stack, and shows if there were emissions of halogens from the PAC as well as further scrubbing of native species.

Table 4-111. November 2008 Method 26A, Halogens and Hydrogen Halides.

M26A Item	Unit 8 Before PAC	TOXECON™ Common Inlet		TOXECON™ Common Outlet		PAC % Difference
	[lb/MMbtu]	[lb/hr]	[lb/MMbtu]	[lb/hr]	[lb/MMbtu]	%
HBr	0.0–0.00002*	1.5953	0.00044	0.62179	0.00023	*
Br_2	0.0–0.00002*	0.0–0.102*	0.0–0.00003*	0.0–0.0811*	0.00003*	*
HCL	0.00172	4.7177	0.00130	3.23354	0.00120	-24
Cl_2	0.00007	0.2808	0.00008	0.15158	0.00005	7
HF	0.00084	1.8064	0.00050	2.00627	0.00074	-40

*ND – Non detected, detection limits were used in the emission calculations

The column labeled "PAC % Difference" in Table 4-111 shows the increase (or decrease) in the constituent vapor over native concentration due to the addition of PAC. Native concentration represents the constituent content of the coal feed. The dramatic increase in HBr was caused by bromine which has been added to the PAC to improve performance. The PAC was measured at roughly 4.7% bromine by weight (using neutron activation analysis)

and was injected into Units 7, 8, 9 at a rate of approximately 81 lb/hr (for 1,100 Kacfm stack flow, 1.2 lb/MMacf PAC concentration.)

Table 4-112 provides a bromine mass balance based on the 2008 test data. The inlet bromine amount was based on the known bromine content of the PAC measured by neutron activation analysis. The following assumptions were made:

- The inlet bromine was calculated from the measured PAC injection rate and the measured bromine content of PAC (3.81 lb/hr Br).
- The PM collected in the baghouse (397 lb/hr) was equal to the inlet PM rate (414 lb/hr) minus the amount of PM measured at the outlet (17 lb/hr).
- The bromine concentration on the fly ash up the stack was equal to the bromine concentration of the fly ash removed by the baghouse.
- Bromine levels in the coal were insignificant. Flue gas measurements upstream of PAC injection confirm this.

Table 4-112. 2008 Bromine Mass Balance.

Inlet		**Outlet**				
Br	**PM**	**PM emitted**	**PM collected**	**Br in gas (M26A)**	**Br on PM (measured)**	**Br on PM (calculated)**
[lb/hr]	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**
3.81	414	17	397	0.71	0.79	3.10

The expected amount of bromine on PM was calculated to be 3.10 lb/hr, see Table 4-112. This was calculated by subtracting the outlet flue gas bromine from the inlet flue gas bromine and assumes that any bromine not measured in the flue gas was on the PM. Using the calculated amount of bromine it can be seen that the amount of bromine on PM collected in the baghouse should have been 0.8%. However, ash analysis done by an independent laboratory found typical bromine levels of 0.2% which would give a calculated bromine on PM of 0.79 lb/hr. It is unknown why there is this disparity in determining the bromine mass

balance. There may have been inconsistencies in the fly ash itself due to PAC distribution in the baghouse.

Table 4-113 contains a chlorine mass balance based on vapor phase chlorine measurements and PM measurements around the baghouse. This is a similar approach to what was used for the bromine mass balance described above. This shows that the amount of chlorine on PM collected in the baghouse should be about 0.45%. However, ash analysis done by an independent laboratory found typical chlorine levels of 12 ppm which would result in a calculated chlorine on PM of less than 0.01 lb/hr. Again, the reason for this disparity is unknown but may be due to ash inconsistencies.

Table 4-113. 2008 Chlorine Mass Balance.

Inlet		**Outlet**				
Cl (M26A)	**PM**	**PM emitted**	**PM collected**	**Cl in gas (M26A)**	**Cl on PM (measured)**	**Cl on PM (calculated)**
[lb/hr]	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**
5.41	414	17	397	3.63	<0.01	1.78

4.15.10.1.6.3 Sulfuric Acid

The June 5, 2009, Consol Controlled Condensate Method for Sulfuric Acid Mist (SO_3) emissions were performed and are presented in Table 4-114. The results were based on four test runs performed at the common baghouse outlet. Tests were attempted at the inlet location upstream of PAC injection but an obstruction in the duct caused questionable results. The purpose of the tests was to determine if the PAC injected into the duct was catalyzing the conversion of SO_2 to SO_3. The average SO_3 measured was 0.485 ppm which was well below the levels indicated from standard combustion calculations for this type of coal, and also indicates that catalysis was not occurring.

Table 4-114. Sulfuric Acid Test Results.

Sulfuric Acid Mist (SO_3 as H_2SO_4)			
Location	**Date**	**SO_3, Range**	**SO_3, Avg**
		[ppmvd]	**[ppmvd]**
Common Outlet	6/5/2009	0.32–0.68	0.485

4.15.10.1.6.4 Metals

Table 4-115 presents the results of the November 2008 M29 tests for eight metals. No data was available for 2006 and 2007. Highest metal concentrations in the flue gas were manganese, selenium, chromium and nickel. The baghouse removed a significant portion of several metals tested from the flue gas stream although removal percentages could not be accurately calculated for arsenic, manganese, beryllium, cadmium and lead since their respective outlet measurements were below the detection limit.

Table 4-115. Method 29, Metals.

M29 Item:	TOXECON™ Inlet	TOXECON™ Outlet	TOXECON™ Outlet
	[lb/hr]	**[lb/hr]**	**[lb/TBtu]**
Arsenic	0.0093	0.0–0.0090*	0.0–2.655*
Selenium	0.0473	0.0309	10.6872
Manganese	0.1063	0.0–0.0060*	0.0–1.593*
Beryllium	0.0020	0.0–0.0015*	0.0–0.531*
Cadmium	0.0027	0.0–0.0009*	0.0–0.266*
Chromium	0.0330	0.0081	2.8187
Lead	0.0100	0.0–0.0090*	0.0–2.655*
Nickel	0.0283	0.0090	3.1993

*ND – Non detected, detection limits were used in the emission calculations

4.15.10.1.6.5 Mercury

Manual mercury measurements were taken in February 2006, June 2007, and November 2008. Mercury baseline concentrations were taken during the 2006 tests while mercury RATAs were performed during the 2007 and 2008 test periods. The 2006 baseline measurements were taken at the common inlet and outlet of the baghouse. The manual RATAs in June of 2007 were performed on the Flue 7 and Flue 9 at the stack (M30B and OH). ADA-ES performed an IRM RATA (M30A) on Flue 8 while the manual RATAs were being performed on the other two flues. The RATAs in 2008 were performed on the Unit 9 inlet duct upstream of PAC injection and at the common baghouse outlet. Table 4-116 shows the mercury results of the three test periods.

Table 4-116. Summary of Mercury Measurements over Three Test Periods.

Date	Test Method	TOXECON™ Inlet	TOXECON™ Outlet	TOXECON™ Outlet	TOXECON™ Hg Removal
		[lb/hr]	[lb/hr]	[lb/TBtu]	[%]
February 2006[@]	OH	0.01692	0.01336	4.390	21.0
June 2007	M30B	0.01844*	0.00115	0.706	93.8
November 2008	M30B	0.01702	0.00109	0.413	93.6

*Calculated from CEMS data since no M30B sorbent traps were taken at the inlet in 2007
[@]No PAC Injection

2006

Mercury baseline measurements without PAC injection were taken during the week of February 13, 2006. A total of 24 test points were sampled using six ports at the baghouse common inlet and outlet test locations. The speciated mercury sample trains met all specifications required by the Ontario-Hydro (OH) method. Table 4-117 displays a comparison of the average inlet and outlet measurements using the Thermo CEMS and the OH method. There was a 0.6% difference between inlet and outlet based on the CEMS, but 9% when using the OH method. The CEMS and the OH results differed by 12% and 4.6%, which was well within the 20% agreement required by EPA to pass the RATA for mercury.

Table 4-117. 2006 Comparison of Thermo CEMS and Ontario Hydro Data.

Test Method	Inlet Average [µg/wScm]	Outlet Average [µg/wScm]	Differential (%)
Thermo CEMS	4.99	4.96	0.6%
Ontario-Hydro	5.67	5.20	9.0%
Differential (CEMS & O-H)	12%	4.6%	

Based on the OH data, the elemental mercury at the inlet was 91% of the total. Oxidized mercury comprised the balance, with just a trace of particle-bound mercury. At the outlet, the elemental portion was 88%, with the remainder in the oxidized form.

2007

The 2007 RATA tests were conducted using the M30A IRM, M30B sorbent traps as well as OH tests for compliance and to confirm the RATA results. Both M30A and M30B were performed under two different conditions over two weeks. The first condition was with the PAC injection rate reduced to provide a higher mercury concentration at the outlet since the OH has a relatively high detection limit. Once it was shown that both M30A and M30B were comparable to OH, the second condition was tested with the PAC injection rate set to provide mercury concentrations at a 90% removal level. Each sample was extracted for two hours the first week, and three hour test were performed the second week due to lower mercury concentrations in the stack gas. The three point, one port sampling was based on a sulfur dioxide stratification test that was performed on June 14, 2007, which passed the single test port criteria. The results from the 2007 mercury CEMS RATA tests are presented in Table 4-118. The passing RATA tests are listed below:

- Passed high level (1.5 to 3.2 µg/wScm)
  - OH to CEMS
  - STM to CEMS
  - IRM to CEMS

- Passed low level (0.48 to 0.93 µg/wScm)
  - STM to CEMS
  - IRM to CEMS

Table 4-118. 2007 Mercury RATA Results Summary.

Location	Test Method	RM Ave. Concentration [µg/wScm]	CEMS Average Concentration [µg/wScm]	Relative Accuracy
Flue 7 Stack	M30B	2.42	2.13	0.29*
Flue 9 Stack	OH	1.58	2.16	0.57*
Flue 7 Stack	M30B	0.52	0.40	0.12*

*Based upon <1.0 µg/wScm mean difference

2008

The 2008 mercury RATA tests were performed on the Unit 9 duct upstream of PAC injection and common baghouse outlet using M30B sorbent traps. For the M30B mercury tests, paired sorbent traps were used at each location. Samples were analyzed on site using an Ohio Lumex, Inc. analyzer for total gaseous mercury. The results of these tests were then compared with the Thermo CEMs installed at the Unit 9 inlet and common outlet of the baghouse.

Table 4-119 shows the results from the 2008 mercury testing. The results indicate that the Unit 9 TOXECON™ inlet CEMS meets the U.S. EPA annual performance specification of less than 20% RA as published in 40 CFR Part 75 and the outlet CEMS meets the U.S. EPA alternative annual performance specification of less than 1.0 µg/wScm mean difference for units emitting less than 5.0 µg/wScm.

Table 4-120 provides a mercury mass balance for each of the three years of mercury test data. The mass balance is used to compare the inlet mercury measurements to the total outlet

mercury. Included in this table is a comparison of coal mercury and inlet CEMS mercury which shows that the percent difference between the two measurements for the three years of testing ranges from 14.2% in 2007 to 19.5% in 2008.

Table 4-119. 2008 Results from Mercury Testing and RATA.

Location	Test Method	RM Ave. Concentration	CEMS Average Concentration	Relative Accuracy
		[µg/wScm]	[µg/wScm]	
Unit 7 Inlet	M30B	5.52	N/A	N/A
Unit 8 Inlet	M30B	6.11	N/A	N/A
Unit 9 Inlet	M30B	5.76	6.11	8.31
Common Outlet	M30B	0.46	0.38	0.08*

*Based upon <1.0 µg/wScm mean difference

Another comparison presented in Table 4-120 is between the measured mercury on the fly ash as determined by ash analysis and a calculated expected amount of mercury on PM. The expected mercury on PM is calculated by subtracting the outlet CEMS mercury from the inlet CEMS mercury and assumes that any mercury not measured in the flue gas is on the PM. There is no clear correlation between the measured and calculated results for mercury on the ash. Again, this may be due to variations in ash.

Table 4-120. Mercury Content by Location.

Year	Inlet			Outlet				
	Coal Hg	CEMS Hg	PM	PM emitted	PM collected	CEMS Hg	Hg on PM (measured)	Hg on PM (calculated)
	[lb/hr]	[lb/hr]	[lb/hr]	[lb/hr]	[lb/hr]	[lb/hr]	[lb/hr]	[lb/hr]
2006	0.016	0.01350	110	2	108	0.01339	0.00036	0.00011
2007	0.016	0.01844	114	18	96	0.00115	0.00791	0.01729
2008	0.014	0.01702	414	17	397	0.00109	0.03098	0.01593

Table 4-121 uses the calculated mercury on PM from Table 4-120 to determine the mercury in parts per million. This table shows that the amount of mercury on PM collected should be about 1 ppm for 2006, about 152 ppm for 2007, and about 38 ppm for 2008. Ash analysis done for the samples taken during the three testing periods found mercury levels of 5 ppm, 80 ppm, and 70 ppm, respectively. Previous testing of the ash collected in the baghouse showed great variability in the results with a range of 0.1 to 87 ppm which suggests that the 2006 and 2008 expected mercury ppm amounts are within the range of reported results for other periods, however, the 2007 amount may be an outlier.

Table 4-121. Mercury on PM comparisons.

	Outlet					
	PM	**PM Hg**	**CEMS Hg**	**Hg on PM (calculated)**	**Hg on PM (Ash Analysis)**	**Hg on PM (calculated)**
Year	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[lb/hr]**	**[ppm]**	**[ppm]**
2006	110	0.00036	0.01339	0.00011	5	1
2007	114	0.00791	0.00115	0.01729	80	152
2008	414	0.03098	0.00109	0.01593	70	38

4.15.10.1.7 Stack Testing Summary

- Emissions for three successive years: 2006, 2007, and 2008 were evaluated for trends and general comparison. SO_3 was measured in 2009.
- Halogens, hydrogen halides, filterable PM, and metals were included in the testing. Mercury was sampled using several methods, including: Ontario Hydro, Method 30A, Method 30B, and CEMS.
- Mercury mass balances had reasonable closures. RATA results using M30A and M30B (sorbent traps) proved that the CEMS were performing within specifications. The comparison of these two methods with OH also proved that they are viable test methods for mercury RATAs.

- The HBr mass balance showed an increase in bromine output from the system due to PAC injection.
- Filterable Particulate emissions were very low in 2006, only 1.7 lb/hr, compared to 2007 and 2008, which were 17.04 and 17.8 lb/hr, respectively. Data taken in 2006 was prior to long-term PAC injection. The injection of PAC for mercury control in 2007 and 2008 could have changed the mechanical properties of the filter cake and allowed more fines to pass through. It is positive to note that the filterable PM emissions did not increase from 2007 to 2008, even with higher inlet loading.
- The baghouse was able to remove some metallic species in significant amounts, primarily selenium, manganese, chromium and nickel.
- SO_3 emissions were very low at <0.5 ppm, indicating that PAC was not catalyzing SO_2 to SO_3 to any measurable extent.

4.15.10.2 Bag Inspection and Testing

4.15.10.2.1 Background

The TOXECON™ baghouse is a pulse-jet design with 10 compartments, each with 648 bags. Each compartment is separated into two, 18 x 18 row bag bundles: there are 648 bags per compartment. The diameter of the circular bag is approximately 5.25 in, the length is 26.25 ft and the filtering area is 35.5 ft^2/bag. The total filtration area in the baghouse is 230,000 ft^2. With all units in service at full load, the gross air-to-cloth ratio is 5.2 ft/min.

4.15.10.2.2 OEM Bag Description

The Original Equipment Manufacturer (OEM) design for the bags in the TOXECON™ fabric filter was to use fabric bags made from polyphenylene sulfide (PPS) fiber with the following specifications:

- Felted, 2.7 denier PPS fabric
- Weight of nominally 18 ounces/yd^2
- Singed on both sides

- Scrim material made from 3 ounces/yd^2 of PPS
- Mullen burst minimum of 500 psi
- Permeability at 0.5 inches H_2O of 25–40 cfm/ft^2

This specification is similar to that used in other pulse-jet installations, including the pulse-jet baghouses at We Energies' Valley Station.

4.15.10.2.3 Test Bag Descriptions

An evaluation of alternative fabrics that could potentially provide either performance or cost advantages was of interest. With EPRI's assistance, alternatives fabrics were selected for this test program.

It was of interest to evaluate different fabrics and monitor whether they were suitable for the flue gas and operating conditions of TOXECON at this site. Specifically, it was of interest to evaluate fabrics that had the potential for

- Operation at higher temperatures (up to 400 ºF),
- Higher collection efficiency
- Lower pressure drop
- Offering a cost advantage.

Initially, six materials were identified for testing, including four different versions of PPS fabric, P84 fabric and Kermel Tech (a recently released pulse-jet fabric). Five were identified for full-scale bag evaluation in this program. It was determined that it was more appropriate to install only swatches of the sixth fabric to reduce the risk of premature failures from unproven, experimental bags. Three of the bag types addressed bag life issues by using different, more robust scrim materials. The fourth bag type was a dual density design, which had the potential to provide higher efficiency filtration. These four fabric types were also being evaluated in EPRI's Novel Filter Bag Program. P84, the fifth test material, was a commercially available product that could operate at higher temperatures than the PPS fabric

and had the potential for higher particulate collection efficiency. Prior to startup, 51 test bags were fabricated and shipped to Presque Isle for installation in one of the baghouse compartments.

All test bags and swatches were installed in Compartment 8. A description of all the different types of test fabrics installed in Compartment 8 throughout the demonstration can be found in Table 4-122. All test bags were installed in bundle A, or the bundle closest to the inlet and outlet plenums.

Table 4-122. Test Bag Description.

Bag ID	Material/Design	Benefit	Quantity
9065	Dual density Torcon (0.9 and 2 denier blend on filter side, 7 denier on other side)	High Perm on one side, high collection efficiency on other side	8
1342	P84	Higher temperature, higher efficiency	10
GE BHA-TEX	Scrim-supported PPS felt with a BHA-TEX Expanded microporous PTFE Membrane	Membrane provides higher collection efficiency and promotes light dustcake formation	9
Toray	Proprietary material		1
Environmental Products and Systems, Inc.	PPS fabric	Alternate source of PPS bags	1
GE PS050	PPS fabric with 0.5 and 2.9 denier fibers on filtration side, 7.9 denier on other side	High Perm on one side, high collection efficiency on other side	5
Ahlstrom GFTS #4406	Armorguard felt, proprietary blend		Swatches only
9054[a]	High- perm, 7 denier Torcon with 2.0 oz. PTFE scrim	High Perm fabric with more robust scrim	8
9055 [a]	High-perm, 7 denier Torcon with 4.0 oz. PTFE scrim	High Perm fabric with more robust scrim	8
9056 [a]	High-perm, 7 denier Torcon with Torcon scrim	High Permeability fabric	12
Kermel[b]	Proprietary material		Swatches only

[a]*All high-perm test bags removed in April 2007 because of high particle penetration*
[b]*Fabric failed from chemical attack, swatches removed in February 2007*

In the case of the Ahlstrom and Kermel fabrics, 4.75” x 9.5” swatches were installed in frames in a swatch holder, which was placed on the supporting steel above the bags and pulse pipes. Although full-scale bags were preferred for the tests, using swatches reduced the risk of premature failures with experimental bags. For comparison, PPS felt swatches were also installed.

A schematic of the compartment layout, bag numbering scheme and locations of the different bag types in bundle A of Compartment 8 at startup in January 2006 is shown in Figure 4-217.

During the three years of testing, additional fabrics were added to the test matrix and bags were routinely removed for strength tests. The schematic in Figure 4-218 is the compartment layout in August 2009 and documents when new bags were installed or removed for various reasons, including:

- New test fabric/bags added to the program
- Bags removed due to heat damage from the overheating incident in February 2006
- High-perm test bags removed due to unacceptable emissions and replaced in April 2007
- Replacement bags for bags removed for testing

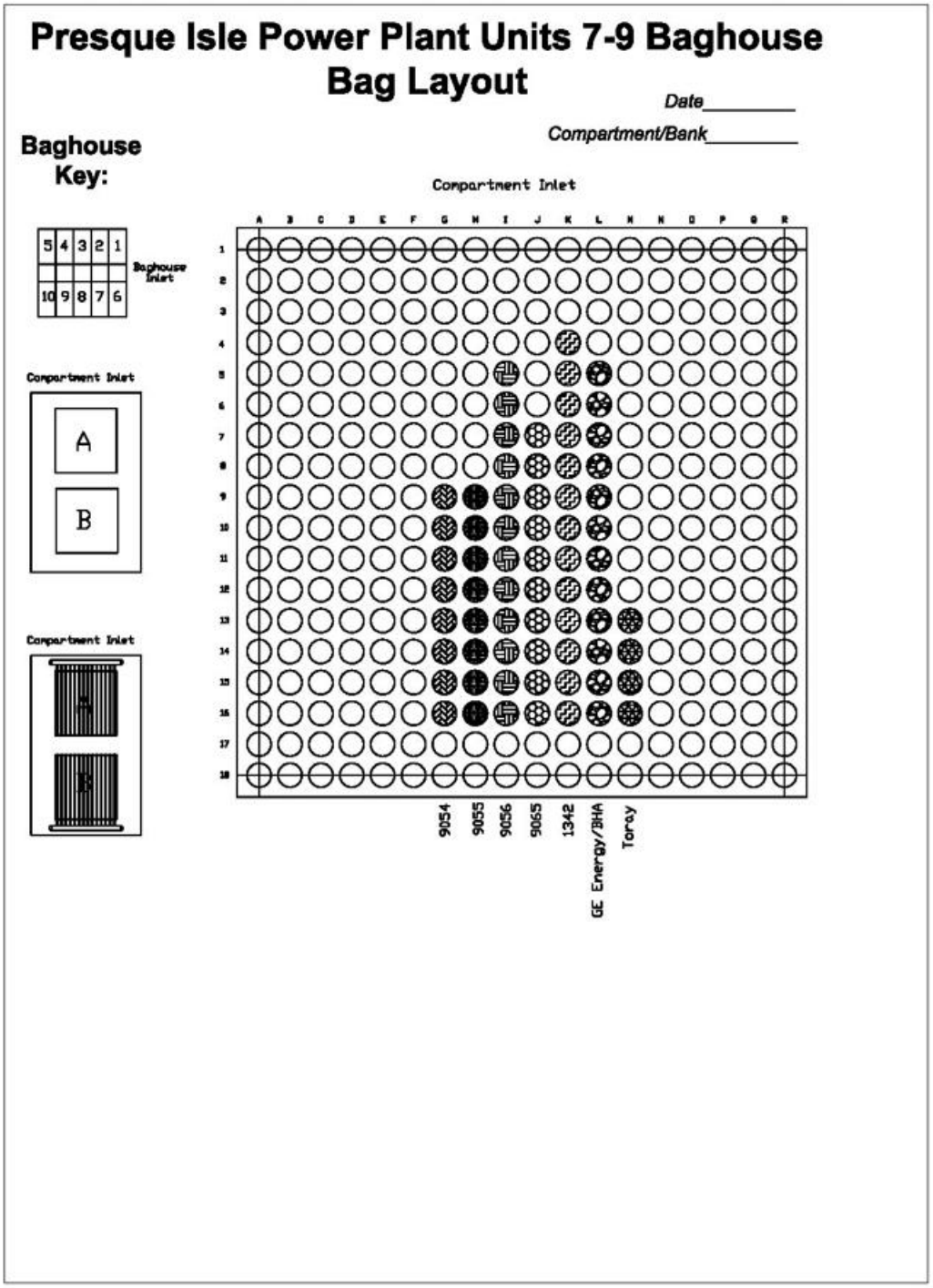


Figure 4-217. Test Bag Layout at Startup of the Baghouse.

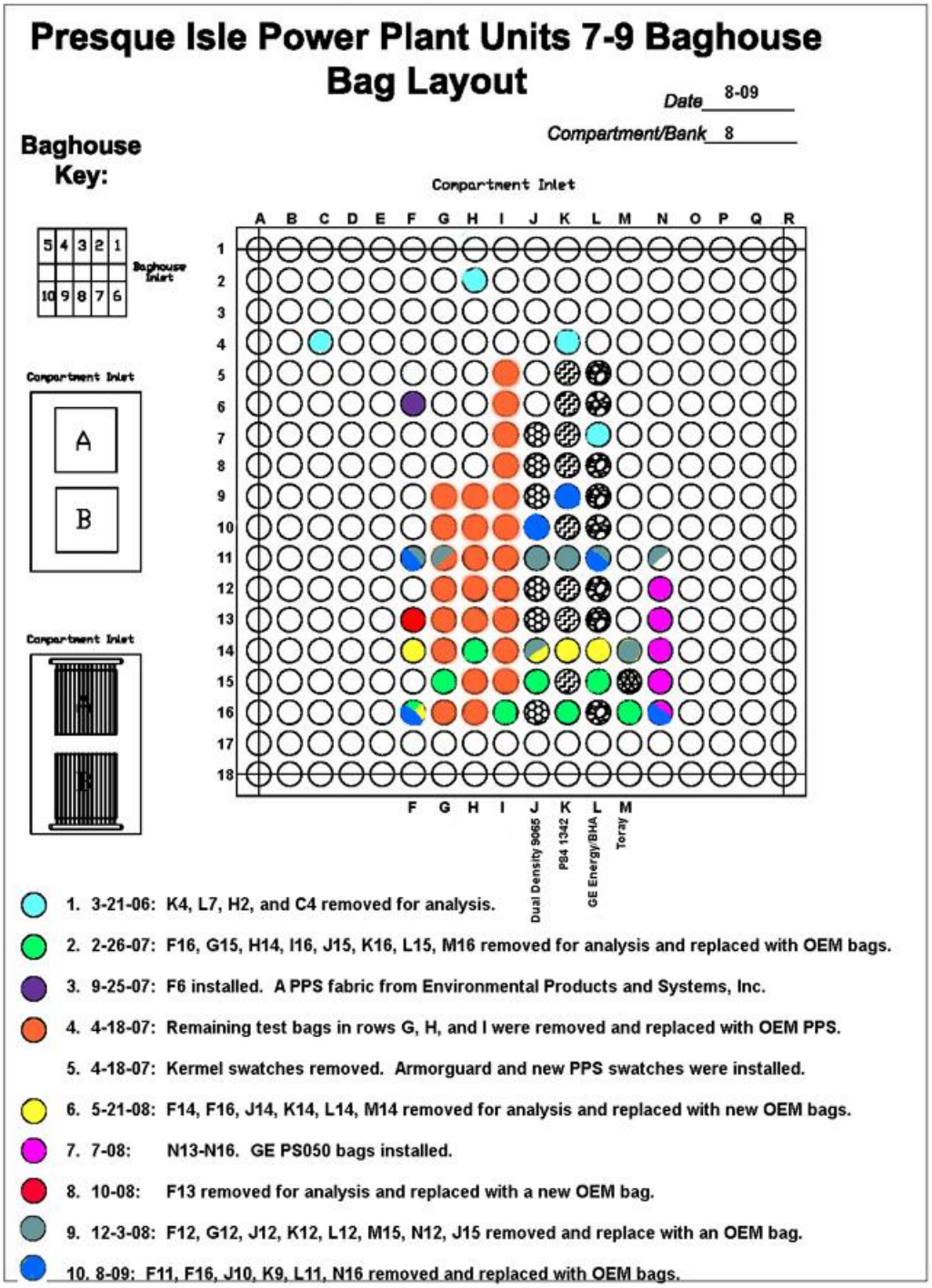


Figure 4-218. Test Bag Layout – August 2009.

4.15.10.2.4 Laboratory Tests

Periodically bags were removed and sent to a laboratory for testing. These destructive tests provided information on dimensional stability, fabric strength, and permeability as received and after vacuuming.

Air Permeability Tests: The method for direct determination of the air permeability of textile fabrics by the calibrated orifice method is covered by ASTM D 737-75 or FTM 5450. Permeability is measured in cubic feet per minute (cfm) of air flow per square foot of fabric area at a pressure drop across the fabric of 0.5" w.c. (unless otherwise specified).

Bursting Strength Tests: One method for measuring the strength of a fabric sample is to measure the pressure required to rupture the fabric. Typically, a hydraulic-diaphragm bursting tester is used (ASTM D 3786 – 80a and FTM 191A – 55122). This method has been modified to be more functional for fiberglass fabric, which has been the standard for utility baghouses. Most laboratories use a B. F. Perkins Model A Mullen Burst tester. These bursting strength tests are commonly called "Mullen Burst" tests.

Scanning Electron Microscopy Tests: This is a method used to view particle penetration into the bag fabric. This method can differentiate between PAC and ash particles.

4.15.10.2.5 Bag Inspection and Drag Testing

During the demonstration the baghouse periodically was in outage which provided the opportunity for select bags in Compartment 8 to be inspected. In-situ drag measurements of test and standard bags were made and select bags were removed for laboratory analysis. These tests were performed in February 2007, May 2008, December 2008, and August 2009.

The drag of individual bags was measured using a drag test apparatus, shown in Figure 4-219, which consisted of a blower, throttling valve, venturi flow meter, and pressure manometer. A flange adapter connected the device to the top of an individual bag/cage and sealed the bag opening at the tube sheet. This provided a means for measuring flow and pressure drop across the bag.

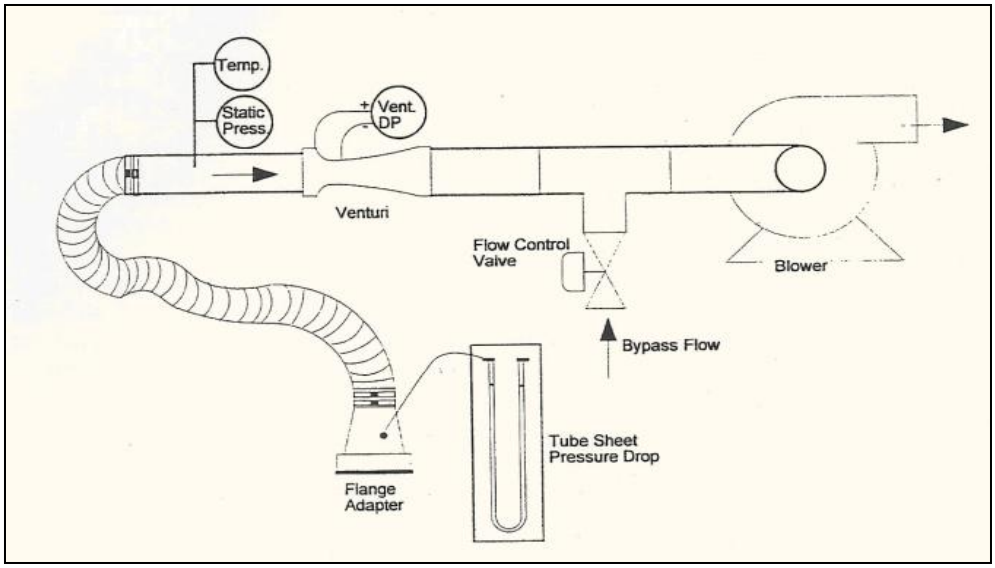


Figure 4-219. Portable Drag Tester.

The formula generally accepted in industry for predicting pressure loss in a fabric filter is:

- $\Delta P = \Delta P_R + K_2 V^2 Ct/7000$ Predictive equation for fabric filter pressure loss, where:
- ΔP_R Residual pressure drop (pressure drop after a clean)
- K_2 Specific resistance coefficient of freshly deposited dust, (inches of water gauge)/(fpm)/(lb/sq ft)
- V Face velocity or A/C (fpm)
- C Dust loading (grains/acf)
- t Filtration time (minutes)

Because flow and the corresponding air-to-cloth ratio vary with operation of individual baghouses and between different units, drag is usually used as the variable to compare performance. The drag is calculated by dividing the pressure drop across the tube sheet by the air-to-cloth ratio:

- Drag = Tube sheet ΔP/(A/C ratio)

Dividing the equation for pressure loss by air-to-cloth ratio results in a similar equation for predicting drag:

- Drag $= \text{Drag}_R + K_2VCt/7000$ Predictive equation for fabric filter drag

The tests performed measured residual drag, Drag_R, or the drag after the bags have been cleaned. These data allow tracking of how dust cake filterability develops and changes over time for each bag type.

4.15.10.2.5.1 Drag Testing Results

Drag provides an indication of the filtering performance of the bags after a period of operation. Ideally, the bags are cleaned, one pulse per bag, prior to taking the compartment off line so that the measurements represent the lowest possible drag with the dust cake formed in the conditions at this site. Not pulsing all of the bags uniformly can significantly affect the drag measurements.

The highlights for each inspection are discussed below, along with a comparison of drag and bag weight for all inspections.

February 2007

The drag of 80 bags was measured in the compartment and 8 were removed for weighing and laboratory testing, one each of the seven different types of test bags and one OEM bag. In addition, two swatches were removed. Looking at the tube sheet, there was obvious discoloration above rows G, H, and I in the area where the test bags were installed. The bags in these rows were all high perm bags, types 9054, 9055, and 9056. The rest of the tube sheet looked clean. This can be seen in Figure 4-220, which is a picture of the tube sheet before entering the compartment.

Figure 4-220. Picture of Compartment 8 Tube Sheet on February 28, 2007.

Some bags were difficult to remove because the bags bunched up and prevented the cages from sliding out. When this happened, the cage was reinserted into the bags and the next cage/bag was tried.

Figure 4-221 is a picture of the OEM bag as it was being removed from the tube sheet. Notice that the outside of this bag has a layer of PRB ash on top of the gray, carbon/ash mixture. Also notice that the swatch tester can be seen sitting on the shelf in the background.

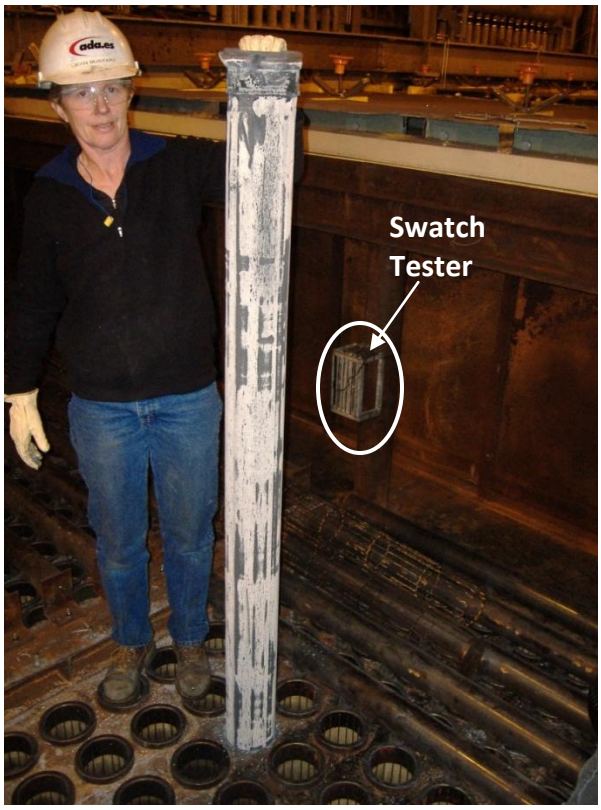


Figure 4-221. OEM Bag as it is being Removed from the Tube Sheet on February 26, 2007.

May 2008

Drag measurements were made on 93 bags. Six of these bags and four swatches were removed for weighing and laboratory testing. The tube sheet was clean, indicating that the bags were in good shape and meeting performance standards.

December 2008

The tube sheet was clean, indicating that the bags were in good shape and meeting performance standards. The final Ahlstrom test swatch and the standard PPS swatch were removed. The test fabric had shrunk, become discolored, and could easily be torn by hand. This kind of failure often indicates chemical attack from exposure to the flue gas. A photo of the test and PPS swatches can be seen in Figure 4-222.

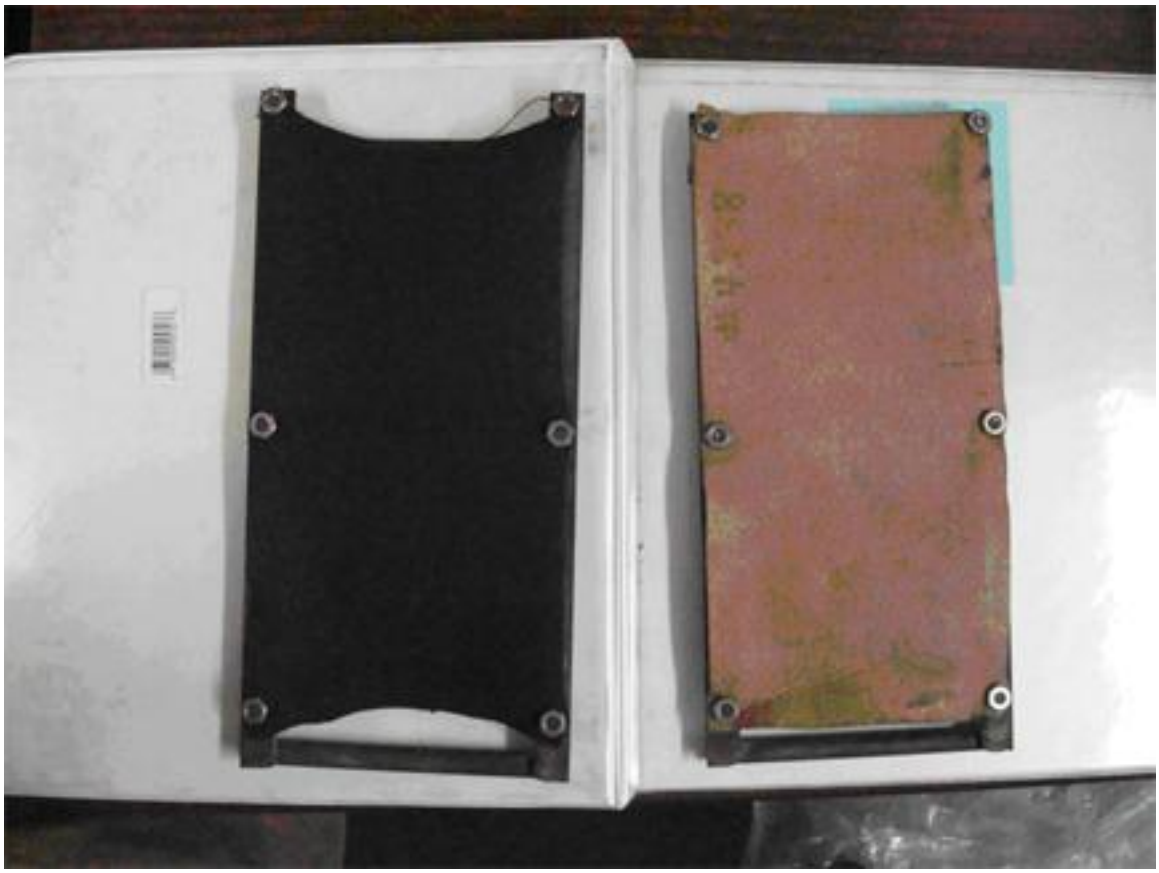


Figure 4-222. Picture of Test and PPS Swatches Removed from Compartment 8.

August 2009

During testing in 2009 the tube sheet on the bundle "A" side was clean, indicating that the bags were in good shape and meeting performance standards (Figure 4-223). The tube sheet on the bundle "B" side of Compartment 8 showed discoloration of the tube sheet as well as inside the bags. The most noticeable discoloration was in the bags located close to the compartment wall opposite of the compartment inlet (Figure 4-224).

Initial tests done the morning of August 27, 2009, produced inconsistent drag measurements with previous tests. The compartment inlet and outlet poppet valves were open with the ID fan on and the penthouse louver fans were on which may have created a different pressure differential through the bags than in previous tests. The tests were repeated with the penthouse louver fans turned off and the results were comparable to testing performed on earlier dates.

Figure 4-223. Compartment 8 Tube Sheet with Replacement OEM Bags Installed; 2009.

Figure 4-224. Bundle B in Compartment 8 Showing Discoloration of Bags and Replacement OEM Bag; 2009.

Seven bags were removed by first removing the cage, then the bag, and then folding the bag up and placing it into a plastic bag. One each of the dual density, P84, GE/BHA, and GE PS050 bags was removed. Three OEM standard bags were removed, two that were installed after initial operation of the baghouse.

4.15.10.2.5.2 All Years

Table 4-123 presents data from drag tests conducted in February 2007, May 2008, December 2008, and August 2009. This table also includes bag weights from the same time periods.

Table 4-123. Comparison of Drag and Bag Weights; 2/2007, 5/2008[a], 12/2008, and 8/2009.

Bag Description	Ave. Drag 2/07	Ave. Drag 5/08	Ave. Drag 12/08	Ave. Drag 8/09	Net Bag Wt. 2/07	Net Bag Wt. 5/08	Net Bag Wt. 12/08	Net Bag Wt. 8/09	Installed
Dual Density 9065	0.19	0.1	0.21	0.10	1.1	0.9	1.4	0.87	Jan-06
P84 – 1342	0.25	0.23	0.26	0.28	1.1	0.8[c]	0.8[c]	1.07[c]	Jan-06
GE/BHA – Membrane	0.32	0.3	0.29	0.33	0.9	0.6[c]	0.7[c]	0.97[c]	Jan-06
Toray	0.16	0.27	0.13	-	2	2.4	2.6	-	Jan-06
OEM Std	0.25	0.19[b]	0.23[b]	0.20	0.8	0.9[b]	1.1	0.87	Jan-06
OEM Std	-	0.16	0.22	-	-	0.8	0.8	-	Feb-07
OEM Std	-	-	0.25	0.16	-	-	0.9	-	Apr-07
OEM Std	-	-	-	-	-	-	-	0.62	May-08
GE PS050	-	-	0.07	0.05	-	-	1.2	0.87	Jul-08

[a]*Only bags installed January 2006 are included, all bags had 22,981 hours of operation*
[b]*Average drag for bags in Row F only. Bag removed for weighing from Row F*
[c]*Bag had to be cut off the cage*

For this baghouse, a drag below 0.3 inches H_2O/ft/min should be considered ideal and should result in acceptable filterability and pressure drop. At an air-to-cloth ratio of 5.5 ft/min and a drag of 0.3 inches H_2O/ft/min, the tube sheet pressure drop after cleaning would be nominally 1.6” w.c.

Drag was measured on an installed, new, OEM bag in February 2007. The drag was 0.05 inches H_2O/ft/min. During the August 2009 tests, the drag on an installed, new, OEM bag was 0.02 inches H_2O/ft/min. This difference is within the expected variability of the measurement.

The average drag of the originally installed standard PPS, OEM bags with over three and a half years of service was 0.20 inch H_2O/ft/min in Row F and 0.11 inch H_2O/ft/min in Row O. These are excellent values and show that the difference in the average drag between the two rows may be the result of Row O being pulsed more recently than Row F.

The average drag of the OEM bags in Row F in February 2007, May 2008, December 2008, and August 2009 was 0.25, 0.19, 0.23, and 0.20 inches H_2O/ft/min, respectfully. These data show that drag is not increasing with time, which is what would be expected. These low, steady drag values indicate that this baghouse design fully meets the requirements for this application and performance is above average.

The average drag of the OEM PPS bags installed in April 2007 in rows H and I was 0.16 and 0.05 inches H_2O/ft/min. These results provide additional confirmation that the drag of the standard bags is in an excellent range and that there are no indications that drag should increase to unacceptable levels any time soon, barring an upset condition. The low drag is probably the result of a very recent clean.

The average drag of the dual density test bags was lower in 2009 than the previous measurement, 0.1 versus 0.21 inches H_2O/ft/min, but the same as the measurements in May 2008 and similar to the measurements in February 2007 of 0.19 inches H_2O/ft/min. These drag values are excellent and are a good indication that these bags should provide long-term, acceptable filtering characteristics. The variations in drag measured in the previous tests may have been the result of when the bags were cleaned. The lower drag measurements directly correlate with the measured bag weights, as the higher drag values occur with higher bag weights.

The average drag of the P84 test bags was 0.28 inches H_2O/ft/min in 2009. This is slightly higher than the PPS bags with similar service hours. There has been very little variation in

the drag of these bags over the three tests; 0.25, 0.23, 0.26 and 0.28 inches H_2O/ft/min. The drag results show that these bags should provide acceptable tube sheet pressure drop for several years, assuming similar operating conditions. P84 is capable of operating at a continuous temperature of 500 ºF while PPS maximum continuous temperature is 375 ºF.

The average drag of the GE/BHA membrane bags was 0.33 inches H_2O/ft/min in 2009, which is similar to the previous three tests; 0.32, 0.30 and 0.29 inches H_2O/ft/min. This bag style has always had the highest drag of any of the other bag sets. This was expected early on because the membrane alone causes a higher drag. It is encouraging that this fabric has experienced no additional increase in drag over the three years. The dual purpose of the membrane is to reduce penetration of the particles into the fabric and provide a "slick" surface to hinder a dust cake from forming. At this time we are seeing no benefit of the membrane in maintaining lower drag than the standard PPS bags.

In September 2007 a single PPS bag from Environmental Products and Systems, Inc. (EPS) was installed in Row F. The drag of this single bag was 0.20 inches H_2O/ft/min in 2009, which is consistent with the standard and test bags over time in this compartment.

In July 2008 five test bags from GE were installed in Row N. These bags are identified as PS050 and are a type of dual density design with a combination of 0.5 and 2.9 denier fibers on the filtering side and 7.9 denier on the other side. The drag of these bags was very low at 0.05 inches H_2O/ft/min, which is only slightly higher than the drag of a new bag of 0.02 inches H_2O/ft/min. This low drag is not surprising considering that the bags have been in service for a relatively short period of 14 months and is similar to the December 2008 results of 0.07 inches H_2O/ft/min. The row they are in may have been pulsed immediately before isolating the compartment.

The GE/BHA membrane bags had previously had the lowest dust cake weight; however the weight from August 2009 was at the upper end at 0.97 lbs. Previous observations showed that the pressure drop was caused by the membrane and not embedded dust in the fabric. It is possible that the latest increase in weight may be because dust is beginning to embed in the fabric.

The dust cake weights of the P84 bag, 1.07 lbs is the highest of the bags weighed in 2009. Previous tests showed these bags to have similar weights as the OEM bags. It is possible that the latest increase in weight may be because dust is beginning to embed in the fabric.

The dust cake weight of the dual density bag was similar to the OEM bags at 0.87 lbs. Previous tests have shown the high perm (7 denier) bags typically have higher bag weights than standard denier fabric even though the drag is often lower. Half of this fabric is made from higher perm fibers and we may be seeing that this portion of the fabric is starting to hold more dust. Bag weights of the high perm bags at other sites were consistently higher than the standard bags even though the drag was typically lower.

4.15.10.2.5.3 Conclusions

This is the first installation of TOXECON™ so there are no other results available to use as a direct comparison of performance. There are two COHPAC® baghouses installed in the U.S. and operating experience from these was considered in the design of TOXECON™. The gross air-to-cloth ratio of the COHPAC® baghouses are 12 ft/min and 8 ft/min and they both have seen significant increases in drag within the first year or two of operation which resulted in high pressure drop and cleaning frequencies. Because of this, this baghouse was designed at a lower air-to-cloth ratio, 5.5 ft/min. The performance of this baghouse since startup and the results from these drag measurement indicate that the combination of the lower air-to-cloth ratio and the optimized cleaning logic implemented by We Energies are ideal for this application and overcome the pressure drop and operation & maintenance issues with the COHPAC® baghouses.

Nine different test bags and two set of swatches have been tested in this test program, including three different high-perm bags that were removed because of particle bleed through that was causing opacity spikes. The other six types of bags all performed well in this application. However, some of these alternative bags come with either a direct or operation and maintenance cost adder that is probably not justifiable for this site.

The dual density fabric has performed well, but no better than the standard fabric. It is unknown whether the dual density fabric would have the same, high collection efficiency as the standard fabric.

The P84 fabric provides the ability to operate at higher operating temperatures. These bags are more expensive and are also more difficult to remove from the cages, so O&M costs for a bag change out would be slightly higher. A possible justification for purchasing these bags would be if operating temperatures increased.

The membrane bags offer no advantage in this application and are considerably higher in cost. These bags also are difficult to remove and would result in higher costs when bags are replaced.

The Toray material had acceptable performance, but does not appear to justify its higher price.

A single PPS bag from Environmental Products and Systems was installed and appears to be similar to the other standard PPS bags in terms of drag. Laboratory integrity tests have not been performed.

The new GE bags (PS050) have performed well so far, although they have only been installed for 14 months.

4.15.10.2.6 GFTS Testing

Select bags removed from Compartment 8 were sent to Grubb Filtration Testing Services for inspection and testing. The report covering testing throughout the demonstration is in Appendix Y. Some conclusions from the report are as follows:

- All of the 100% PPS felts in the standard OEM bags and in three types of test bags lost from 47–58% of their strength during the initial 14 months of service. The cumulative strength loss was 75–85% after 44 months. Despite the strength loss, the bags were in excellent condition, both physically and in terms of the filtration capabilities.

- The P84 bags lost only 43% strength after 44 months of service. The permeability values were about equal to the PPS felt. The one negative feature of the P84 bags was the inability to extract the support cages from them.
- The dual density bags performed similar to the standard PPS bags. This material started with a 30% lower strength than the standard PPS bags, so the strength reduction to 58 psi indicates that the bags could fail sooner than the standard bags.
- BHA-TEX bags had a much lower permeability than the other bags, and the strength loss was similar to the standard PPS bags. The membrane remained in remarkably good condition.
- Toray composite felt bags accumulated a much heavier external dust cake due to the "fuzzy" surface produced by the glass fibers and the absence of a singed finish. This fabric was much weaker initially, but it lost only 52% of its strength due to its 40% non-PPS (glass and PTFE) batt fabric content.
- All of the high-perm PPS felt bags (three types) bled severely at their tops and had to be removed after 14 months of service.
- PPS felt with PTFE scrim bags demonstrated the fact that PTFE scrim-supported PPS felt retains more strength than 100% PPS felt when operating in flue gas conditions that are degrading to PPS. These were also high-perm bags and had to be removed due to bleeding.
- PS050 dual density PPS bags: There seemed to be a discrepancy between the control bag submitted and the used bag pulled from the PIPP compartment. See the GFTS report for details.

4.15.10.2.7 SEM Testing

Four bag samples were sent to University of North Dakota Energy and Environmental Research Center (UND-EERC) to be analyzed using scanning electron microscopy and tagged image spectroscopy. The four bags were: standard OEM PPS bag; a high-perm

Torcon bag; a P84 bag; and a dual-density Torcon PPS bag. Results from this series of tests are detailed in Appendix Z and Appendix A.

Conclusions from the EERC reports are summarized as follows:

- The OEM PPS bag had particulate penetration 0.7 mm into the fabric.
- The high-perm sample had visible particle accumulations throughout both cross sections.
- Both P84 and dual-density samples showed little particulate penetration (0.5–0.55 mm). Small amounts of particulates were observed throughout the entire cross sections of both samples.
- Inspection of the outer dust layers from P84 and dual-density samples revealed that the ash generally had particle sizes smaller than 5 µm. Very few ash particles were over 10 µm. PAC was also identified in this layer and the largest observed particles were in the 10–15 µm range. Embedded ash particles were similar to the outer layer particles while the embedded PAC was closer to 10 µm in size.
- The P84 material was composed of fibers having a noncircular cross section. The dual-density sample was composed of three sizes of circular fibers.

4.15.11 Equipment and Operational Issues

4.15.11.1 J-Tube Precipitate Buildup

During the inspections for damaged bags following the hopper fires in 1Q06, the pulse pipes were removed in order to pull the bags and inspect the tube sheet. The personnel conducting these inspections noticed that the pulse pipe J-tubes on the exterior wall in section 1B had one-fourth to one-half inch of precipitate build up near the openings (Figure 4-225). The precipitate was hard, brittle, and smelled of sulfur, and is shown in Figure 4-226. Samples of the precipitate were collected and bagged for analysis, if needed.

Figure 4-225. Precipitate in Compartment 1 J-Tubes.

Figure 4-226. Close-Up of Precipitate from Compartment 1.

The majority of the precipitate was at the horizontal run where the J-tube connected to the pulse pipe. There were also small piles of this precipitate below the connection of the pulse pipes and the J-tubes where this had leaked out from the tube. There was no buildup in the pulse pipes themselves although there were signs that precipitate-laden liquid had run down some of the cages in the first row near the wall. The J-tubes in section 1A (interior of the baghouse) had no noticeable precipitate, as shown in Figure 4-227. All precipitate was removed before reinstalling pulse pipes.

Figure 4-227. Interior Wall J-Tubes in Compartment 1.

We Energies and Wheelabrator determined that because the pipes along the exterior wall went outside the building envelope between the header and the J-tubes (Figure 4-228), that flue gas was diffusing into the cool section, precipitating, and then flowing down to the horizontal section. Enclosures and insulation were installed around the exterior drop tubes (Figure 4-229). There has been no additional precipitation noted during subsequent inspections.

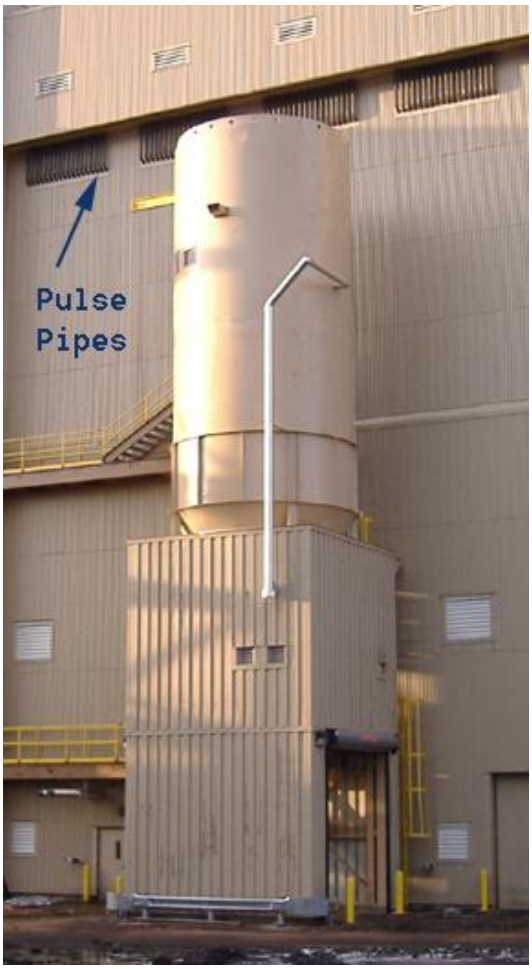


Figure 4-228. Pulse Pipes before Insulation.

Figure 4-229. Enclosed Pulse Pipes.

4.15.11.2 Baghouse Cage Inspections

During 1Q06 inspections were conducted to look for damaged bags following the hopper fires. While pulling the bags up to look for damage, personnel noticed that several of the cages were separated at the connecting collar. These are 2 piece cages with the connection collar being at the midpoint of the assembled cage. A more detailed inspection of the cages in one compartment was initiated. This inspection showed that a majority of the cages had defects, resulting from either issues with installation or fabrication. We Energies decided it would be best to conduct a complete inspection of all bags and cages and conduct repairs as necessary. While conducting this inspection, in 2Q06, the following items were checked and repaired:

- Connecting rings – check for separation and broken welds
- Locking pins – check for proper seating
- Cage separation – check for separation at the middle of the cage, whether due to a defect or an unknown reason

Figure 4-230 shows the installation of the upper section of the cage with the connecting collar welded to the lower section. Figure 4-231 shows the connecting portion of the upper section of the cage which fits over the top of the lower section. Also shown in this figure is the locking pin (dashed circle) which should seat flush with the ring after the two sections are fitted together. As seen in Table 4-124 improper clip seating this was the most common defect found during the inspection.

Figure 4-230. Connection of Upper and Lower Baghouse Cages.

Figure 4-231. Baghouse Cage Upper Section.

The results of the cage inspection are shown in Table 4-124. As shown in the table, the percent of cages that did not have any problems ranged from less than 1% to a high of 33.3%. Only three compartments had defect free averages above 10%. The defective welds were repaired and the cages and bags re-installed in April 2006.

Table 4-124. Summary of Cage Inspections.

Comp. #	Number in Each Category						% Good
	Cage not able to be pulled from bag	Broken Ring Welds	Clip Not Seated	Both Ring and Clip Problems	Ring and Clip Good – Separated	Ring and Clip Good – No Separation	
1A	0	1	145	104	71	3	0.9
1B	1	1	193	86	27	16	4.9
2A	0	43	95	65	91	30	9.3
2B	0	15	149	92	41	27	8.3
3A	0	151	27	38	0	108	33.3
3B	0	107	59	81	45	32	9.9
4A	0	3	229	57	4	31	9.6
4B	0	41	127	61	70	25	7.7
5A	0	2	227	80	0	15	4.6
5B	0	18	158	122	0	26	8.0
6A	1	27	73	215	0	8	2.5
6B	1	13	72	235	0	3	0.9
7A	0	26	219	63	0	16	4.9
7B	12	15	184	88	0	25	7.7
8A	21	52	106	131	0	14	4.3
8B	18	25	176	97	0	8	2.5
9A	1	0	254	47	0	22	6.8
9B	16	2	245	44	0	17	5.2
10A	1	106	106	21	1	89	27.5
10B	14	81	106	70	1	52	16.0

4.15.11.3 Duct Inspections and Corrosion Issues

There were two distinct issues regarding corrosion of the ductwork to and from the baghouse during the project. One involved precipitation on and corrosion of the interior walls of the ductwork. The other involved an improper weld during installation that resulted in exterior corrosion.

4.15.11.3.1 Ductwork Interior Corrosion Issues

4.15.11.3.1.1 March 2006 Duct Inspection

The supply and return ducts were inspected on five separate occasions during the project. The first was after the hopper fires and occurred over a two-day period from March 27–28, 2006. Both supply and return ducts were inspected. Both were very clean with only a small amount of ash in the supply duct and very little in the return duct (Figure 4-232). There were a few areas of corrosion on the return section of Unit 7 along the walls, but not on the floor (Figure 4-233).

Figure 4-232. Supply Duct: March 28, 2006.

Figure 4-233. Unit 7 Return Duct Corrosion: March 28, 2006.

4.15.11.3.1.2 February 2007 Duct Inspection

The second duct inspection occurred on February 25, 2007. Due to time constraints only the main supply and return runs were inspected, along with the Unit 7 supply and return drops. The drops on Unit 8 and 9 had appeared to be in good condition. During this inspection it was discovered that portions of the Unit 7 supply and return ducts had significant in-leakage from expansion joints. Based on these observations it was suspected that duct corrosion and deposit build-up could become a significant problem over time (Figure 4-234 and Figure 4-235). The rest of the ductwork appeared to be in good condition with minimal build-up, and only one small point-source of apparent in-leakage. There was leakage at the expansion joint in the Unit 7 supply duct at the high point of the riser, just before the duct turns 90 º into the main horizontal duct run to the baghouse.

Figure 4-234. Supply Duct Corrosion: February 25, 2007.

Figure 4-235. Corrosion on Return Duct Riser before Unit 7 Diverter: February 25, 2007.

During 2Q07 an external inspection of these expansion joints was. It was determined that the joints were functioning properly but could use additional insulation to reduce the likelihood of flue gas condensing and causing subsequent corrosion.

4.15.11.3.1.3 May 2008 Duct Inspection

The third duct inspection was on May 20 2008, and consisted of an internal inspection of both supply and return ducts to the baghouse. During this inspection no evidence of fallout or problems related to PAC injection, trona injection, alternative carbon testing, or ESP detuning was found. Corrosion and rust lines on the duct walls and floor of the return ducts suggested stratification of flue gas temperatures. A photo of some of the corrosion is shown in Figure 4-236. The corrosion began at the outlet of Unit 9 and was progressively worse towards the Unit 7 outlet. This was not evident in the supply ductwork.

Figure 4-236. May 2008 Duct Inspection Showing Corrosion on Walls and Floor.

During this inspection it was witnessed that all expansion joints were deteriorating. The insulation inside the cavity of the expansion joints appeared to be saturated with flue gas

condensation and had become brittle, cracked, or was missing. The degradation was predominant in the first 6–8 feet from the duct floor.

4.15.11.3.1.4 December 2008 Duct Inspection

The fourth duct inspection occurred on December 2, 2008. C&B and Pons Engineering were on site for the inspection. A string of thermocouples were installed on the interior of the duct to obtain temperature readings during operation.

Visual inspection showed significant corrosion on the return duct and mild corrosion on the supply duct. Duct wall thickness was measured in three 6 feet by 8 feet areas of both the supply and return duct. Data showed between 5–10% metal losses in the bottom half of the return duct between Unit 9 and Unit 7 diverter damper (Figure 4-237). The corrosion was progressively worse from Unit 9 to Unit 7. Supply duct steel showed mild signs of corrosion between the Unit 7 and the Unit 8 diverter damper.

Figure 4-237. Duct Corrosion: December 2008 Inspection.

There are 13 joints on the supply duct and 12 joints on the return duct. Expansion joints were originally filled with fiberglass “pillows” to insulate and prevent accumulation of material. Expansion joint pillows showed significant deterioration in the floor and lower side wall areas due to acidic condensation.

As the pillows deteriorated, ash and scale material accumulated in the joints of the supply duct. Material build up in the joints was a concern because it would lead to the loss of expansion at the joints.

During the inspection, one previously damaged joint was repaired by patching. Although a successful repair was made, the OEM (PAPCO) recommended replacing the entire patched joint at the next available opportunity. The design of expansion joints would make it very difficult to change them in the future due to lack of accessibility.

Inspections identified significant corrosion of the duct steel frame that held the expansion joints. Chunks of metal could be peeled off frames. Further corrosion would lead to leaks. In duct areas under pressure, flue gas would escape under lagging. The spacing between the duct and insulation allowed a chimney effect under the lagging, and if this occurred, significant damage to the insulation and lagging could be expected.

The duct had two inches of insulation mounted on top of eight-inch wide duct stiffeners. The duct stiffeners were mounted to the duct steel on approximately four-foot centers. Draft stops were not installed. The cavity between insulation and duct wall with lack of draft stops could be a major factor in cooling of the lower portion of duct steel and resulting corrosion issues.

Unit 7 and Unit 9 diverter dampers showed significant corrosion around flanges and seals. Flange nuts were corroded to the point where it would not be possible to put a wrench on the nut. It was assumed this would eventually compromise integrity of the flange bolts. The Unit 8 diverter damper did not show any significant corrosion. The issues could be a result of operating seal air fans continuously during the first year of operation.

4.15.11.3.1.5 August 2009 Duct Inspection

The fifth and final duct inspection during this project occurred in August 2009. All units were diverted from the baghouse from August 24–28 to allow for an inspection of the ductwork and drag testing of bags in Compartment 8. The expansion joint dust shields were removed to inspect expansion joint in areas where the pillow appeared to have been chemically attacked. The insulation pillow in these areas had either disintegrated or was very brittle. This material was removed to inspect the integrity of the expansion joint. Internally, the joints appeared to be in good condition. Scale was removed from the expansion joint frames.

Contractors removed ash build up from the lower corners and bottom side of expansion joints packed with ash under the dust shields. The plant reinstalled expansion joint dust shields that were removed for inspection. These areas were filled with a high temperature mineral wool prior to installing dust shields.

The wall thickness readings of supply and return duct steel were taken in the same locations as duct inspection done in December of 2008. No change was found in thickness of the steel. The readings were actually slightly higher than the previous inspection. This could be the result of a different meter.

4.15.11.3.2 Duct Temperature Monitoring

During 4Q08 thermocouples were installed inside the return duct between Unit 7 and 8 near the wall where corrosion was evident during the inspection. A thermocouple was installed on the outside of the duct wall. A thermocouple was also added to monitor ambient conditions. Figure 4-238 shows duct temperatures with Units 7 and 9 online until March 30 when Unit 7 came off line. The duct wall temperature dropped to 118 ºF, which corresponds to the Unit 7 duct becoming dead-ended. This is low enough to result in condensation on the walls of the duct.

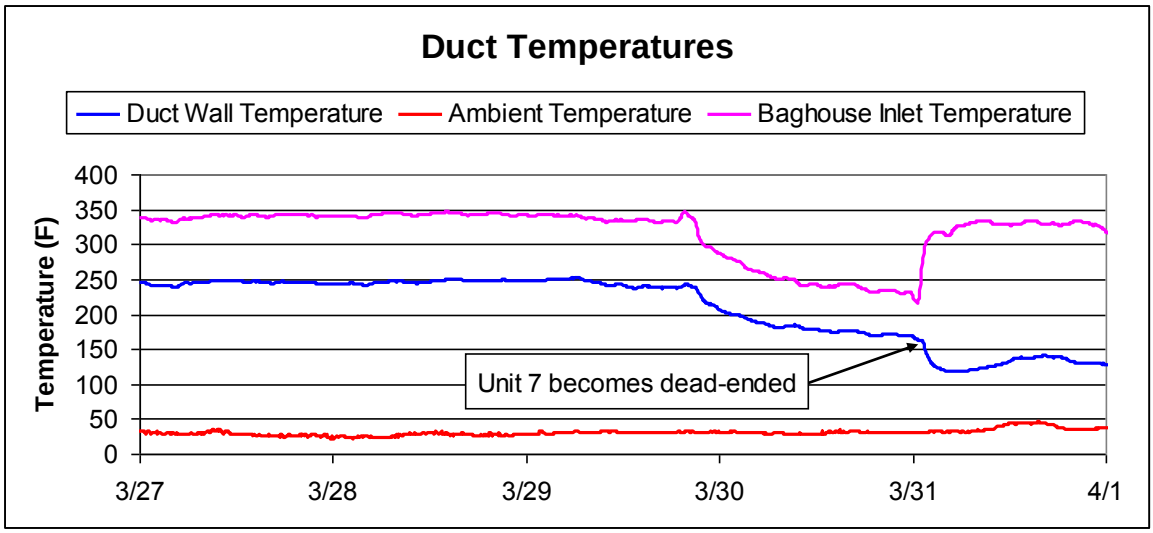


Figure 4-238. Duct Wall Temperature during Unit Outages.

Figure 4-239 shows the flue gas temperatures during the same period as in Figure 4-238. This shows there is significant stratification between the flue gas at the bottom of the duct (T1) compared to that at the top of the duct (T5) during the time that there was no flow in the Unit 7 return duct. This corresponds to the visual inspection which found the severe corrosion was only located at the lower duct walls and duct floor.

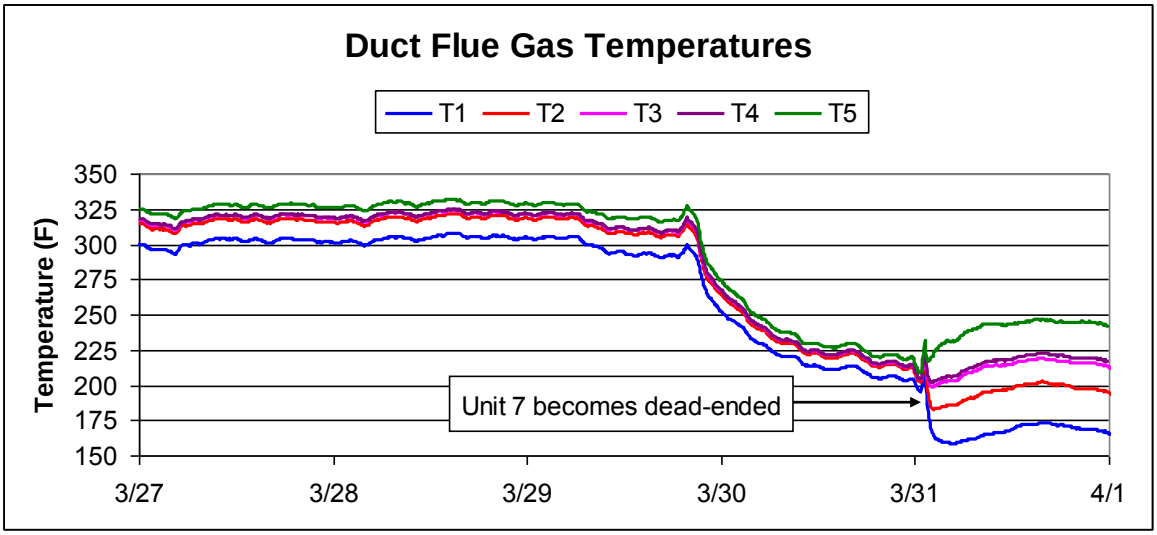


Figure 4-239. Duct Flue Gas Temperatures during Unit Outages.

4.15.11.3.2.1 Duct Temperature Monitoring – Diverter Damper Test

In April 2009, the plant performed a test to increase wall temperature during the scheduled Unit 7 outage. The baghouse operated with the diverter damper partially open while Unit 7 was off line (Figure 4-240). The damper was opened in increments and the duct wall temperature monitored. At 20% open the ductwork was heated to 180–190 ºF. This was believed to be high enough to prevent further condensation and subsequent corrosion.

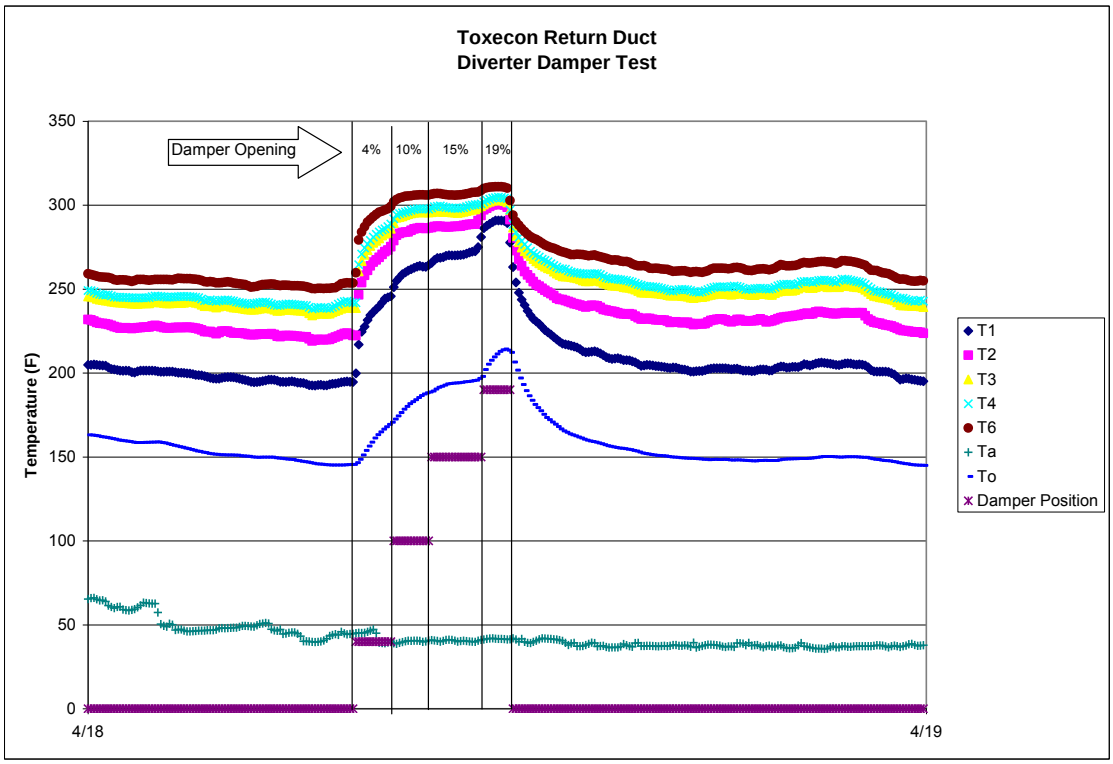


Figure 4-240. Duct Wall Temperatures during Diverter Damper Test.

4.15.11.3.3 Ductwork Exterior Corrosion

In April 2008, severe corrosion was found on the outside of the supply duct. In May, plant personnel began removing the insulation and lagging from both supply and return ducts in the area of corrosion (Figure 4-241).

Figure 4-241. Corroded Lagging.

There were no obvious points of leakage where the insulation and lagging had been removed. Also, no leaks had been identified during the internal inspection in May. Once the units were back online and the baghouse was returned to service further removal of lagging and insulation uncovered a weld that was not completed during construction. This was the source of flue gas corrosion of the exterior in this area. Repairs were made to complete the weld and then reinstall lagging and insulation in this area. During this time additional corroded insulation and lagging was removed and replaced on the ducts. Repairs were also made to the structural steel duct where the flue gas had leaked and discolored the lagging. All of the repair work was completed by October 2008.

In 3Q08 work began on adding insulation around the exterior of the duct expansion joints. The original design had called for these joints to be un-insulated on the outside and insulated on the inside. After determining that the material of the expansion joints could handle maximum flue gas temperatures, a decision was made to add the external insulation and protect the expansion joints from corrosion. This work was complete in 4Q08.

4.15.11.4 Access Platforms

During 3Q08 additional duct access platforms were installed to allow safer access for future inspection and repair work. The steel for the platforms was fabricated on site during July 2008. Installation began in September and was complete by early October.

4.15.11.5 PAC Injection System Issues

4.15.11.5.1 Fluidizing Fitting Replacement

In early January 2008, the plastic elbow fittings on the PAC fluidizing system had to be replaced. There were problems with leaking of PAC through a hole in one of the fittings as seen in Figure 4-242. The plastic fittings were replaced with metal.

Figure 4-242. Hole in Fitting in the PAC Fluidizing System.

4.15.11.5.2 Eductor Replacement

In June 2008, the Unit 7 PAC blower gasket was leaking carbon on the discharge end. This was caused by loose screws which sandwich the gasket in place. The gasket was replaced and the blower experienced no further issues. While work was performed on fixing the gasket, the eductor was inspected. The eductor venturi and nozzle had worn beyond tolerance so it was replaced. The replaced eductor was cut apart which revealed wear on the venturi.

4.15.11.6 Ash Handling System

4.15.11.6.1 Dusting during Unloading Ash

Throughout the project there have been issues surrounding unloading of the PAC/ash mixture using the wet unloader. Dust emissions during startup of the wet unloading system were the most common problem. When too much water was added to the PAC/ash mixture, the unloader clogged and tripped the motor on high amps.

Late in 2Q06, PAC injection was halted due to excessive dust emissions from the wet unloader. A picture of an ash unloading event is shown in Figure 4-243. The vender, United Conveyor Corporation (UCC), recommended installing a new diffuser-type flow control valve to improve the flow of ash into the mixer. This modification was made and tested, but proved inadequate for controlling the flow of PAC and ash into the pin mixer.

The flow control valve was designed to meter PAC and ash from the ash silo at the entrance to the pin mixer. As the material came into the mill it was sprayed with water to prevent dusting. The PAC/ash mixture was bridging across the opening in the valve and halting constant material flow into the mixer. To assist the unloading process, operators would have to open the flow control valve to counter bridging. When the valve was opened material would surge through the flow control valve and overwhelm the mixer. The material surge also resulted in a large dust plume since the spray nozzles were not able to adequately control the dust from the large volume of material as it was discharged into the mixer and truck bed.

Figure 4-243. Dust Emissions during Ash Silo Unloading 2Q06.

In July 2006, UCC recommended installing air cannons in the ash silo near the fluidizing nozzle and flow control valve. It was anticipated this arrangement, with additional fluidization nozzles, would help to overcome issues with fluidizing PAC/ash above the control valve during ash unloading. In the process of completing this task, an access door was added to the side of the silo to allow safer inspection and maintenance. This work was complete in mid-August, allowing PAC injection to resume, although the new changes had not been tested.

At the end of August, the modified ash unloading system was tested and found to still be excessively dusty. Although there was improved flow control of ash into the wet mixer, excessive dusting was still an issue. Based on the results of this test, it was determined additional modifications were needed. These included adding internal baffling to the wet mixer, adding a flexible discharge chute to enclose the area of free-fall from the wet mixer to the ash truck, and changing the water spray nozzle configuration. In mid-September, these changes were tested but still did not result in dustless operation. An additional test was done

using a surfactant added to the spray water. This seemed to help reduce the dusting but did not eliminate it.

In order to continue with parametric testing, an alternative method for emptying the ash silo was tried using a vacuum truck. This proved to be dustless at the plant site but resulted in difficulty unloading the truck at the ash landfill. As a result, on September 22, 2006, PAC feed was discontinued.

At the end of September, a trailer-mounted aggregate mixing plant was brought to the site. This equipment had been used successfully at other facilities to process PRB ash. Although it had never been tried on PAC/ash, there were expectations that it could provide a dustless mix and a temporary solution to the material handling problem. However, the equipment was not able to control dusting and this test was halted.

In early October, the dry unloader was used to unload the silo. This was the first test of the dry unloader and that portion of the process proved a success. The dry ash unloader was used to fill a bulk hopper trailer for hauling to the ash landfill. At the landfill, a water sluicing connection was used to empty the hopper. Although this minimized any dust formation, it generated excessive water, which was not acceptable at the landfill.

Due to the difficulties onsite with the unloading equipment, UCC conducted extensive pilot-scale testing at their laboratory with the PAC/ash mixture. At the end of September, they reported successfully generating a dust-free product in their test lab. They indicated that a redesign of the existing wet unloader based on their test results should effectively solve the ongoing material handling issue. The redesign would include a new mixer cover, raising the spray nozzles, dividing the mixer into three compartments, increasing the mixer speed, adding a stop to the diffusion valve, and adding a surfactant to the spray water. The modifications recommended by UCC were completed by early October 2006. When tested, this revision showed uneven feeding of the PAC and ash mixture into the pin mixer and continued dusting.

In parallel with efforts to find a solution for the installed mixer, other dust handling equipment venders were contacted for alternative equipment solutions and testing. The

purpose of this initiative was to have an alternative ash unloading option in the event dusting issues with the UCC equipment were not resolved. One of the alternatives considered was a batch-type process. This same batch process configuration had been successfully employed at other facilities, primarily for PRB ash. Samples of the PAC/ash mixture were sent to both Hockmeyer and DustMASTER to test in their mixing systems. These tests were performed to provide a backup alternative in case the modifications performed by UCC were not successful. Hockmeyer ran the mixture and was able to get the material to form a paste. DustMASTER ran extensive tests and were able to generate a dust-free product suitable for landfill.

During the modifications in October 2006, a rubber extension was added to the TOXECON™ ash silo discharge below the wet unloading system to reduce dusting due to wind. A photo of the curtain is shown in Figure 4-244.

Figure 4-244. TOXECON™ Ash Silo Dust Curtain.

UCC replaced the diffuser valve with a rotary valve in December. The silo was then unloaded using the wet unloader and there were minimal dusting issues. The ash flow into the mixer was controlled very well, and chemical surfactant was not needed even though it had been required previously to control fugitive dust.

The modifications made in October 2006 showed improvement over the previous arrangement and proved to reduce dusting during unloading. However, the ratio of water required for the ash proved difficult to predict. The water variability caused dusting to vary since the amount of water needed was dependent on the amount of PAC present in the ash. During this period there were variations in PAC injection concentrations due to parametric testing of the TOXECON™ system. Due to the variability in the PAC/ash mixture, there were still difficulties in operating the ash unloading system in a completely dustless manner. It was also observed to be some dusting during startup of the pin mill.

During 2Q07, UCC recommended installing additional atomizing nozzles and a variable speed drive for motor on the pin mixer. A vacuum line was installed at the end of the pin mixer to catch the dust prior to the wetted material moving out of the mixer and into the truck. The dust from this system was routed back to the top of the ash silo. When tested, during 3Q07, it did result in reduced dust emissions from the mixer. However, it drew moisture in from the atomizing spray heads which was problematic since this vent returned to the ash silo. For this reason use of this line was discontinued to prevent moisture-induced problems in either the ash silo vent filter bags or the ash silo itself.

During 3Q07 UCC recommended modifications to the pin mixer sprocket, chain, and guard to increase the speed to enhance mixing. In lieu of this recommendation a variable speed drive was installed on the pin mixer motor to provide more variability in tuning the pin mixer to an optimal speed and horsepower required to mix and control dust effectively. This decision was based on the need to have flexibility of the system during the trona injection trial since it was uncertain how the unloader would operate with this product. This change showed that mixing at a higher speed improved the dust control during PAC/ash unloading evolutions. This change also reduced the time required to fill a truck.

In early August 2007 the pin mixer experienced a failure of the chain drive mechanism and shaft seals. The end seals, packing and bearings on both the driven and non-driven ends of the pin mixer were replaced. It was determined that this damage occurred while attempted to operate the pin mixer backwards when attempting to un-jam it. A flow meter was also installed on the water line supplying the pin mixer. The flow meter was installed to determine the ratio of water to the PAC/ash required for dust-free mixing and believed to be helpful for ash unloading operations during trona injection testing.

Despite all the modifications and improvements, there was still dusting during startup. This dusting issue was linked to the short material retention time in the mixer that occurred until the material bed height was established. The We Energies project engineering team and UCC investigated ways of increasing the initial retention time including pre-charging the mixer with high expansion foam.

During this time many ideas surfaced as potential solutions to this issue. It was believed that sequencing the atomizing nozzles so each come on sequentially as the ash bed height increased would help. Another idea was to add fogging nozzles at the discharge of the mixer around the discharge chute (inside the rubber curtain). UCC had seen this arrangement work well at other installations. An alternative suggestion was to build a windscreen which would extend around the truck so it would be totally enclosed during the unloading evolution. The screen would effectively confine all fugitive dust during from initial startup of the unloading system.

During 4Q07, a remote shelter was installed to allow the TOXECON™ ash-unloader operator to observe the truck bed during unloading. Figure 4-245 is a photograph of the installed shelter.

Figure 4-245. Operator Enclosure for Ash Unloading (Prior to Shelter Being Built).

In December 2007, three atomizing nozzles were installed near the exit of the pin mixer. This reduced dust emissions during startup of ash unloading throughout 1Q08. In February 2008 a second set of atomizing nozzles were installed in the center section of the pin mixer. However, this did not appear to result in further reduction of dust emissions during startup.

During 3Q08, significant progress was made correcting the problems with dusting during startup and unloading of the ash silo. In July 2008, UCC was onsite to view the ash being unloaded using the wet mixer. UCC checked the rotary feeder speed, the rate at which the rotary feeder ramps, and re-arranged the atomizing shower nozzles in the mixer. Despite these changes there was still dusting for 15 to 20 seconds upon startup.

During August 2008, a high-pressure water curtain was added at the discharge of the mixer which was set to operate for 20 seconds during startup. With this change dust-free operation was finally achieved. The high-pressure water curtain was subsequently automated and improved for permanent operation.

During 3Q08, there continued to be issues with overloading the pin mixer motor, breaking the chain tensioner, and jamming the mixer shafts. It was discovered that the mixer shafts were bent and needed a complete rebuild. UCC worked on plans for rebuilding the mixer and investigated how to upgrade this equipment to increase reliability. In December 2008, it was decided the best path forward was to replace the pin mixer.

A partial enclosure was built around the base of the ash silo to eliminate the wind tunnel effect and prevent airborne dusting. This enclosure was completed in April 2009.

The improved UCC ash unloading system was delivered in April 2009. Plant labor installed and commissioned the system in May. The improved design had a new mixer, a larger motor, increased horsepower, and a new end shower nozzle which reduce dust emissions. Ash unloading was finally performed satisfactorily and the criterion of no visible dust emissions was met. A photo of the system unloading is shown in Figure 4-246.

Figure 4-246. Dust-Free TOXECON™ Ash Unloading.

4.15.11.6.2 Filter Separator Issues

The filter separator in the TOXECON™ ash silo consisted of two modules with 14 polyester bags in each module. The filters were used to remove particulates from the air leaving the ash silo while pulling down the baghouse ash hoppers. During 1Q07 this system experienced bag blinding issues due to cold weather and condensation on the fabric. The bags were changed out to fix this problem. Additionally insulation was added to the lines in the filter separator room to prevent further condensation.

During 2Q07, TOXECON™ ash was discovered to be bleeding through the fabric causing dust emissions into the air. The bags in each module were changed every month to maintain emissions to permitted levels. Two sets of bags were ordered; one consisting of a PTFE membrane coated polyester bags and one consisting of P84 fabric. The PTFE membrane bags were installed and immediately blinded over, causing the system to trip due to high differential pressure. The bags were removed and replaced with the polyester bags. While the P84 bags worked well initially, they had to be replaced in 3Q07, after approximately the same running time as the standard polyester counterparts. Consequently no benefit was found in this application with these filter bags to justify the additional cost.

In 2Q07 a regulator was added in the pulse air line of the filter separator to reduce air pulse pressure from 100 psi to 80 psi. Investigations into the pulse timer on the filter separator showed that the pressure set points were incorrect, resulting in over-pulsing of the filters.

During August 2007, air leakage in the filter separator resulted in increased dust emissions during TOXECON™ ash unloading. RTV sealant was placed on the seams of the bags and on the sheet metal screws in the tube sheet. The pulse timer card for the filter separator was also replaced in August 2007. Investigations early in the month showed that the system was performing continuous cleaning during a portion of the ash unloading process. Continuous pulsing would result in over-cleaning of the bags and subsequent loss of filter cake on the bags, and would then allow dust to penetrate the fabric. Ultimately this scenario resulted in decreased filtering ability and shortened bag life.

In September 2007 both ash system exhaust blowers failed. Two new blowers were ordered and received on site September 26. PAC injection was discontinued due to the inability to pull ash from the baghouse. PAC injection was resumed on September 14 after repairs were made to one of the blowers and to the pin mixer.

During October 2007 the filter separator performed well. During November 2007 there was a failure of filter separator bags which resulted in excessive dust emissions. The bags were changed out at the end of November and an inspection performed on the source of the dust. It was discovered that the inside of the bags was clean. This typically indicates that the dust emissions were not due to bag failure. It was found that the connection between the bag and the tube sheet was the likely source of the leak. New bags were installed in December using a double clamp above the cage groove. The system performed well for the remainder of the quarter.

New bags were installed in December 2007 using the double clamp above the cage groove. The double clamping was found to resolve the majority of the issues with the filter separator and increased bag life.

4.15.11.7 Leaking Baghouse Compartment Covers

During 2Q07 the solution for the leaking baghouse compartment covers was completed. This involved installing a new gasket material which was done under warranty. Also, some minor rain leaks were also fixed under warranty.

4.15.11.8 Fan Building High Ambient Air Temperature

A problem experienced from the time the TOXECON™ baghouse was initially brought online in January 2006 was high temperatures in the fan building. An engineering study was performed during 2Q07 to determine possible solutions. Data was gathered at a variety of operating conditions and ambient temperatures.

An engineering study concluded in September 2007 and recommended adding louvers and control dampers along with changes to the HVAC logic. New louvers and control dampers were ordered in October 2007 and installed in January 2008. These changes proved

satisfactory for controlling the fan building temperature. During February snow and ice breaks were installed on the penthouse louver hoods. These were added to prevent ice from falling to the ground below and creating a safety hazard.

4.16 Task 16: Operate, Test, Data Analysis, and Optimize TOXECON™ for SO_2 and NO_x Control

4.16.1 Summary

One of the specific objectives of this project was to determine the viability of sodium injection for up to 70% sulfur dioxide (SO_2) control and trim control of nitrogen oxides (NO_x). Trona (sodium sesquicarbonate) injection tests were performed at PIPP from July 31 through August 10, 2007. The purpose of these tests was to not only determine if dry trona injection prior to the TOXECON™ baghouse would result in the desired SO_2/NO_x reduction, but to also assess any related change in mercury removal. Balance-of-plant issues associated with trona injection and subsequent ash handling were also evaluated. A topical report covering this testing was issued in 2008 and is shown in Appendix BB.

A temporary injection system was set up near the Units 7–9 stack with individual hoses and lances feeding each of the unit ducts. The injection point was near the existing PAC injection ports in each duct and downstream of the plant NO_x analyzers used for boiler feedback. SO_2 and NO_x analyzers were temporarily installed upstream of the trona injection point on each of the three ducts for monitoring during the tests. Existing analyzers were used at the stack to measure SO_2, NO_x, and opacity.

During the test period, the trona injection rate was varied, which provided the data necessary to complete an SO_2 removal curve. PAC injection continued at pre-trona injection test levels with trim control on, which allowed some variability (± 20%) in injection rate. PAC injection was turned off one day to determine if there was an effect from PAC on SO_2 removal. Due to an unexpected negative effect from trona injection on mercury removal, PAC injection was increased on one day to try to regain a > 90% removal rate.

The goal of 70% SO_2 removal was achieved during this two-week test period when using 5926 lb/hr of trona. This corresponds to an average Normalized Stoichiometric Ratio (NSR) of 1.02. The NSR is the molar ratio of the sorbent injected to that theoretically required for complete reaction with SO_2. The inlet concentration of SO_2 varied from 0.48 to 0.64 lb/MBtu. The highest removal was 74.1% with PAC injection at 3.8 lb/MMacf. There was very little reduction in total NO_x during the test period, although the presence of the side reaction with NO producing NO_2 was observed when PAC injection was turned off. Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. The mercury removal slowly recovered overnight to the pre-trona injection levels of > 90%.

An economic assessment of a full-scale trona injection system included equipment and other capital costs along with sorbent cost (trona and increased amount of PAC to maintain 90% removal) and O&M costs. The cost to remove SO_2 varied from $1,448/ton at 45% removal and one silo to $2,231/ton SO_2 at 70% removal with three silos.

4.16.2 Background

Testing of SO_2/NO_x control sorbents prior to the testing at PIPP in the TOXECON™/COHPAC® configuration included:

- Full-scale tests injecting sodium bicarbonate and sodium sesquicarbonate (trona) upstream of the Big Brown COHPAC® baghouse for SO_2 control (EPRI, 1994).
- Pilot tests of sodium and lime sorbents injected upstream of COHPAC® for SO_2 control at Southern California Edison's Mohave Station (EPRI, 1996).
- Slipstream tests of sodium-based materials, lime, activated carbon, and a proprietary catalyst for NO_x, SO_2, SO_3, HCl, HF, and Hg at the PSEG Hudson Generating Station (EPRI, 1998).

Test results indicate that sodium-based products can achieve from 30 to 70% SO_2 reduction. At normal flue gas temperatures, lime/calcium products are not effective for SO_2 control. Sodium-based sorbents also reduced NO_x by 10 to 20%. HCl removal was as high as 50% at Hudson using sodium sesquicarbonate.

4.16.3 Test and Equipment Description

This test effort was designed to support the overall objectives of the TOXECON™ retrofit at PIPP as well as to further the technical understanding of the TOXECON™ technology for both We Energies and the greater industry. Parametric and continuous tests were planned to assess the capability of trona injection upstream of the TOXECON™ baghouse to control SO_2 and NO_x. Injection equipment and measurement instrumentation were installed specifically for these tests. The following were the objectives of the testing program:

- Quantify the trona injection rate versus SO_2/NO_x removal.
- Record baghouse performance over the test period, showing how pressure drop, cleaning frequency, and mercury removal change.
- Determine whether there is any negative effect of trona injection on emissions (NO_2 production).
- Evaluate the technical and economic performance of trona as an option for full-scale SO_2 control.

The tests for SO_2/NO_x control were conducted in two phases, baseline and parametric testing, as shown in Table 4-125. During baseline testing there was no effort made to control boiler load. Full load was requested for parametric testing. Measurements were taken during July to determine baseline conditions. Parametric testing data was used to characterize the performance of trona across a range of injection concentrations and at different PAC injection concentrations. Originally, a five-day continuous test was scheduled but, because of shipping and material handling issues, this phase was cancelled.

Table 4-125. Schedule of Activities for SO_2/NO_x Control Testing.

SO_2/NO_x Control Activity	Duration (Days)	Start Date	Boiler Load
Baseline Testing	21	07/09/2007	Normal Operation
Equipment Installation and Shakedown	2	07/30/2007	Normal Operation
Parametric Testing	10	08/1/2007	Full Load 6 AM–6 PM

The final test plan for injecting trona to control SO_2 and NO_x was distributed to the project team in July. We Energies completed the installation of SO_2 and NO_x analyzers at each of the three ducts upstream of the sorbent injection point in early July. These analyzers provided data on untreated SO_2 and NO_x levels for both baseline and injection testing.

Plant operators kept the three units at full, steady load during the two-week test period. The boiler soot blowers were used every hour on a staggered schedule with the three units to keep the flue gas temperature from fluctuating during testing. PAC injection was left unchanged initially. The logic allowed for the injection rate to vary ± 20% to keep 91% mercury removal.

4.16.3.1 Trona Background Information

Trona is a sodium-based, naturally occurring mineral (sodium sesquicarbonate). The trona used during this test program was obtained from Solvay Chemicals, Inc., and was mined in Green River, Wyoming. The purified SOLVAir Select 200 trona was shipped by rail to Chicago then loaded into dry hopper trucks for delivery to Marquette, Michigan. The hopper trucks typically carried 45,000–48,000 pounds of trona. The particle size of the trona averaged 26 µm according to the Certificate of Analysis accompanying the material.

The formula for sodium sesquicarbonate is:

$$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$$

sodium carbonate · sodium bicarbonate · water

When heated to 257–482 ºF in a duct or a calciner, the sodium trona decomposes to sodium carbonate according to the formula:

$$2(Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O) \rightarrow 3Na_2CO_3 + CO_2 + 5H_2O$$

When injecting trona into a coal-fired power plant flue gas, it reacts with hydrochloric acid and SO_2 according to the following:

$$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O + 3HCl \rightarrow 3NaCl + 4H_2O + 2CO_2$$

$$2(Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O) + 3SO_2 \rightarrow 3Na_2SO_3 + 4CO_2 + 5H_2O$$

$$3Na_2SO_3 + 1.5O_2 \rightarrow 3Na_2SO_4$$

Review of industry literature emphasizes the benefit of injecting trona in a hot-side (greater than 700 °F) location. Trona experiences what is referred to as a "popcorn effect" where, at high temperature, the thermal decomposition reaction results in an expanded particle with a high surface-area-to-mass ratio, improving the chemical availability of the sodium compound. This change improves the effectiveness by a factor of between 5 and 10. Trona will still react with SO_2 if injected at lower temperatures (typical cold-side temperature around 300 to 350 °F) but loses the reactivity otherwise gained by the particle expansion. Consequently, for lower temperature applications more trona is usually required to achieve the same SO_2 removal efficiency. During the first ten days of August, the flue gas entering the baghouse at Presque Isle varied from 333–372 ºF.

4.16.3.2 Trona Injection Equipment

The injection equipment for this test program was obtained from Bulk Conveyor Specialist, Inc., and was staged near the Units 7–9 stack as shown in Figure 4-247. This equipment consisted of a trailer holding approximately 40 tons of trona and a separate trailer housing the blowers and controls (Figure 4-248). This system injected sorbent at the shipped particle size. Feed rate for the trona was from 2,200 lb/hr up to 5,900 lb/hr at full load to cover a wide range of stoichiometric ratios.

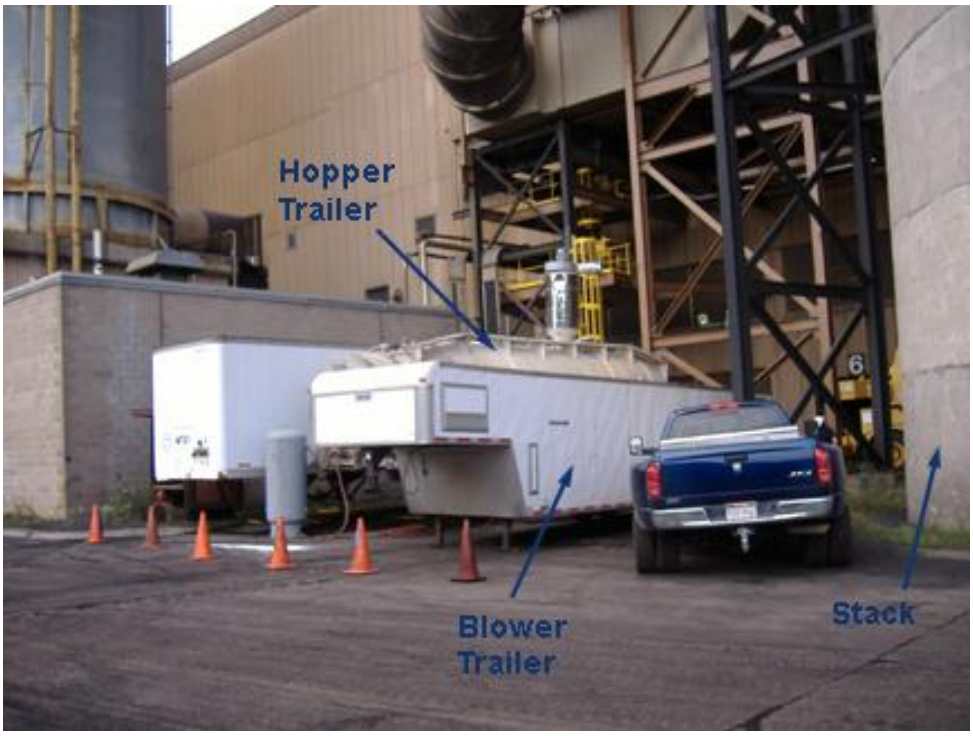


Figure 4-247. Staging Area for Trona Injection Equipment .

Figure 4-248. Trona Injection Trailer Blowers and Controls.

The trona was fed to three injection lances which were located downstream of the ID fan discharges, but upstream of the point where the ducts combine. Each lance discharged

sorbent into the center of its duct, where turbulent flow provided gas/sorbent mixing. The lances were located below the existing PAC injection lances (white hose in Figure 4-249). This was downstream of the NO_x analyzer probe used for boiler feedback.

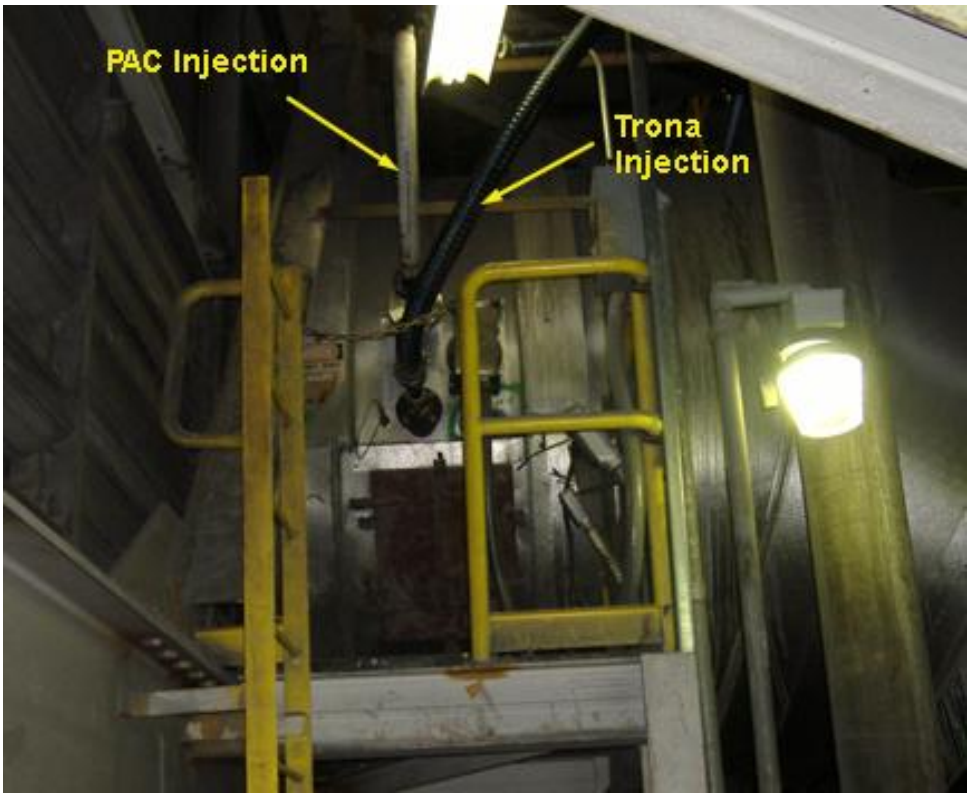


Figure 4-249. Trona Injection Ports.

4.16.3.3 Trona/Ash Unloading Issues

Prior to field testing, there was some concern that the reacted trona/ash/PAC from the baghouse would be difficult to unload and transport using the existing ash-handling equipment. The reacted trona hardens when wetted, and PIPP typically uses a wet unloader for the PAC/ash mixture. This mixture is then hauled by truck to the landfill.

Benetech, Inc. performed a series of laboratory tests on the anticipated final product from the baghouse and developed a chemical to prevent hardening of the mixture. A tanker truck of the proprietary chemical along with injection equipment was prepared and shipped to PIPP for the testing. Provisions were made to add this chemical to the water spray used in the wet unloader.

4.16.3.4 SO_2, NO_x and Opacity Measurement

SO_2 and NO_x monitors were installed on a temporary basis by We Energies near the exit of the ID fan on each duct to establish baseline levels coming from each boiler. At the stack, the plant continued to utilize the installed SO_2 and NO_x monitors to establish native removal across the TOXECON™ system and provide removal rates during trona injection.

Data from the inlet and stack monitors was collected continuously by the plant data acquisition system (EDS) and saved on the historian computer. The data was downloaded every week during baseline and every day during trona injection.

Prior to the trona injection testing, three RATAs were performed on the SO_2 and NO_x monitors in the Units 7, 8, and 9 flues. The Unit 7 RATA was performed on June 13, 27, and 28, 2007. The Unit 8 RATA was performed on June 5 and 6, 2007. The Unit 9 RATA was performed on June 5 and 6, 2007.

The results of the RATAs reported by the testing company were: "The test results from this test program indicate that each CEM system meets the United States Environmental Protection Agency (USEPA) annual performance specification for relative accuracy as published in 40 CFR Part 60 and/or 40 CFR Part 75."

4.16.4 Trona Injection Results

4.16.4.1 Baseline Testing Results

The purpose of the baseline test was to establish the concentrations of pollutants leaving the air preheater and to determine if there was any native capture across the TOXECON™ fabric filter without sorbent injection. Figure 4-250 shows inlet and outlet data for SO_2 and NO_x for the three ducts and flues during July. As expected, none of the three graphs show any removal across the baghouse prior to trona injection. In addition to the flue gas measurements for SO_2/NO_x, and ash samples were taken from the baghouse hoppers. A composite sample of ash from four hoppers was used to characterize the ash during this time.

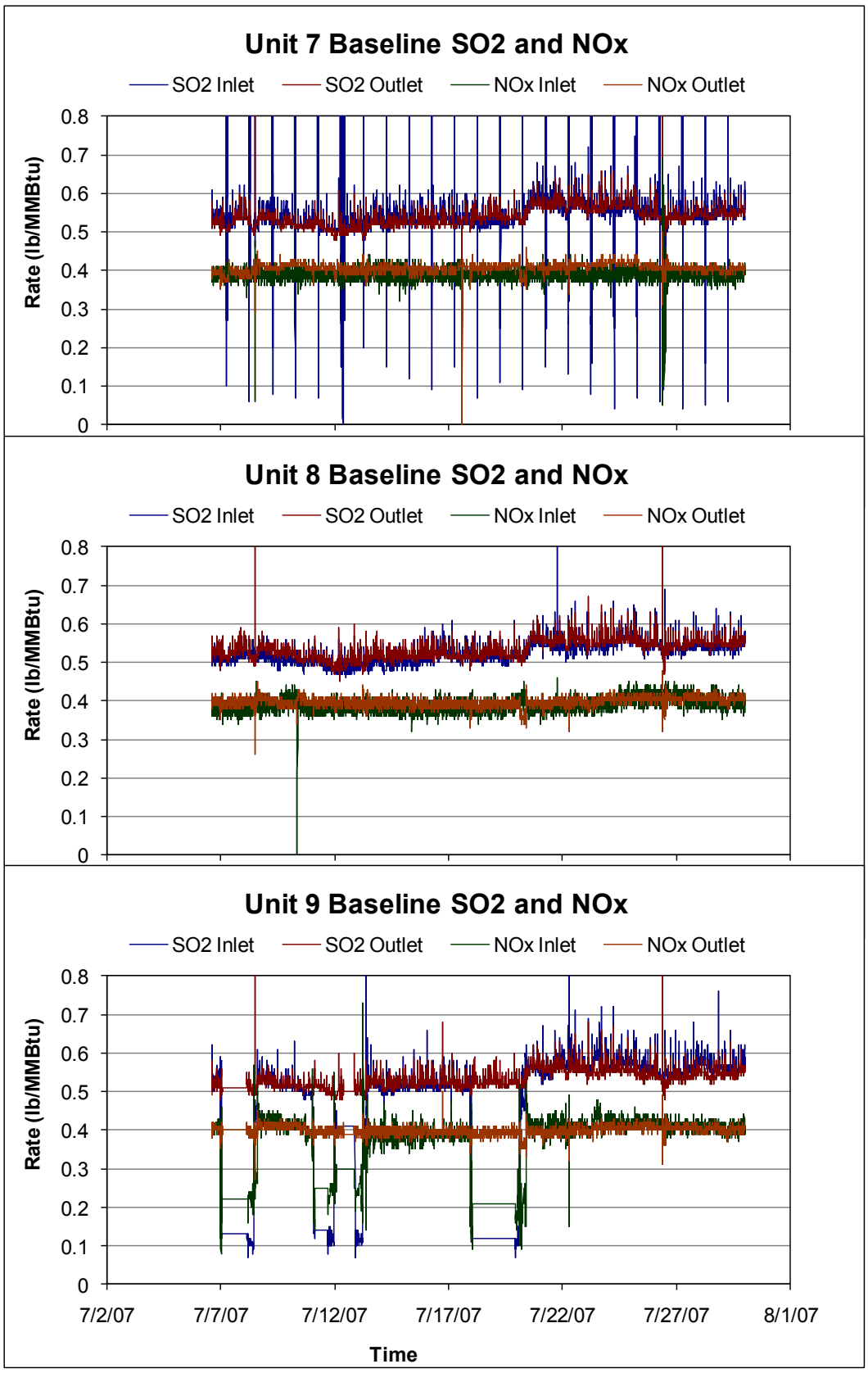


Figure 4-250. Baseline SO_2 and NO_x Data.

4.16.4.2 Parametric Testing

4.16.4.2.1 Schedule and Materials Handling

The trona injection equipment was set up at PIPP on July 30, 2007. All of the injection hoses and lances were installed by late afternoon. Electricity was connected to the blower trailer by 3:30 p.m.

The first truckload of trona arrived on site Tuesday morning. This truck carried 48,000 lbs, which partially filled the hopper truck. In order to test the wet unloader and the effect of the anti-setup chemical supplied by Benetech, four hours of injection at 2,200 lb/hr was performed on July 31. At the end of the four hours, the ash silo was unloaded using the chemical in the water feed to the pin mixer. The ash silo had been unloaded earlier in the day so the majority of the ash in the silo contained reacted trona.

There were no problems with hardening or setting up of the reacted trona/ash/PAC in the wet unloader or in the ash truck. Benetech also provided 10 gallons of a proprietary "trona release chemical" for spraying on the inside of the ash truck bed and the inside of the pin mixer. Bottom ash from Units 5 and 6 (bituminous coal) was used to line the bottom of the ash truck also since the efficacy of the release chemical or anti-setup chemical had not been tested at full scale. Figure 4-251 shows the material being unloaded at the landfill. The consistency was similar to wet sand. The next day the material still had not changed in consistency.

Figure 4-251. Unloading Reacted Trona/PAC/Ash Mixture

On August 1 the ash silo was unloaded to remove the accumulated material from overnight. This material contained significant amounts of reacted trona that had been cleaned from the bags over the course of several hours after injection had stopped. This unloading process was inadvertently performed without the anti-setup chemical, and there were no problems with the material setting up in either the mixer or the truck. Over the course of the next few days, unloading at the end of injection was done with the chemical, and in the morning without. There were no issues with setup either with or without the chemical. The wetted material showed a significant heat of reaction and was still steaming when unloaded at the landfill.

During the second week of testing, the ash silo was unloaded after injection using water only (no anti-setup chemical). Although there was a noticeable heat associated with the mixing, the material didn't set up in the pin mixer or in the truck. A sample was taken at the landfill and the next day it still hadn't set up. The reaction with water to form a solid hydrate may have occurred in the pin mixer but the action of the mixer may have kept the material from forming large pieces. The main risk of wetting the trona/ash/PAC without the anti-setup

chemical was that if the mixer stopped, the wet material in the mixer would likely solidify and would be very difficult to remove.

Parametric testing began August 1, 2007. During this test phase all three units were at full load. The original plan was to vary the sorbent injection rate from approximately 2,200 lb/hr up to 5,400 lb/hr. There was some concern that the ash system could not handle a sorbent injection rate above 5,400 lb/hr. The vacuum system used to pull ash from the hoppers and transport it to the silo was rated for 5,000 lb/hr. Adding the ash and PAC (110 lb/hr and 130 lb/hr approximately) put the highest injection rate well above the rating for the vacuum system.

4.16.4.2.2 SO_2 and NO_x Removal

Table 4-126 shows the injection rate and SO_2 removal for the test period. The maximum removal achieved during the testing was 74.1% when co-injecting 3.8 lb/MMacf PAC.

Table 4-126. Trona Injection Results.

Date	Trona Injection Rate (lb/hr)	Average NSR*	SO_2 Inlet (lb/MBtu)	SO_2 Removal (%)	Comments
8/1/07	2223	0.37	0.50-0.66	46.6	
8/2/07	2223	0.41	0.48-0.63	47.6	
8/3/07	4446	0.81	0.48-0.59	65.4	
8/4/07	4446	0.79	0.50-0.58	65.5	
8/5/07	5432	0.97	0.49-0.57	69.8	
8/6/07	5926	-	-	-	Difficulty feeding trona – test stopped
8/7/07	5926	1.02	0.52-0.60	70.7	
8/8/07	5926	1.02	0.52-0.66	68.5	PAC injection turned off during am
8/9/07	5926	1.03	0.49-0.62	72.1	PAC injection ramped up to 3.8 lb/MMacf
8/10/07	5926	1.02	0.51-0.64	74.1	Started PAC injection at 3.8 lb/MMacf at start of trona injection

* Normalized Stoichiometric Ratio

As seen in Table 4-126 and Figure 4-252 below, the best SO_2 removal was observed when PAC was being injected at an unusually high level for this site (3.8 lb/MMacf). This was done to try to recover the >90% mercury removal. This PAC injection rate was at the end of a test day, and the mercury removal was at 89%. During all trona injection tests, mercury removal degraded, and then slowly recovered overnight when no trona was injected (discussed below).

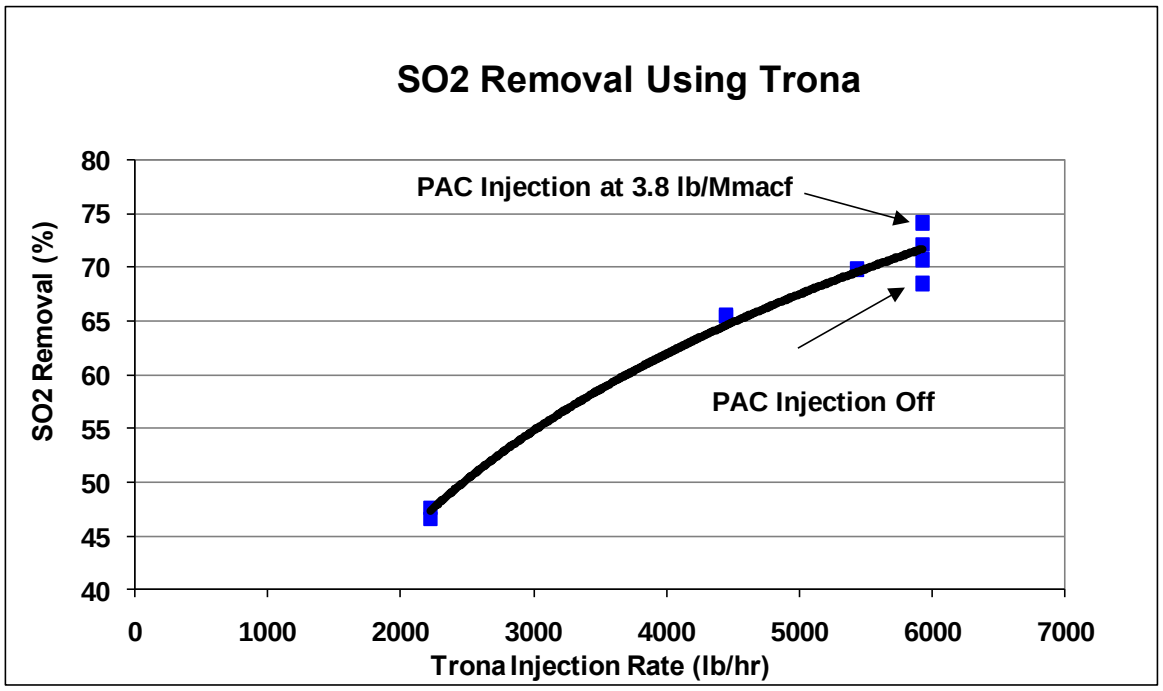


Figure 4-252. Removal vs. Trona Injection Rate.

Figure 4-253 shows typical SO_2 removal profiles at varying trona injection rates. There was an initial rapid increase in removal but it took 3–4 hours before removal became somewhat steady. Most test periods were 8 hours, but one day was only 6 hours. When trona injection was turned off, there was an initial rapid decrease in SO_2 removal, but it did not come back to baseline levels for 5–6 hours, which was the time required to perform a full cleaning cycle on the baghouse.

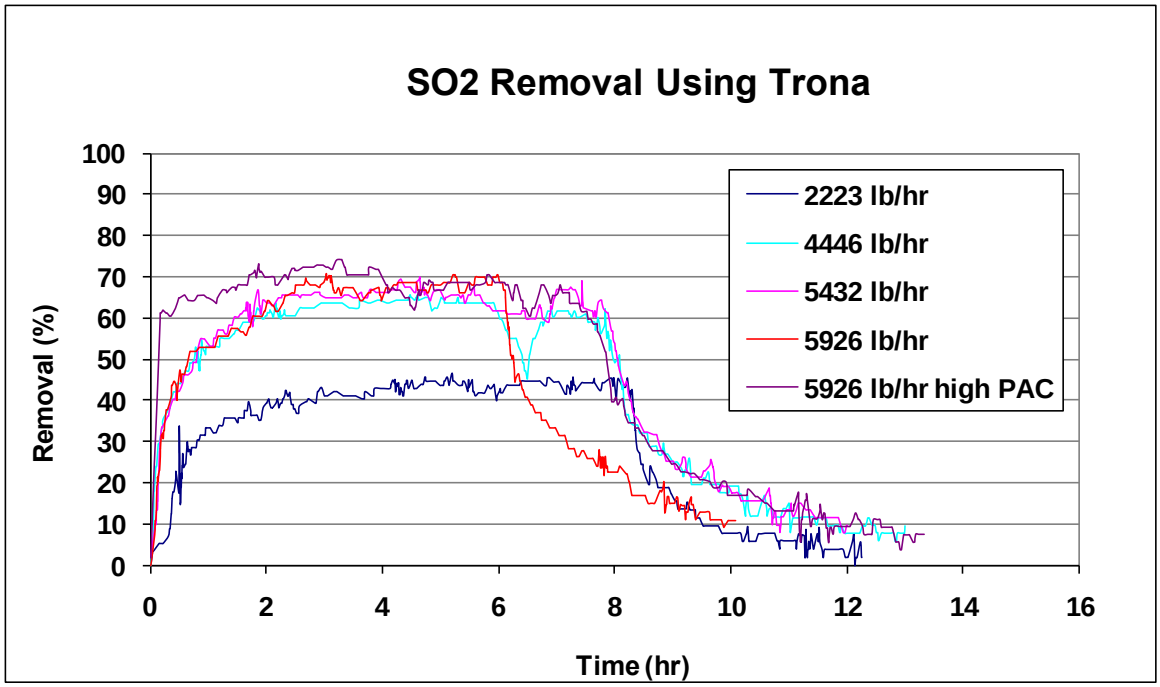


Figure 4-253. SO_2 Removal Profiles.

In addition to the impacts on SO_2, a small reduction in NO_x emissions was expected based upon work at other test sites. As shown in Figure 4-254, there was no noticeable reduction in NO_x.

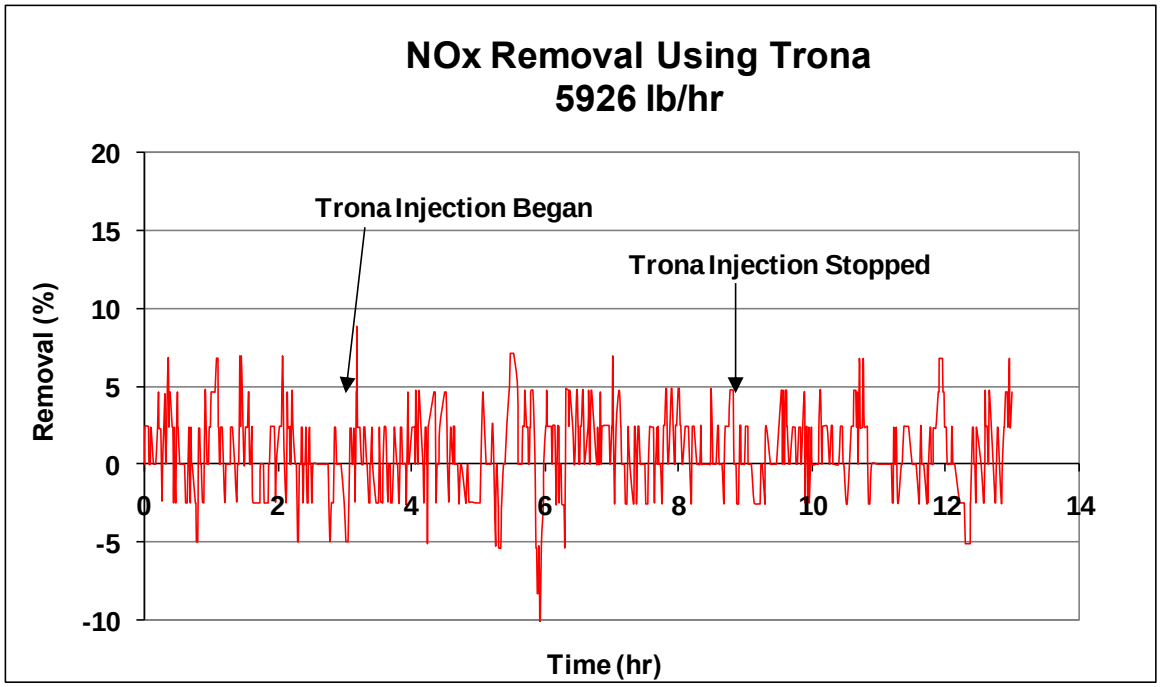


Figure 4-254. NO_x Removal During Trona Injection.

At other test sites, a side reaction from using trona is the creation of small amounts of NO_2, which results in a brownish plume and an increase in opacity. Figure 4-255 shows an increase of about 0.75% in the three opacity monitors during the highest injection rate used. There was no visible brown plume during this test.

At the end of the trona injection period on August 7, PAC injection was also turned off and kept off overnight and through the start of trona injection on August 8. At mid-day on August 8 a brownish plume was seen coming from the stack. This is the first time this had occurred. The opacity levels on all three monitors increased by almost 3% (Figure 4-256). PAC injection was resumed at 1:00 pm and within 30 minutes the plume had been visibly reduced and the opacity decreased.

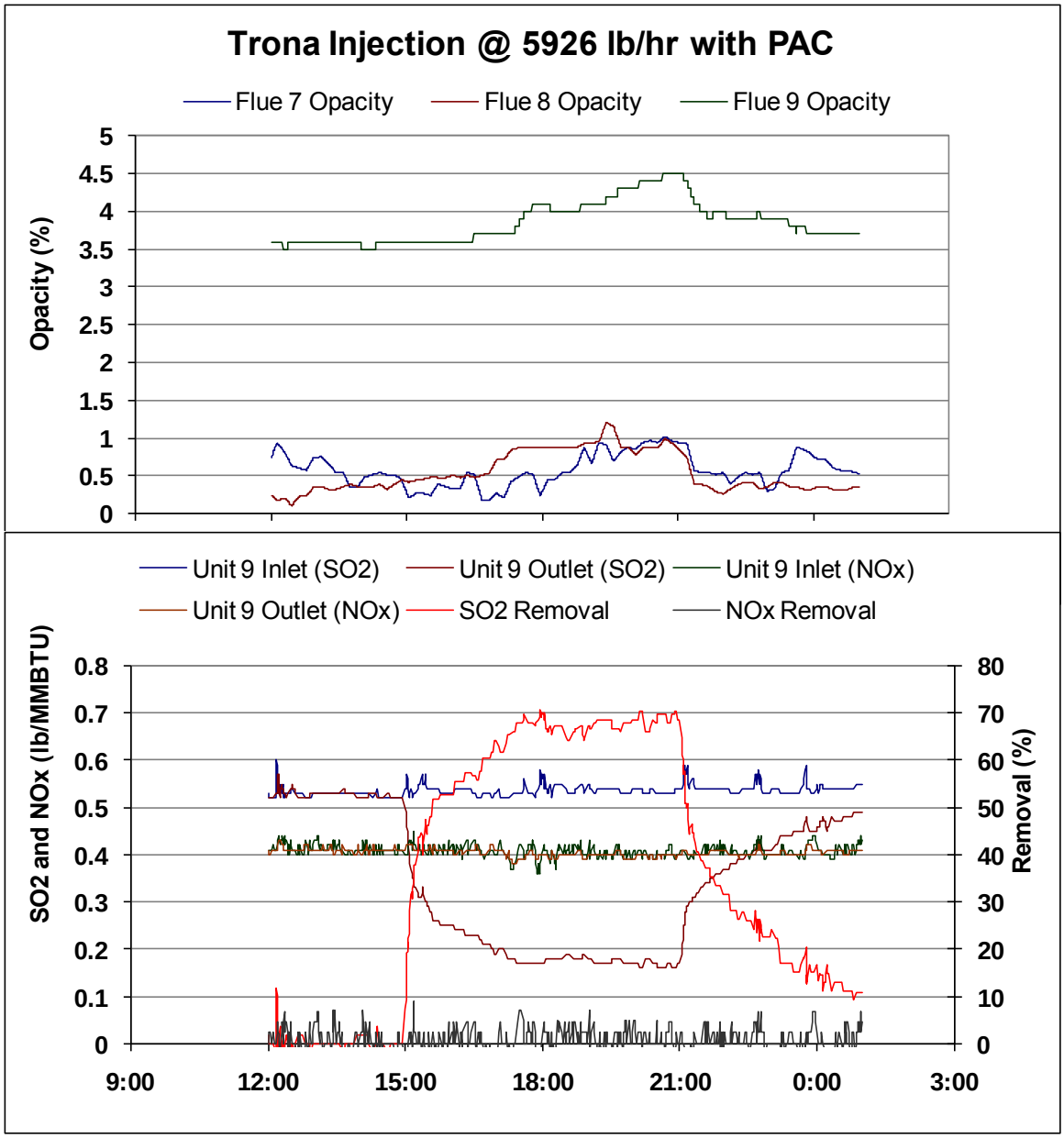


Figure 4-255. Effect of 5926 lb/hr Trona Injection on SO_2, NO_x, and Opacity.

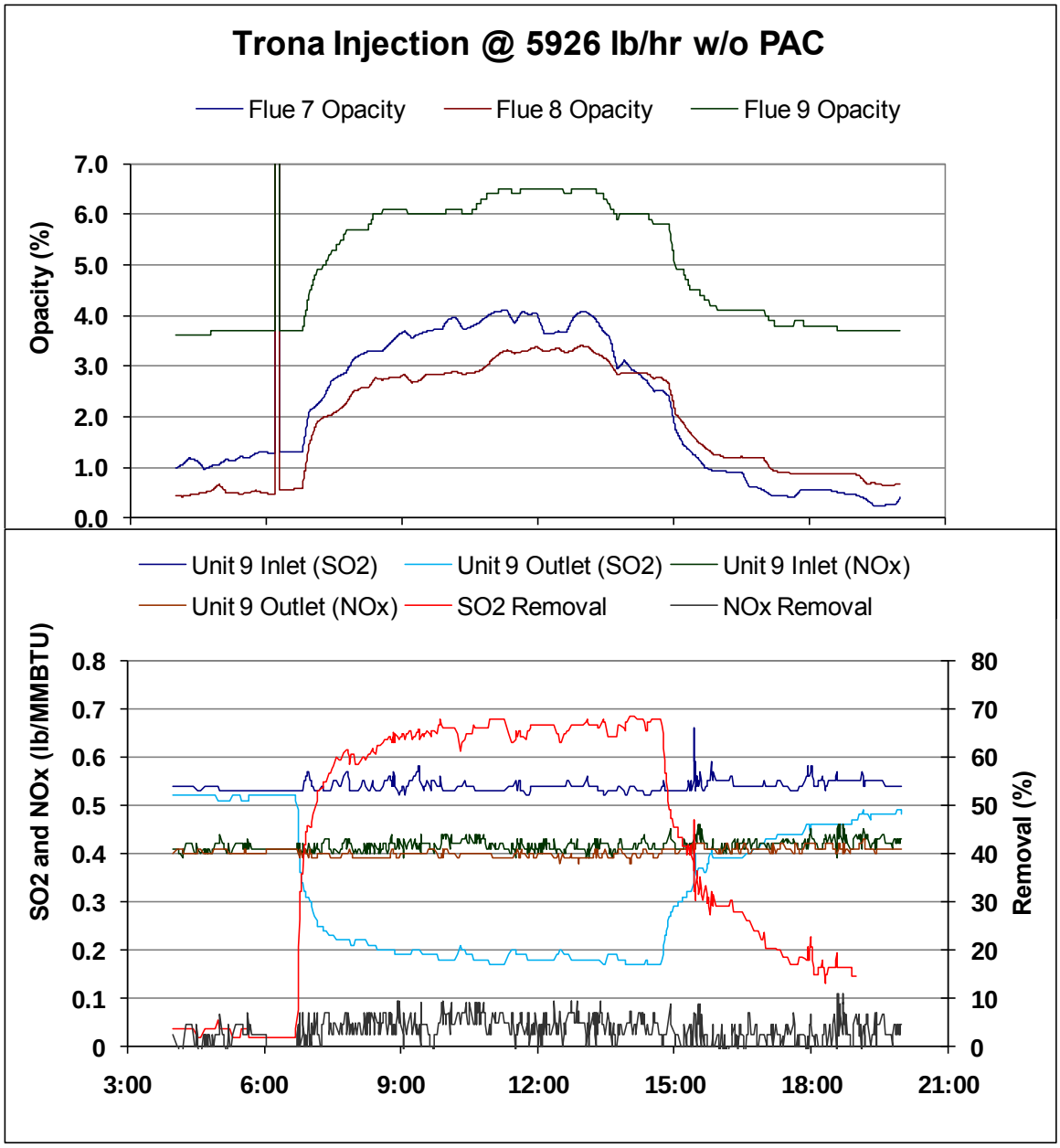


Figure 4-256. Effect of 5926 lb/hr Trona Injection without PAC Injection.

4.16.4.2.3 Baghouse Pressure Drop and Cleaning Frequency

Any impacts on the cleaning cycle and pressure drop were closely monitored. The fabric filter was cleaned in an online mode for all parametric tests. Figure 4-257 shows the effect of trona injection on baghouse operation during the entire injection period. As mentioned earlier, mercury removal was negatively affected during trona injection, but recovered overnight. The air-to-cloth ratio didn't change during testing. The cleaning frequency increased slightly during testing.

One unexpected side effect due to trona injection into the baghouse was degradation in mercury removal. On August 9, the PAC injection was increased throughout the trona injection period to try to recover 90% mercury removal. By the end of the injection period, PAC injection was at 3.8 lb/MMacf and mercury removal was at 89%. On August 10, PAC injection was increased to 3.8 lb/MMacf at the start of trona injection and there was still a reduction in removal initially. PAC injection reached 4.6 lb/MMacf without regaining 90% mercury removal. Previous tests show an initial drop in removal, then a partial recovery after several hours.

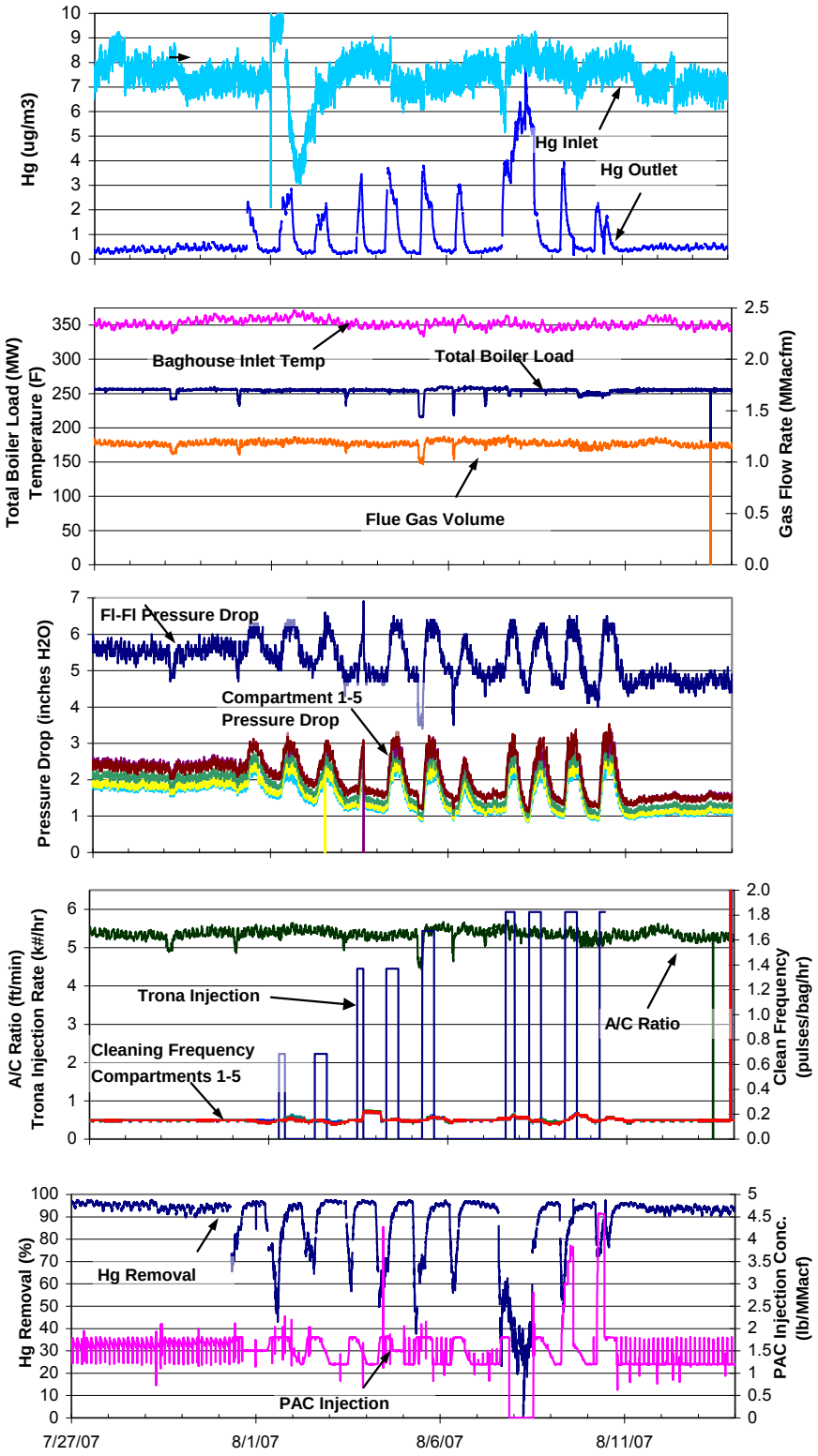


Figure 4-257. Baghouse Operation During Trona Injection Testing.

4.16.5 Economic Assessment of Full-Scale Trona Injection

4.16.5.1 Introduction

An economic assessment was performed to determine the cost for the installation and operation of a full-scale, commercial trona injection system at PIPP Units 7, 8, and 9. Based on the results from the tests described above, cost and design estimates were made for a permanent trona injection system. The design premises and the results of the economic analysis are presented here.

Estimates were made for sorbent usage and costs were estimated for three injection rates of 2223 lb/hr, 4446 lb/hr, and 5926 lb/hr, which included treatment for the flue gas from all three units. From the tests completed in August 2007, these injection rates correlate to SO_2 removal rates of approximately 45%, 64%, and 70%. The cost and design of process equipment has been estimated based on the test results for up to 70% SO_2 control and on the plant-specific requirements such as sorbent storage capacity, plant arrangement, sorbent transportation and delivery options, retrofit issues, controls interface, etc.

A consequence of simultaneously injecting trona for SO_2 control and injecting PAC for mercury control was significant degradation in mercury removal. August 2007 tests showed an initial drop in mercury removal, then a partial recovery after several hours. This economic assessment includes cost estimates for the increase of PAC usage required when injecting trona. Normal average injection rates at PIPP of PAC for 90% mercury removal were 1.5 lb/MMacf for DARCO® Hg-LH and 2.5 lb/MMacf for DARCO® Hg. To achieve 90% mercury removal while injecting trona at a rate required for 70% SO_2 removal, DARCO® Hg-LH would need to be injected at approximately 4.5 lb/MMacf and the injection rate for DARCO® Hg was assumed to be at 7.5 lb/MMacf, based on the required increase in DARCO® Hg-LH usage.. The increased requirement for PAC was not measured at the lower trona injection rates. The PAC increase was calculated based on a linear increase from baseline to the highest injection rate. PAC injection rates costs for the SO_2 removal rates are summarized below in the section regarding variable operating costs in Appendix CC.

4.16.5.2 Process Design

4.16.5.2.1 Trona Injection System Design

Costs were estimated for two different equipment setups. The first setup consisted of one bulk storage silo with three pneumatic conveying systems. The second setup consisted of three bulk storage silos, each dedicated to a single unit with one pneumatic conveying system on each silo. Note that the silo size was the same (150,000 lbs trona/silo) for the one- and three-silo systems. The three-silo setup was the type that is installed at Mirant's Potomac Station.

The conveying distances and the storage site are assumed to be the same as the test in August 2007. The silo is sized based on the capacity to hold approximately a one-day supply of trona at the maximum design injection rate of 6,000 lb/hr. This would be approximately four truckloads (40,000 lb each) or one rail car load (200,000 lb) for the combined three units. The issue of material packing in the silo and inhibiting the flow-ability of the material was considered in the sizing of the silo. The three-silo option outlined in the tables below would provide the plant with a three-day supply of trona. Table 4-127 displays the design criteria for an SO_2 control system.

Table 4-127. System Design Criteria for SO_2 Control System at Presque Isle (6000 lb/hr injection, > 70% SO_2 control).

Parameter	3-Silo System	1-Silo System
Number of silos	3	1
Number of injection trains	3	3
Design feed capacity/train (lb/hr)	2000	2000
Total trona storage capacity (lbs)	450,000	150,000
Conveying distance (ft)	300	300
Sorbent	Trona	Trona
Aerated density (lb/ft^3)	49	49
Settled density (lb/ft^3)	69	69
Particle MMD (microns)	26	26

The trona can be delivered by two methods. One option is to have the trona railed to nearby Ishpeming in 200,000-lb capacity rail cars and then transferred to self-unloading pneumatic bulk tanker trucks and delivered in 40,000-lb batches. Another option is have a rail spur installed to the plant and have rail cars directly unload to the storage silo(s). Both options have been cost estimated; however, the cost for a rail spur was not included.

The silo is equipped with a bin vent filter to contain dust during the unloading process. The silo is a shop-built, dry-welded tank with level indicators and load cells to monitor sorbent level and inventory. If only one silo is used, then that silo will have three hopper cones with a blower for each cone. If three silos are used, then each silo will have one hopper and blower.

The sorbent is fed from the hopper(s) by rotary valves into the conveying lines. The conveying air is supplied by blowers. The air provides suction to draw the sorbent into the conveyer piping and carries it to the injection lances where it is dispersed into the duct. There are three injection lances, which are located downstream of the ID fan discharges, but upstream of the point where the ducts combine. Each lance discharges sorbent into the center of its duct, where turbulent flow will provide gas/sorbent mixing. The lances will be located below the current PAC injection lances. This is downstream of the NO_x analyzer probe used for boiler feedback. Figure 4-258 shows the schematic of the plant and includes the two options for the trona silo(s).

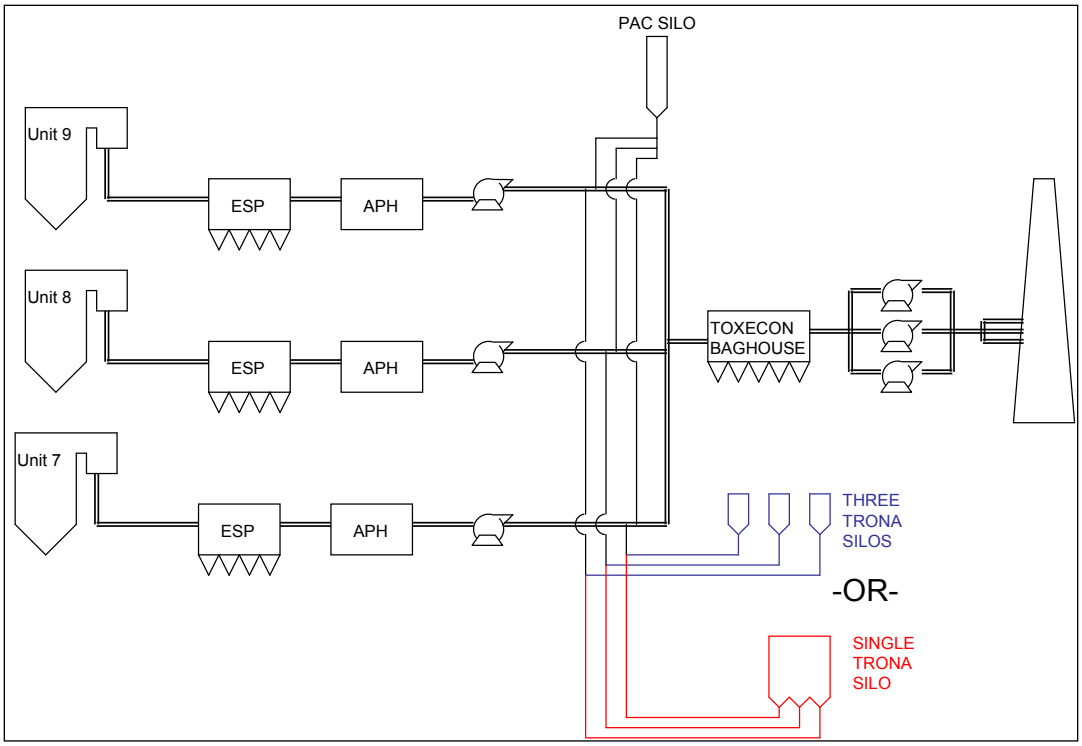


Figure 4-258. Schematic of the Trona Injection Equipment at PIPP Units 7, 8, and 9.

4.16.5.2.2 Ash Handling System

Some modifications and upgrades to the existing plant equipment would be required to accommodate a full-scale trona injection system. These include upgrades to the electrical supply to provide new service to the injection system as well as intercom phones and area lighting.

The spent trona/ash/PAC mixture will be collected in the baghouse, conveyed to the ash silo and unloaded into ash trucks that dispose of the material in the landfill as is the current operating procedure. The ash handling capacity will need to be increased to accommodate the higher loading of material. The existing four-inch conveyor piping system is adequate although a new mechanical exhauster capable of up to 15 in Hg will need to be installed. The new mechanical exhauster motor size would need to be increased from 10 HP to 20–25 HP.

The increased vacuum level produced by a new mechanical exhauster increases the gas flow rate in the ash system and therefore creates a larger air-to-cloth ratio in the filter separator.

An air-to-cloth ratio of 4:1 is desirable so an increased filter area would be required with trona injection. To achieve this ratio the existing filter/separators could be operated in parallel, however this leaves the system without a redundant filter/separator. Another option is to replace the existing filter/separator with two larger capacity, continuous operating, filter/separators. Modifications to the ash silo building would be necessary, such as extending the bin roof and modifying the bin structure to support the higher loadings of the bigger filter/separators. An alternative would be to install pleated bags in the existing system.

4.16.5.3 Cost Estimates and Results

Costs for capital equipment, operations, maintenance, and power were provided by vendors as well as estimated using the economic basis provided in EPRI's Economic Evaluation of Dry-Injection Flue Gas Desulfurization Technology[6]. The capital and fixed and variable O&M costs were then converted into and combined as 20-year levelized costs using the traditional EPRI Levelized Cost or Uniform Annual Cost analysis typical of historical EPRI studies. This methodology provides a suitable first-cut approximation and comparison of the time-value of money over the 20-year estimated life of the trona injection system options considered.

Different scenarios of equipment set-up and injection rates were priced and compared. These scenarios and the economic analysis results are summarized below. A more-detailed description of the analysis is presented in Appendix CC.

4.16.5.3.1 Capital Costs

The costs of equipment and installation for the trona injection system and balance-of-plant systems are shown in Table 4-128. This table compares the capital cost elements for the one-silo vs. three-silo systems. Capital costs for a permanent trona injection system include the storage silo(s), blowers, conveyor piping, dehumidifiers, and modifications to the ash handling system. Bulk Conveyor Specialist, Inc provided the cost estimates for the trona storage and injection equipment and installation. The required capital equipment is

summarized below. A more-detailed description of these capital cost elements is presented in Appendix CC.

- Storage Silo: Skirted, carbon steel shell with cone. Storage capacity of 75 tons. Includes bin vent collector, bin discharger, discharge valve, bin indicators, weigh hopper, rotary valves, control panel, blowers, dehumidifiers.
- Blowers.
- Conveyor Piping.
- Lances.
- Housing for Redundant Blowers and Dehumidifiers.
- Mechanical Exhauster Package
- Larger Capacity Filter/Separator

As shown in Table 4-128, the total capital requirement (TCR) for a project includes not only the capital cost estimates provided by the vendor (without installation costs), but also such factored estimates as funds for general facilities, engineering and home office fees, project and process contingencies, and preproduction costs. These factored estimates were calculated in accordance with EPRI guidelines and are consistent with those factors used in the analysis in Reference 6 as shown in the table. The TCR for a three-silo system is about 1.6 times that for a one-silo system.

Table 4-128. Summary of Equipment, Balance-of-Plant, and Engineering Costs.

Trona Injection System and Balance-of-Plant Equipment and Installation Costs **Presque Isle Power Plant Units 7, 8, and 9**		
CAPITAL COST ELEMENT DESCRIPTION	**COST**	
	1 Silo	**3 Silos**
Trona Storage/Injection System (Equipment Cost)		
Silo (s) – Including: 75 ton Capacity Storage Silo, 1 Hopper Below Silo, 1 Blower, 1 Dehumidifier Pkg, Conveyor Piping (300 ft)	$ 595,000	$ 1,785,000
Lances (*Injection lances from test can be used in permanent system; additional lances are optional at $5,000 per lance)	$ 5,000*	$ 5,000*
Redundancy (equipment added for 3 injection lines per 1 silo), Including: Splitter Valve, 2 Hoppers, 2 Rotary Valves, 2 Blowers, 2 Dehumidifier Packages, Housing for Blowers and dehumidifiers	$ 98,500	$ -
Installation of Trona Storage/Injection Equipment Includes civil, electrical, mechanical and piping	$ 580,000	$ 580,000
TOTAL PROCESS EQUIPMENT	$ 1,273,500	$ 2,365,000
Increase In Ash Handling Capabilities		
2 Mechanical Exhauster Packages Larger Capacity Filter/Separator (Design and Supply)	$ 15,000 $ 200,000	$ 15,000 $ 200,000
TOTAL ASH HANDLING EQUIPMENT UPGRADES	$ 215,000	$ 215,000
TOTAL EQUIPMENT COSTS (Installed Cost, TEC)	$ 1,488,500	$ 2,580,000
General Facilities (10% of TEC)	$148,850	$258,000
Engineering and Home office Fees (12.5% of TEC)	$186,062	$322,500
Project Contingency (25% of Process Equip. + 20% of Ash Handling Equip.)	$361,375	$634,250
Process Contingency (7.5% of Process Equip. + 5% of Ash Handling Equip.)	$106,262	$188,125
TOTAL PLANT COST (TPC)	$2,291,050	$3,982,875
Preproduction Costs (=(1/12)*(Fixed O&M + Var O&M)+.02*TPC)	$397,921	$431,757
TOTAL CAPITAL REQUIREMENT (TCR)	**$2,688,971**	**$4,414,632**

4.16.5.3.2 Operating and Maintenance Costs

The operating and maintenance (O&M) costs associated with trona injection for SO_2 control include fixed and variable costs. Fixed O&M costs include labor, maintenance materials, and administrative and support labor. The variable O&M costs vary depending on unit and other capacity factors and include sorbent, power, and waste disposal.

4.16.5.3.2.1 Fixed O&M Costs

The fixed O&M costs include:

- labor costs for ash handling
- operating and maintenance labor costs for the silo and injection equipment
- maintenance materials
- administrative and support labor

The maintenance labor, materials and support labor are estimated using known costs for the TOXECON™ system installed and operating at PIPP.

Applicable labor rates, maintenance, and operating materials costs were determined for three SO_2 removal rates (45%, 64%, and 70%). For example, the ash handling system labor costs increase as SO_2 removal rates increase due to the need for more frequent ash unloading and disposal because of the increased sorbent injection rates. Operating labor costs also vary slightly depending on the type of PAC used due to slight differences in injection rate.

The operating labor costs for the silo and injection equipment are constant for different SO_2 removal rates as well as constant with either one-silo or three-silo systems. The operating, maintenance and project overhead costs are estimated from the annual costs associated with the TOXECON™ system currently at PIPP. The maintenance materials are estimated in the same manner.

Table 4-129 summarizes the first-year fixed O&M costs calculated for this analysis. As seen, the fixed O&M costs do not vary depending on whether a one- or three-silo system is used. However, costs do vary depending upon the type of sorbent used and on the SO_2 removal rate. This table shows the total first year fixed O&M costs comparing costs at different SO_2 removal rates.

Note that these first-year O&M costs in Table 4-129 can also be expressed in terms of $/yr, although such numbers do not reflect the application of levelization factors to reflect the

time-value of money. Levelized O&M and capital costs are discussed below. The development of these fixed O&M costs and the assumptions made are described in more detail in Appendix CC.

Table 4-129. First-Year Total Fixed O & M Costs.

Total First Year Fixed O&M Cost			
1 or 3 Silos	**SO_2 Removal Rate**		
O&M Labor & Material Costs*	**45%**	**64%**	**70%**
Labor Costs for Ash Handling			
Trona + DARCO® Hg + Ash	$132,740	$265,880	$357,860
Trona + DARCO® Hg-LH + Ash	$126,470	$256,800	$345,500
O&M Labor & Materials & Support Labor for Silo & Injection Equipment			
O&M Labor Costs	$360,000	$360,000	$360,000
Maintenance Materials	$108,000	$108,000	$108,000
Total First Year Operating, Maintenance, & Support Costs (Silo & Injection)	$468,000	$468,000	$468,000
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg + Ash)	$600,740	$733,880	$825,860
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg-LH + Ash)	$594,470	$724,800	$813,500

*PAC injection rate varied for each SO_2 removal rate.

4.16.5.3.2.2 Variable O&M Costs

The variable O&M costs vary depending on unit and other capacity factors and include estimates for:

- Power Costs
- Sorbent Costs
- Landfill Costs

The sorbent costs include trona as well as the increased PAC needed to keep the mercury removal at 90%. Power costs were estimated from the equipment power requirements and the current busbar cost of power production as obtained from the utility.

Power Costs

The electrical requirements for the trona injection system include power for blowers, rotary valve motors, bin discharger, and dehumidifiers. Each injection system requires power for one blower, one dehumidifier, and one rotary valve. There is one bin discharger per silo. Therefore, for a one-silo system with one large silo, power for one discharger is needed. For a three-silo system, power for three dischargers is needed. The long-term running power required is roughly half of the power required for startup (connected load). The system power in kW is calculated knowing the amperage and voltage needed for the different components, along with a power factor and knowledge of the estimated time that each component operates.

Table 4-130 summarizes the estimated variable first-year operating cost for power estimated for one- and three-silo injection systems by summing the power usage requirements for each component and using an assumed busbar cost to produce power of $0.03/kWh as estimated by the utility. The calculations and intermediate steps used to determine the power cost estimate are presented in more detail in Appendix CC.

Table 4-130. First-Year Variable O & M Costs for Power.

Variable O&M Costs: Power		
	1 –Silo System	**3-Silo System**
Power Usage, in kW	42.35	127.05
Unit Power Cost, in $/kWh	$0.03	$0.03
Power Cost, in $/yr	$11,125	$33,375

Sorbent Costs

Sorbent costs vary depending on the desired SO_2 removal percentage and on the delivery method. Costs for trona and PAC increase as SO_2 removal levels increase due to the need for higher sorbent injection rates; this includes the increased trona injection rate as well as the increased PAC injection rate to maintain mercury removal levels. The cost for trona to be railed directly to the plant is $140/ton assuming the costs to install a rail spur is picked up under another project. If a rail spur is not installed to the plant, the trona can be railed to

Ishpeming, then loaded into a truck from there and delivered to the plant by truck. Using a combination of rail and truck would cost $155/ton.

The amount of PAC needed to maintain 90% mercury control increases as trona injection increases due to the interference of trona injection with the PAC's ability to capture mercury. Table 4-131 summarizes the sorbent costs for the two delivery methods for the three SO_2 removal rates of 45, 64, and 70%. Also reflected in the table are the effects on first-year sorbent costs of different unit costs, and injection rates for trona and the PAC mercury sorbent, whether DARCO® Hg or DARCO® Hg-LH. The unit costs and injection rates assumed for each sorbent, delivery method and for each SO_2 removal rate as well as the steps taken to arrive at the total values summarized in Table 4-131. Additional details are provided in Appendix CC.

Table 4-131. First-Year Variable O & M Costs for Sorbent Delivered by Rail and by Rail/Truck Combination.

Variable O&M Costs: Sorbent Delivered By Rail* or Combination to Plant			
Sorbent Costs in $/yr**	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
Delivered by Rail* to Plant			
Trona + DARCO® Hg	$1,405,651	$2,836,597	$3,887,797
Trona + DARCO® Hg-LH	$1,460,182	$2,934,162	$3,920,647
Delivered by Rail† and Truck†			
Trona + DARCO® Hg	$1,514,056	$3,053,407	$4,178,520
Trona + DARCO® Hg-LH	$1,568,587	$3,150,972	$4,211,370
* Trona rail spur assumed to be installed under separate project ** Minus PAC that would already be injected † Trona railed to Ishpeming and trucked to plant			

Waste Disposal Costs

The variable O&M costs for waste disposal are the costs required to landfill the spent sorbent captured in the baghouse. The 2007 unit cost to landfill material was $44.40. The unit cost for landfill along with the waste production rates for each sorbent was used to calculate the total cost to landfill the waste for both PAC sorbents for each of the three SO_2 reduction rates

as summarized in Table 4-132. Since this is a differential cost estimate that considers only the effect of adding a trona injection system, the costs do not reflect the ash and PAC waste that is disposed of while running at full load with no trona injection. The waste production rates and steps used in calculating the waste disposal costs are shown in Appendix CC.

Table 4-132. First-Year Variable O & M Costs for Landfill Waste Disposal.

Variable O&M Costs: Waste Disposal			
Waste Disposal Costs, in $/yr**	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
Trona + DARCO® Hg	$336,780	$674,575	$907,940
Trona + DARCO® Hg-LH	$330,360	$661,010	$886,060
**minus PAC/Ash waste that would already be disposed of			

Total Variable O&M Costs

Table 4-133 shows the total variable O&M costs at the three different SO_2 removal rates and for the different delivery methods. The total O&M costs include costs for power, sorbent usage, and disposal costs.

Table 4-133. First-Year Total Variable O & M Costs.

Total Variable O&M Costs			
Total Variable O&M Costs, $/yr	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,775,800	$3,544,550	$4,829,115
Trona + DARCO® Hg-LH	$1,823,915	$3,628,550	$4,840,085
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,884,210	$3,761,360	$5,119,840
Trona + DARCO® Hg-LH	$1,932,320	$3,845,360	$5,130,810

4.16.5.3.3 Levelized Costs

Levelized costs were computed to represent a constant cost value for the operating and capital costs over the lifetime of the equipment and project. In other words, the levelized costs take the present value of the net costs and spread them evenly over a period of time.

This makes it possible to compare costs looking into the future. For this assessment levelized costs are presented in units of mills/kWh, where a mill is 1/1000 of a dollar.

The key economic parameters and factors used in this analysis are summarized in Table 4-134. The calculations to determine levelized costs assumed a discount rate of 7.5% and a 20-year levelization factor was used. The capital costs are converted using a fixed charge rate of 15.0% and the O&M costs are converted using levelization factors of 1.29 for all costs including power and consumables.

This methodology is consistent with typical historical EPRI studies. The use of a 15% Fixed Charge Rate is consistent with using a Capital Recovery Factor of 0.15, a typical approximation currently used by EPRI and utilities today for levelizing capital costs. Although the factors used here are generalizations, their use is a reasonable approximation for a first-cut economic evaluation for the rough comparison of these similar options. Should any utility desire to pursue these options more seriously for a given plant, a detailed economic analysis using economic factors and a methodology specific to the utility's current normal practice would be advised to confirm the economic viability of each option.

Table 4-134. Economic Factors and Parameters.

Economic Factors & Parameters	
Year of Estimate	2007
Plant Life	20 Years
Capital Recovery Factor	0.15
Fixed Charge Rate	15%
O&M Levelization Factor	1.29
Normal Capacity Factor	0.75
Power Capacity Factor	0.85

4.16.5.3.3.1 Levelized Capital Costs

Table 4-135 summarizes the levelized total capital requirement for the one- and three-silo options. The total capital requirement for three silos is less than double the requirement for one silo.

Table 4-135. Levelized Capital Costs.

Levelized Capital Costs (20 yr, Current $ Basis)		
LEVELIZED TOTAL CAPITAL REQUIREMENT	**1-Silo System**	**3-Silo System**
Levelized $/yr	$403,345	$662,195
Levelized $/kW	$1.49	$2.45
mills/kWh	0.23	0.37

By comparison, the total capital requirement for a green-field installation of a pulse-jet baghouse on a 250 MW unit might cost approximately 50 $/kW as suggested by an EPRI study published in 1992.[7]

4.16.5.3.3.2 Levelized O&M Costs

Table 4-136 and Table 4-137 summarize the levelized fixed and variable O&M costs, respectively, resulting from this analysis. These tables summarize the levelized costs for the two PAC sorbents versus the three SO_2 removal rates.

Table 4-136. Levelized Total Fixed O & M Costs.

Levelized Total Fixed O&M Cost			
Levelized Total Fixed O&M Costs	**SO_2 Removal Rates**		
	45%	**64%**	**70%**
Trona + DARCO® Hg + Ash			
Levelized $/yr	$774,950	$946,705	$1,065,360
Levelized mills/kWh	0.44	0.53	0.60
Trona + DARCO® Hg-LH + Ash			
Levelized $/yr	$766,870	$934,990	$1,049,415
Levelized mills/kWh	0.43	0.53	0.59

Recall that the variable O&M costs are dependent not only on the SO_2 removal rate and type of PAC sorbent used, but also on the transportation mode to the plant; i.e., whether the sorbent is taken to the plant directly by rail or whether the Rail/Truck combination is used. This is reflected in the levelized total variable O&M costs given in Table 4-137.

Table 4-137. Levelized Total Variable O & M Costs.

Levelized Total Variable O&M Costs			
Levelized Total Variable O&M Cost	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
Levelized $/yr	$2,290,785	$4,572,465	$6,229,555
Levelized mills/kWh	1.29	2.58	3.51
Trona + DARCO® Hg-LH			
Levelized $/yr	$2,352,850	$4,680,825	$6,243,710
Levelized mills/kWh	1.33	2.64	3.52
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
Levelized $/yr	$2,430,630	$4,852,150	$6,604,590
Levelized mills/kWh	1.37	2.74	3.72
Trona + DARCO® Hg-LH			
Levelized $/yr	$2,492,695	$4,960,510	$6,618,740
Levelized mills/kWh	1.41	80	3.73

4.16.5.3.3.3 Total Levelized Costs

Table 4-138 shows the total levelized costs, which includes the total variable O&M costs, total fixed O&M costs and total capital costs at three removal rates and for the two PAC sorbents for the two sorbent delivery methods. This is presented for the both the one- and three-silo systems.

Table 4-138. Levelized Total Costs (Capital and Fixed & Variable O&M Costs).

TOTAL Levelized Costs			
Total Levelized Cost (Capital and Fixed & Variable O&M Costs)	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
1-SILO SYSTEM			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
mills/kWh	1.96	3.34	4.34
Trona + DARCO® Hg-LH			
mills/kWh	1.99	3.39	4.34
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
mills/kWh	2.03	3.50	4.55
Trona + DARCO® Hg-LH			
mills/kWh	2.06	3.55	4.55
3-SILO SYSTEM			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
mills/kWh	2.10	3.48	4.49
Trona + DARCO® Hg-LH			
mills/kWh	2.13	3.54	4.48
Trona Delivered by Rail/Truck			
mills/kWh	2.18	3.64	4.70
Trona + DARCO® Hg-LH			
mills/kWh	2.21	3.70	4.70

4.16.5.3.4 Removal Cost per Ton of SO_2 Removed

The best way to compare SO_2 removal technologies is on the basis of $/ton of SO_2 removed. Table 4-139 shows the cost per ton of SO_2 removed using trona at full scale for the three SO_2 removal rates considered as compared for the two PAC sorbent options and the two sorbent delivery options. These values are levelized over 20 years.

Table 4-139. Removal Cost per Ton of SO_2.

Levelized Total Cost per Ton of SO_2 Removed ($/ton)			
No. of Silos, Delivery Method, and Sorbent	**SO_2 Removal Rate**		
*****	**45%**	**64%**	**70%**
1 SILO			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,483	$1,780	$2,116
Trona + DARCO® Hg-LH	$1,506	$1,809	$2,115
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,543	$1,864	$2,219
Trona + DARCO® Hg-LH	$1,566	$1,893	$2,218
3 SILOS			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,594	$1,858	$2,187
Trona + DARCO® Hg-LH	$1,617	$1,887	$2,186
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,654	$1,942	$2,290
Trona + DARCO® Hg-LH	$1,677	$1,971	$2,290

Inspection of Table 4-139 reveals that the greatest impact on the cost per ton of SO_2 removal is primarily due to the rate of sorbent injection. Note that in a one-silo system for both sorbents and both delivery methods, the cost typically increases by a factor of about 1.4 to increase SO_2 removal from 45% to 70%. For a three-silo system, the capital required for the larger system becomes a more significant in total cost. However, the sorbent cost still dominates and the total cost per ton of SO_2 removed increases by a factor of about 1.35.

4.16.6 Conclusions

The goal of 70% SO_2 removal was achieved during this two-week test period when injecting 5926 lb/hr of trona. This corresponds to an average NSR of 1.02. The inlet concentration of SO_2 varied from 0.48-0.64 lb/MBtu. The highest removal was 74.1% with PAC injection at 3.8 lb/MMacf.

There was very little reduction in NO_x during the test period. In addition, the effect of a side reaction, where NO is oxidized to produce NO_2, was observed on one test day when PAC injection was turned off. This indicates that there is some conversion of NO to NO_2. The NO_2 level was high enough to be visible and cause an increase in opacity of almost 3%. On days when PAC injection was occurring, the opacity increased by a maximum of 0.75% but there was no visible plume.

Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. This effect was seen every day that trona was injected. The mercury removal slowly recovered overnight to the pre-test level of > 90%. On the last two days of testing, PAC injection was increased to regain the > 90% removal rate. Test conditions did not allow sufficient time to achieve this target rate while injecting trona. An estimate of the required PAC is 3X the pre-trona test rate.

Baghouse and tube sheet pressure drop increased during trona injection, causing an increase in cleaning frequency from 0.18 p/b/hr to 0.22 p/b/hr.

Plant operators kept the three units at full, steady load during testing. The boiler soot blowers were used every hour on a staggered schedule to keep the flue gas temperature from fluctuating during testing. Trona was injected near the PAC injection port, which should have resulted in excellent mixing with the flue gas before reaching the baghouse. The trona injection had no effect on boiler operations.

The reacted trona, PAC, and ash were unloaded from the ash silo using a wet unloading system. Because sodium carbonate will react with water to form solid hydrates, an anti-setup chemical was initially used with the water during unloading. No setup of the baghouse mixture was seen either in the mixer or in the transport truck. During the first week, an unloading during the morning occurred without the chemical, also resulting in no setup in the mixer or truck. The material may have been forming hydrates during mixing, preventing a hard setup. The use of the anti-setup chemical should be considered in future tests unless it can be shown that the mixing system prevents a solid setup in the mixer or truck.

An economic assessment of a full-scale trona injection system included equipment and other capital costs along with sorbent cost (trona and increased amount of PAC to maintain 90% removal) and O&M costs. The cost to remove SO_2 varied from $1,483/ton at 45% removal and one silo to $2,290/ton SO_2 at 70% removal with 3 silos.

4.17 Task 17: Carbon-Ash Management System

4.17.1 Mercury Recovery Processes

Two thermal desorption methods were investigated under this task. The first method utilized the "air slide" technology patented by We Energies and licensed by United Environment & Energy (UEE). This is a patented technology (U.S. Patent 7217401, Mercury Removal from Activated Carbon and/or Fly Ash). Sorbent and/or fly ash with affixed mercury compounds is exposed to heated flowing air until the sorbent reaches a temperature of at least 700 ºF (372 ºC). For activated carbon, the temperature range is 700 ºF–1000 ºF (372 ºC–538 ºC). This temperature change occurs in a fluidized bed conveyor, in which the metal floor has openings and heated flowing air passes through the openings to move the sorbent from the inlet to the exit of the bed. The openings are 10 microns or less. The air flow is greater than 0–10 ft^3/min. The sorbent should be at least 300 ºF (150 ºC) before exposing the sorbent to the air.

The second technology used microwave energy to selectively heat the PAC/ash particles, thereby saving on energy costs. This technology was demonstrated under this project by UP Steel. The following are the final reports submitted to We Energies by UEE and UP Steel.

4.17.1.1 United Environment & Energy

4.17.1.1.1 Task 1. Obtain and Characterize the PAC/Ash Mixture Provided by We Energies

UEE received three 55-gallon drums of PAC/ash from We Energies. The material was transported in sealed steel containers. The PAC/ash sample was characterized in terms of composition, density, particle size (scanning electron microscopy), and surface area. The composition analysis was conducted at Test America Inc, a certified outside laboratory. It showed that the PAC/ash contains 25% carbon and 31 ppm mercury, which are different

from the numbers provided by We Energies. The carbon content of 25% is close to the optimal carbon content for the nitrogen fertilizer production (Table 4-140).

Table 4-140. PAC/Ash Composition.

Sample	Analyzed by	Al (wt.%)	Si (wt.%)	C (Wt.%)	Ca (Wt.%)	Fe (Wt.%)	Hg (ppm)
PI 7-9 Ash analysis	We Energies	16	32	1	21	5	0.0045
PAC-Ash	We Energies			50			62
	UEE			25.46	7.1	1.8	31

The BET surface area of PAC-ash was measured at UEE using the Quantachrome BET Surface Area System. The surface area of PAC/ash was 123 m^2/g. Because the PAC activated carbon had a surface area of 523 m^2/g, the surface area of PAC-ash correlated well with the carbon content in the ash of 25.46 wt% (Figure 4-259). The fly ash and activated carbon existed in the form of agglomerates. The density of the PAC-ash was 0.60 g/ml.

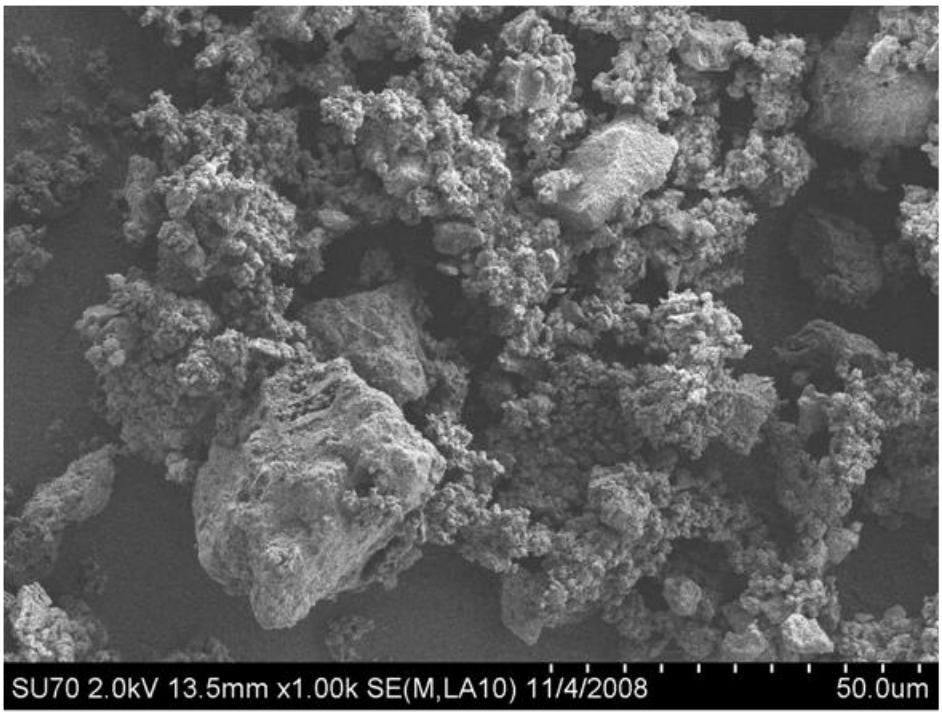


Figure 4-259. SEM Images of the PAC/Ash.

4.17.1.1.2 Task 2. Set up a Large Batch Reactor and Run Trials

A rotary furnace fertilizer production system has been set up and put into operation. The system mainly is comprised of the following main components:

- a sample hopper
- rotary tube reactor
- nitrogen gas control system
- mercury chemical absorbent
- carbon monoxide measuring system (GC)
- mercury analyzer

The PAC/ash powder is fed into the rotary reactor tube from the hopper. The maximum feeding rate of the rotary feeder is 3 kg/hour. The rotation and the slope of the reactor tube cause the powder to gradually move downhill to the other end of the reactor tube. The residence time of the powder is controlled by the rotational speed and the degree of slope of the tube (Figure 4-260).

Figure 4-260. Large Batch Reactor.

4.17.1.1.3 Task 3. Identify and Obtain Effective Mercury Capture Chemical Absorbent and Integrate it into the Reactor System

A new mercury chemical absorbent was developed at UEE to chemically capture mercury from the gas phase during fertilizer production. The absorbent was cylindrical pellets with 1 mm in diameter and 3-5 mm in length that consisted of activated carbon and sulfur powder. The pellets were extruded using a high throughput extruder. This chemical absorbent exhibited excellent mercury capture performance. However, the economic analysis on the production cost of this absorbent showed that it was too expensive for any commercial applications.

To commercialize the "PAC/ash to fertilizer" technology, an inexpensive mercury chemical absorbent should be obtained. After extensive literature search and discussion with sorbent manufacturers, a commercially available inexpensive mercury chemical absorbent was identified. The absorbent was produced by Calgon Carbon Corporation. It was a sulfur containing activated carbon in granular shape. The mercury was completely removed by thermal desorption from the PAC/ash and was captured by this absorbent. The resulting mercury containing material was thermally and chemically stable and presented no risk to the environment.

4.17.1.1.4 Task 4. Produce Fifty Pounds Fertilizer

To perform a farmland field testing, a large quantity of PAC/ash fertilizer is produced. The farmland testing will be conducted at Watts Farms. Watts Farms will provide one acre of corn ground for the testing. Around fifty pounds of fertilizer have been produced. A bottle of the sample will be sent to We Energies Project Manager. The farmland testing phase was outside the scope of the TOXECON™ project.

4.17.1.1.5 Task 5. Conduct an Economic Analysis

Capital and operating costs to produce UEE's fertilizer correlate to size of the plant. Significant economies of scale can be more easily realized with a larger plant. The capital cost components include equipment, land and building, utilities, installation of electrical and water systems, transportation, engineering and permitting, and contingency. A kiln will be

the major equipment cost for the facilities. A kiln similar to the commercial rotary cement kiln for clinker formation can be used. The production cost includes the cost of the day-to-day operation of the plant and is divided into three categories: direct production costs, indirect production costs, and general expenses. Direct production costs consist of raw material costs and labor related costs. The costs of raw materials were calculated based on the market price of each feedstock. Indirect production costs include overhead, local taxes, and insurance. General expenses include administrative costs, distribution, and selling costs.

The plant capacity is mainly determined by the PAC/ash availability on site. PAC/ash is a bulky and heavy material, which limits how far it can be economically moved. It costs between $0.10 and $0.13 /ton/mile to transport PAC/ash. This estimate represents a plant built on a green site next to a We Energies power plant (within a mile from the power plant). We assume that all the fly ash contains mercury-contaminated activated carbon.

A production plant, modified from industrial rotary kiln cement production process design, will be used for the fertilizer production. The plant mainly consists of a PAC/ash precalciner (to remove the mercury from PAC/ash and to heat the PAC/ash), a mercury capture column, a rotary kiln (to produce fertilizer), a cooler, a coal mill, and fans.

Nitrogen gas is assumed to be readily available at the power plant. Cleaned flue gas from the power plant can be utilized as a source of nitrogen gas. A commercial gas separation process would be used to separate all the other gases from nitrogen gas.

For a plant with PAC/ash processing capability of 500,000 tons annually, the estimated fixed-capital is $19.5 million and the working capital is $2.93 million.

The reaction energy required to heat the PAC/ash and provide heat for fertilizer synthesis is provided by combustion of coal. The estimated costs of the coal is $1.33 million.

We assume that 120,000 tons of fertilizer is produced in the first commercial plant. The following Table lists the production cost and final product price details:

Table 4-141. Fertilizer Product Cost Calculation.

Items		Costs
Direct production costs (million $)	Coal (the same coal used in power plant)	1.33
	Fly ash (transportation cost: move fly ash from power plant to fertilizer plant feed area within a mile distance)	0.02
	Nitrogen gas (generated on-site)	0.82
	Operating labor (5 FTE)	0.54
	Maintenance (9% fixed capital of $19.5 million)	1.76
Indirect production costs (million $)	Overhead (60% of sum of operating labor and maintenance)	1.38
	Local taxes (1.5% of fixed capital of $19.5 million)	0.29
	Insurance (0.7% of fixed capital of $19.5 million)	0.14
General expenses (million $)	Administrative (16% of the overhead)	0.22
	Distribution and selling (9.5% of the total above expenses of $6.49 million)	0.62
Annual capital charge (million $)	15% of the total capital of $22.43 million	3.36
Total annual production costs (million $)	(120,000 tons of fertilizer)	**10.47**
Profit (annually in million $)	(150% of the total production costs)	**15.71**
Production costs per ton fertilizer ($)		**87**
Final product price to dealers ($ per ton)		**218**

The nitrogen content of the fertilizer produced by this process would be equivalent to commercially available ammonium nitrate fertilizer. Even with 150% profit, the PAC/ash fertilizer price to dealers is only $218 per ton. In contrast to the price of $382 per ton paid by farmers for ammonia nitrate fertilizer in April of 2007, the price of this new fertilizer is significantly lower. In the calculation, the utilization of the power plant waste heat as well as the savings from avoiding PAC/ash disposal which will further reduce the production cost was not taken into account. This cost comparison did not take into account any difference in total nitrogen between ammonia nitrate and the PAC fertilizer.

4.17.1.1.6 Task 6. Complete a Preliminary Design for a Commercial-Scale Production Plant

This Task aimed at a preliminary design for a commercial-scale production plant. A description of the flow diagram associated with such a plant is illustrated in the following Figure 4-261. The fly ash powder is fed into the precalciner through the cone shaped hopper along with hot air (1). The hot air arrives in a duct directly from the fertilizer cooler. The fly ash feed speed is controlled by a rotary feeder with assistance from air and aeration stones. The fly ash-bearing hot air stream is passed tangentially into the conical precalciner vessel. This produces a vortex within the vessel. Both fly ash and gas spiral down toward the vessel bottom. Pulverized coal is blown in by air (3) through the burner, producing a large concentric flame in the vessel. The precalciner has the advantage of controlling the flame core temperature by adjusting the air/coal flow to the burner and the hot air flow (2). An increase in hot air volume leads to a high acceleration of the initial combustion of coal, resulting in a higher temperature in the precalciner. The fly ash is heated by contact with the hot gases from combustion of coal. The gases leave the vessel through a vortex-finder. The hot exhaust gases are sent to a nitrogen gas heat exchanger and then flow to the mercury capture equipment to capture the mercury and remove other air pollutants. The fly ash is thrown to the outside edge of the vessel by centrifugal action and leaves through a valve in the bottom of the cone to the inlet of the rotary kiln.

At the inlet of the rotary kiln, the hot fly ash encounters a high flow nitrogen gas stream (4) containing pulverized coal. The coal reacts with the oxygen gas entering with the hot fly ash from the precalciner. An excess amount of coal will be added so that all the molecular oxygen will be consumed and a sufficient amount of carbon will be left and available for the fertilizer production. Because the coal is present in excess, carbon monoxide, instead of carbon dioxide, will be the major product. The carbon monoxide will leave the kiln with nitrogen from the kiln inlet and be sent to the precalciner. The reaction of coal with oxygen is exothermic and provides additional energy for the carbonitridation reaction. The high flow nitrogen stream (4) spreads the fly ash and mixes the fly ash and coal uniformly. The fly ash then undergoes the fertilizer forming process when it moves slowly through the rotary kiln. To guarantee the availability of sufficient nitrogen gas, the other stream of hot nitrogen flow (5) is injected into the kiln through the other end of the kiln in a counter current flow mode

with respect to the fly ash/carbon. The hot fertilizer product is discharged from the kiln to the fertilizer cooler. In the cooler, most of energy from the fertilizer is recovered to the air stream by a heat exchanger. The hot air from the cooler is sent to the precalciner. A data logger connected to platinum thermocouples located at different locations in the plant is used to record the temperature readings. In addition, all necessary safety measures for the plant will be taken carefully to ensure a safe working environment.

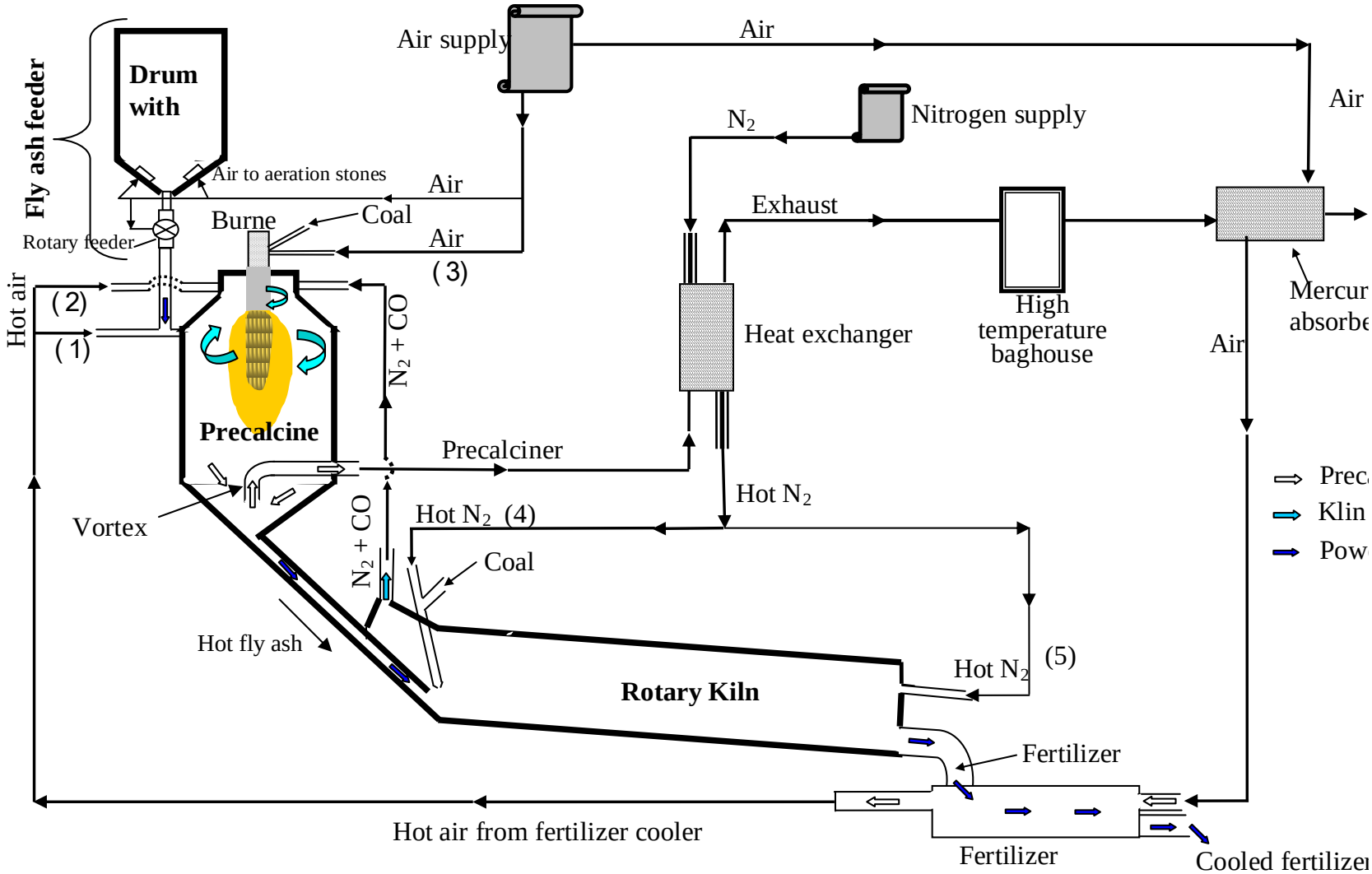


Figure 4-261. Fertilizer Production Process Flow Diagram.

4.17.1.1.7 Conclusions

This PAC/ash utilization and mercury capture technology has been successfully demonstrated in the study. The technology is technically and economically viable, which can meet the TOXECON™ project's two goals if it can be successfully scaled up for commercial application.

The PAC/ash has been fully characterized. The activated carbon content in the ash is in the optimal range for fertilizer production. No additional carbon is needed.

A commercially available effective chemical absorbent has been identified and integrated into the fertilizer production system.

A rotary furnace fertilizer production and mercury capture system has been set up and put into operation.

The economic analysis verifies the economic viability of this technology.

A conceptual design for a commercial scale fertilizer production plant has been provided.

The field testing phase of the fertilizer produced was outside the scope of the TOXECON™ project. These tests are needed to verify that the fertilizer promotes plant growth and that toxic materials from the coal ash do not impact the soil or the plants..

4.17.1.2 UP Steel

4.17.1.2.1 Abstract

The consumed PAC sorbents from We Energies Presque Isle PJFF (Pulse Jet Fabric Filter) were investigated for mercury removal from the sorbents utilizing the microwave technology developed by UP Steel. In this laboratory study, the consumed sorbents were irradiated with microwave for three minutes under a nitrogen gas flow. Mercury is evaporated from the consumed sorbents by microwave heating. The evaporated mercury is carried by the nitrogen gas to a condenser to condense the mercury by cooling down. The mercury that is not condensed is scrubbed by a potassium permanganate solution. The results of this study

demonstrate the effectiveness of this approach. The mercury content in the consumed sorbents is reduced from 14,800 ppb to 252 ppb after the microwave treatment. Analysis of the condensed crystal products by SEM (Scanning Electron Microscope) shows the presence of mercury and that mercury is probably present in the form of mercury sulfate. Mercury is also present in the scrubbed solution and can be precipitated out from the solution with sodium sulfide. The precipitates have also been analyzed with SEM and the existence of mercury sulfide is confirmed.

4.17.1.2.2 Background

PAC has been utilized as the basic material for mercury adsorption from the emission gas. After adsorption, the disposal of the mercury-loaded sorbents is an issue. In addition, it is desired to recover and reuse the PAC for mercury removal in the current system due to the high cost of PAC.

In the TOXECON™ system, PAC is injected in a PJFF for mercury removal. The PAC is collected together with fly ash particles that were not collected in the ESP. This results in a material coming out of PJFF with about 50% PAC and 50% fly ash.

The removal of mercury from loaded sorbents can be achieved by heating the sorbents to temperatures above the boiling temperature of mercury, as taught by Hwang and Li (1997) in U.S Patent 6027551. This heating approach for mercury unloading has also been adopted by Ramme et al (2007) of We Energies as described in U.S. Patent 7217401.

The conventional heating of the carbonaceous material is a slow process. It takes a long period of time to heat the carbon material and unload the mercury from it. This will take a lot of energy and can cause serious oxidation or combustion of PAC in air and the loss of PAC recovery.

UP Steel has conducted a series of studies led by Hwang to overcome these issues. A new, fast acting, process for mercury unloading from PAC has also been discovered. This process employs microwave to remove mercury from PAC. It was found in a UP Steel study that mercury removal for PAC can be accomplished within minutes under microwave irradiation.

The purpose of this study is to verify that two products, a mercury removed sorbent product and a mercury concentrate product can be obtained from the process.

4.17.1.2.3 Experimental Methods

4.17.1.2.3.1 Experimental Setup

Figure 4-262 shows a schematic of the setup for the experiment. Weigh 22 g ± 0.2 g dried carbon sample (PAC/ash) into a glass test tube, and place some glass fibers on top of the sample to prevent the carbon powder flying into the connecting tube. Then put the tube in the middle part of a microwave oven. Pure nitrogen is utilized to carry the vapor generated in the tube forward. The flow rate of nitrogen is measured with a Cole Parmer flow meter at 600 ml/min, which gives a continuous bubble stream in the KMnO4 scrubbing solution. The carbon sample was irradiated with a 1 KW microwave oven at power 4 of maximum setting 10 for 2.5 minutes. The evaporates are carried by the nitrogen gas to a water-cooled condenser and then the KMnO4 scrubbing solution. Figure 4-263 is a picture of the microwave apparatus.

Mercury concentration in the gas flow after the microwave irradiation and the scrubbing can be determined with a gold film mercury vapor analyzer (JEROME 431-X, Arizona Instrument Corp.). The measuring range of the analyzer is 0.000 to 0.999mg/m^3, with a resolution of 0.001mg/m^3 and a sensitivity of 0.003mg/m^3.

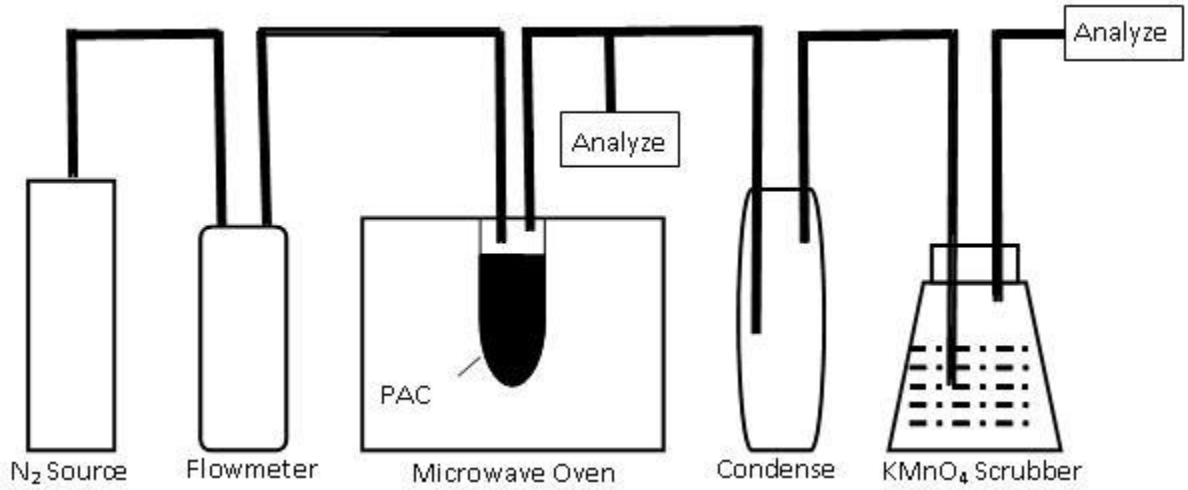


Figure 4-262. Schematic Diagram for the Mercury Separation Experiment.

Figure 4-263. Apparatus of Microwave Experiment.

4.17.1.2.3.2 Materials

Consumed TOXECON™ sorbent samples were obtained from We Energies Presque Isle power plant. For each test, the sample is first dried in an oven to remove most of the water adsorbed in the activated carbon. Heat the carbon at 105 ºC for 4 hours. The sample is utilized for mercury desorption experiments within 2 hours in order to avoid adsorbing water vapor from the air.

The scrubbing solution contains 1.5% potassium permanganate in 10% sulfuric acid (Shendrikar et al., 1984). The gas was introduced into a flask of 200ml solutions before being exited into the air.

4.17.1.2.4 Results and Discussion

4.17.1.2.4.1 Mercury Contents and Weight Loss

The mercury content of the feed sample is 14,800 ppb. After the microwave treatment, the mercury content is 252 ppb. The mercury concentration of the gas coming out from the glass test tube at 1, 2, and 3 minutes is 0.015, 0.012, and 0.002 mg/m^3, respectively. The mercury concentration for the gas exiting from the scrubber is not detectable.

The weight loss from each run is shown in Table 4-142. The average weight loss is about 12%. There is still quite a bit of water condensed in the condenser. It is also observed that carbon powders are accumulated in the connecting tubes and condensers.

The experiment has been repeated for over 300 times to see if metallic mercury liquid droplets or film can be observed. This was found not possible because the carbon powder has covered all the surfaces.

Table 4-142. Weight Change of Carbon Before and After Heating.

Sample	Weight of Carbon before heating(g)	Weight Loss (g)	Weight Loss %
1	22.023	2.611	11.86
2	22.077	2.490	11.28
3	22.093	2.774	12.42
Average	22.064	2.625	11.90

4.17.1.2.4.2 Condensed White Crystals

When the microwave experiments were started over with new Tygon tubing, some white crystals can be found in the connecting Tygon tube outside the microwave furnace after repeating the experiments for 8~10 times. The crystals are disseminated on the inside wall of the Tygon tube, as shown on Figure 4-264. These crystals can turn into liquid droplets after cool down under the atmospheric conditions (Figure 4-264). By heating, the droplets turn back to crystals.

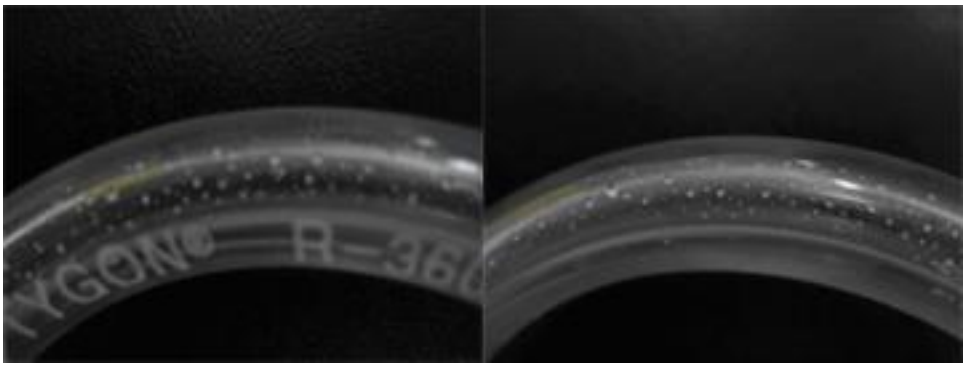


Figure 4-264. The Crystals Condensed on the Connecting Tube and Liquid Droplets.

The white crystals condensed on the inside wall of the Tygon tube were analyzed with SEM. Figure 4-265 shows the SEM images of the crystals. They are mostly in plate shape. The chemical compositions of the crystals were analyzed qualitatively with the electron probe. The EDS spectrum, as shown in Figure 4-266, reveals that the crystal has the characteristic peaks of mercury, sulfur, and oxygen. Since the crystals can absorb moisture and turn into liquid droplets, it is reasonable to believe that the crystals are primarily mercury sulfate crystals with various amount of crystalline water. The EDS analysis of the spectrum gives an estimation of 7.89% mercury in the crystal (Figure 4-267).

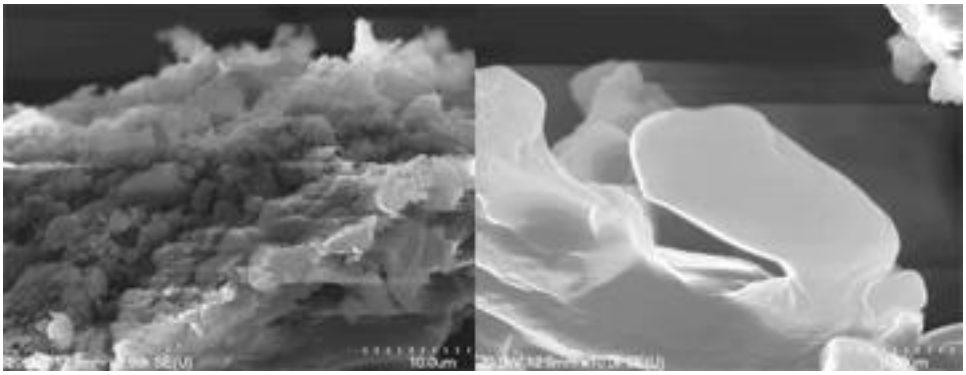


Figure 4-265. SEM Image of the Condensed White Crystals.

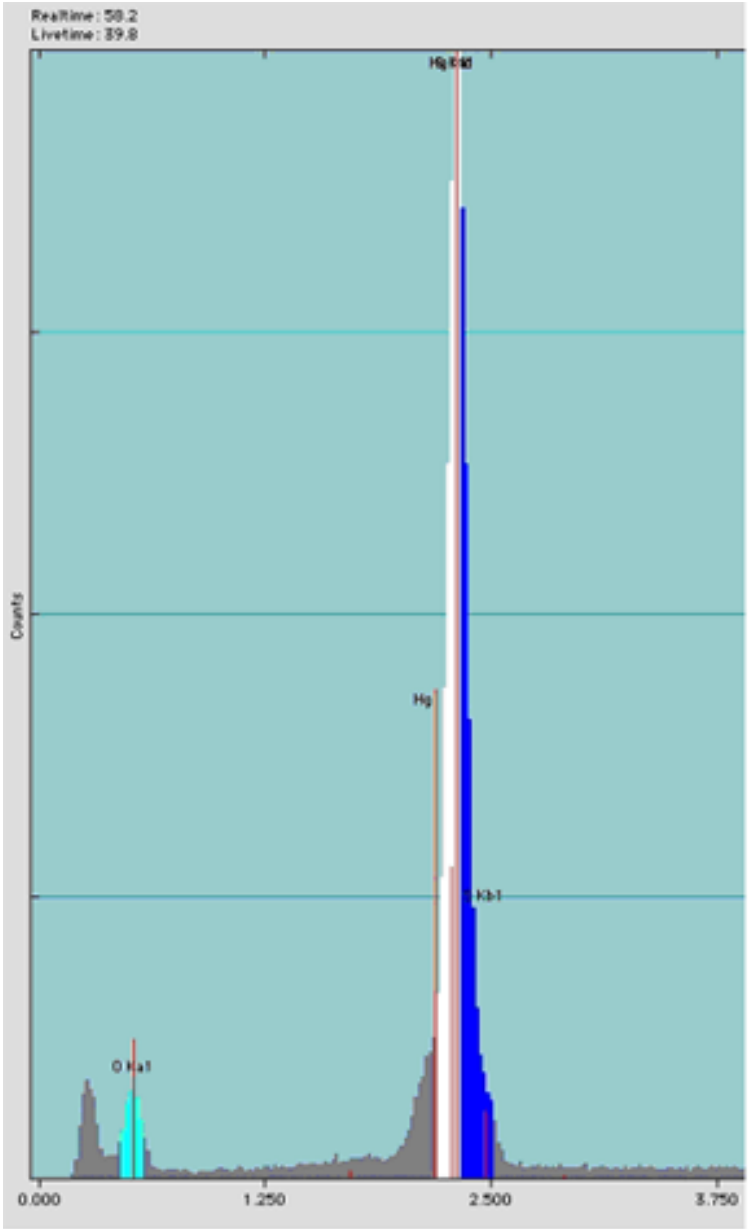


Figure 4-266. EDS Spectrum of the Condensed White Crystals.

Quantitative Results for Spectrum1
Analysis: Bulk Method: Standardless
Acquired 09-Sep-2008, 20.0 KeV @20 eV/channel

Element	Weight %	Std. Dev.	MDL	Atomic %	k-Ratio	Intensities	ROI (gross)
O	21.78	1.34	1.39	37.88	0.1023	1857.6	2230.21
S	70.33	1.81	0.46	61.03	0.6413	29723.5	31232.49
Hg	7.89	1.07	1.29	1.09	0.0784	1955.2	
Total	100.00						

Figure 4-267. EDS Standardless Analysis of the Condensed Crystals.

4.17.1.2.4.3 Mercury Scrubbing without a Condenser

In a separate set of experiments, the gas was bubbled into the scrubbing solution without going through the condenser. The experiments were repeated 8 times. After that, we add 10 grams of $Na_2S{\cdot}9H_2O$ to a beaker contains 100 ml of the original solution (Figure 4-268) and 10 grams of $Na_2S{\cdot}9H_2O$ to a beaker contains 100 ml of the evaporated gas scrubbed solution (Figure 4-268). Dark precipitates were formed from the scrubbed solution. The precipitates were filtered and dried.

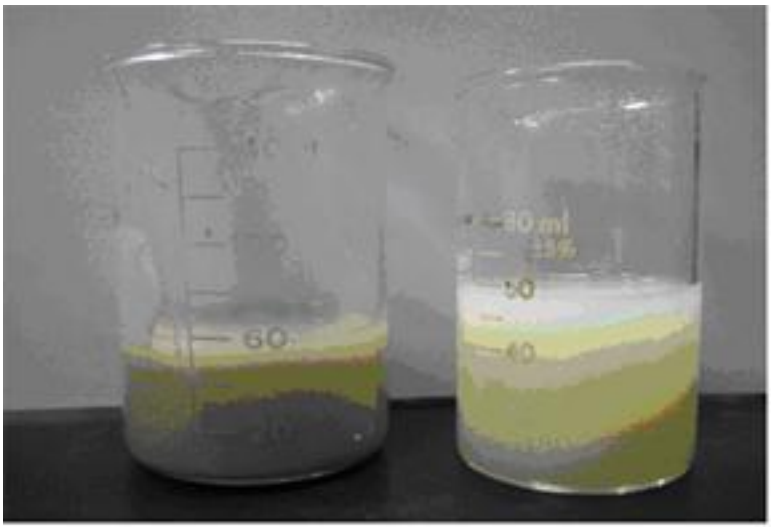


Figure 4-268. (a) The dark precipitates in the scrubbed solution with sodium sulfide addition on the left, and (b) the original solution with the addition of sodium sulfide on the right.

The precipitates are believed to be mercury sulfide (HgS). The reactions in the process are designed by the follows:

$$5Hg+2MnO_4^-+16H^+ \rightarrow 5Hg^{2+}+2Mn^{2+}+8H_2O$$

$$Hg^{2+}+S^{2-} \rightarrow HgS(s)$$

When the mercury in the gas passed through the scrubbing solution, it is oxidized into the soluble divalent mercury and is therefore dissolved in the solution. When sodium sulfide is added into the solution, the divalent mercury ions and the sulfide ions formed insoluble mercury sulfide and precipitates out.

To prove this is what happened, the precipitates were examined under the SEM as well. Figure 4-269 shows the SEM images of the sulfide precipitates. Figure 4-270 shows the EDS spectrum of the precipitates. Only the mercury and sulfur characteristic peaks are dominant. The oxygen peak is very weak. No other elements were found in the spectrum. The precipitates are, therefore, proved to be mercury sulfide. This demonstrates that mercury released from the sorbents in the microwave processing has been successfully scrubbed. An analysis of the EDS spectrum gives an estimation of 23.07% Hg in the precipitates, as shown in Figure 4-271.

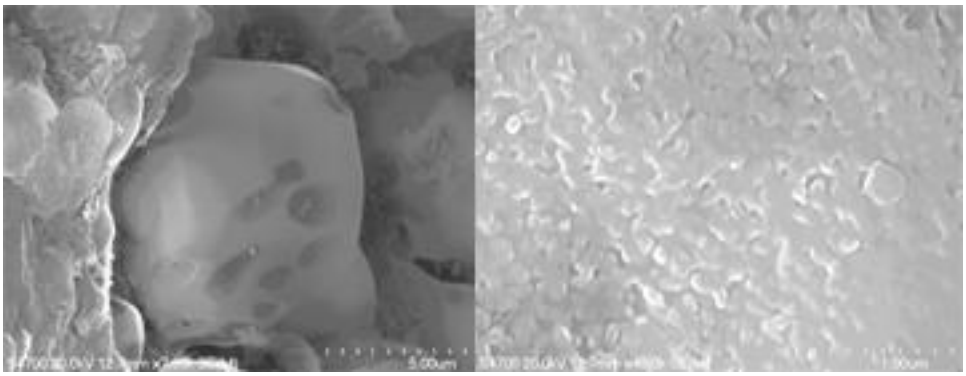


Figure 4-269. SEM Images of the Sulfide Precipitates in the Scrubbed Solution.

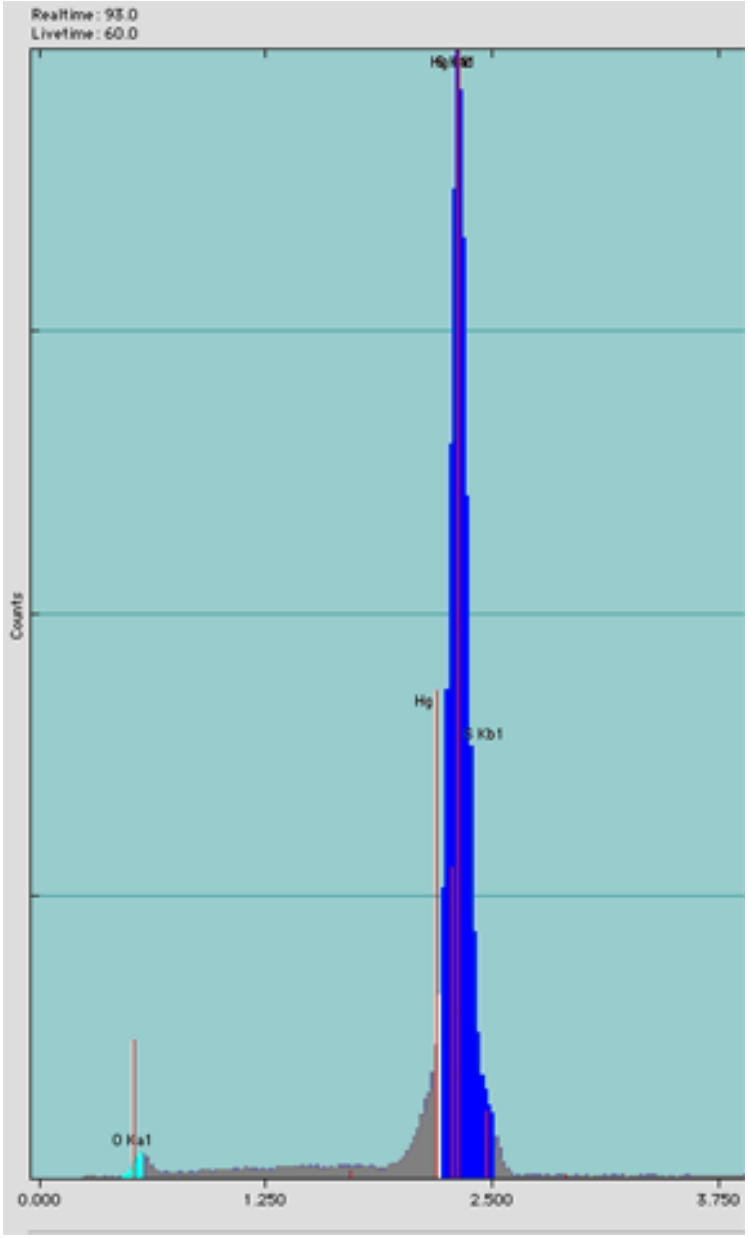


Figure 4-270. Spectrum of the Sulfide Precipitates in the Scrubbed Solution.

Quantitative Results for Spectrum1
Analysis : Bulk Method : Standardless
Acquired 13-Oct-2008, 20.0 KeV @20 eV/channel

Element	Weight %	Std. Dev.	MDL	Atomic %	k-Ratio	Intensities	ROI (gross)
O	4.60	1.13	1.12	10.83	0.0236	925.1	1282.87
S	72.33	1.74	0.16	84.85	0.6266	62313.4	77697.20
Hg	23.07	1.06	1.84	4.33	0.2301	12262.8	
Total	100.00						

Figure 4-271. EDS Standardless Analysis of the Sulfide Precipitates in the Scrubbed Solution.

4.17.1.2.5 Conclusion

In this study, mercury has been successfully evaporated from the sorbents and can be captured. Two products from the consumed sorbents can be obtained: a mercury depleted sorbent material that can be recycled for mercury adsorption and a mercury concentrate, either by condensation as mercury sulfate crystals or by scrubbing and precipitation as mercury sulfide precipitates.

4.17.2 Concrete

4.17.2.1 Introduction

ADA-ES evaluated distinctly different beneficial reuse outlets for the TOXECON™ baghouse ash from PIPP. Both involved the use of the ash in making concrete. The first use was to create electrically conductive concrete by adding high-carbon ash either with or without carbon fibers to enhance the electrical properties. The use of high-carbon fly ash as a method to favorably and inexpensively modify the electrical properties of concrete was initially patented by We Energies in U.S. Patent 6821336 (Ramme et al., 2004). For the second application, ADA-ES developed structural concrete formulations using as high as 30% LOI from PAC that also had stable air entrainment. The effect of carbon on air entrainment has been the major barrier to using PAC-laden ash.

Fly ash is commonly used in numerous applications, primarily as a substitute for Portland cement in concrete manufacturing. In 2007, 31.6 million tons of fly ash were beneficially used, and of that amount 13.6 million tons were used in concrete, concrete products, and/or grout manufacturing. The remainder was used to make flowable fills/embankments, raw feed for clinker, mining applications, waste stabilization, and other applications.

Two classifications of fly ash are produced, depending on the type of coal used. Anthracite and bituminous coal produce Class F ash. Class C fly ash is produced from lignite or subbituminous coal. Fly ash can be cementitious or pozzolanic, or both. Class F fly ash is pozzolanic while Class C ash is cementitious and pozzolanic. Cementitious fly ash hardens when wetted while pozzolanic ash requires a reaction with alkali (lime) before hardening. This is why Class C fly ash is used as a partial cement replacement in making concrete.

Fly ash also affects the plastic properties of concrete by improving workability, reducing water demand, reducing segregation and bleeding, and lowering the heat of hydration. Fly ash also increases strength, reduces permeability, reduces corrosion of reinforcing steel, increases sulfate resistance, and reduces alkali-aggregate reaction.

Full-scale activated carbon injection for mercury control is becoming more common in the utility industry, but this can have a significant impact on ash sales for concrete due to the carbon content. In order to create concrete suitable for exterior structural applications, concrete must be able to withstand multiple freeze-thaw cycles. This freeze-thaw durability is obtained by the introduction of numerous small air bubbles in the concrete. The carbon content of fly ash has a negative effect on most air entrainment additives (AEA), resulting in increased cost for additional chemical and, more importantly, unreliable batching operations, which generates significant material and labor cost increases.

ADA-ES prepared a number of concrete formulations in which the amount of fly ash, additives, and water content were varied. Fly ash used in the formulations was characterized for mercury content using U.S. EPA Method 7473 (Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry) and analyzed for carbon content using ASTM D7348-07 (Standard Test Methods for Loss on Ignition (LOI) of Solid Combustion Residues). While the methodology of the analysis is the same, for the purposes of this report, unburned carbon produced in the combustion process in the boiler will be referred to as “UBC” and the total amount of carbon measured using the LOI test that comes from PAC plus UBC will be referred to as “LOI.”

4.17.2.2 Electrically Conductive Concrete

4.17.2.2.1 Introduction

Discussions between We Energies and ADA-ES regarding the reuse of the TOXECON™ high-carbon ash in concrete revealed that engineers and scientists at We Energies were investigating the use of high-carbon ash for conductive concrete applications. Conductive concrete has been used in heated slabs by inducing a current in the concrete, and for electrical shielding/grounding of structures in the case of lightning strikes.

4.17.2.2.2 Background

ADA-ES reviewed published patents as far back as 1914 to document materials added to concrete to improve durability, workability, strength, and electrical and thermal conductivity. Patent claims in many cases shared similarities with respect to the type of materials used in concrete, with subtle differences in particle size or mixing order that distinguished one invention from another. Patents shared very similar formulations but the application or how the inventions were used varied. The field of use for electrically conductive concrete was diverse with applications to provide heat to a surface, provide electromagnetic shielding and grounding, and serve as a stress/strain sensor.

Patent review revealed overlap and commonalities in the materials used with cement to produce conductive concrete. Iron addition was found in many of the patents examined. Iron in the form of magnetite was described by Haldeman (U.S. 1113555) in 1914 to improve the durability of the concrete with regard to freeze-thaw cycling. Magnetite was added to concrete to improve its electrical conductivity as taught by Greger (U.S. 3121065) and McCormack (U.S. 5346547). Steel shavings and steel fibers were incorporated in concrete by Tuan et al. (U.S. 6825444 B1) to reduce the resistivity of concrete and used in precast cement slabs for heated bridge decking.

Carbon is another additive that has found widespread use in concretes primarily to reduce the resistivity of the material. As early as 1926, Nowotny (U.S. 1582141) combined graphite and coke with cement and a metal oxide (iron or tungsten) to produce electrical elements such as heating devices, rheostats, and starter boxes, while Wilsnack (U.S. 2186792) added carbon black to raw cement clinker not to improve its conductivity but to help disperse and make the cement particles more available for hydration. More recently, Pye et al. (U.S. 6503318) produced low-resistance cement by using two size fractions of coke breeze; a byproduct from the steel industry.

The use of carbon fibers in concrete was investigated by Chung (U.S. 5032181). A patent granted in 1991 related to cement concrete-carbon fiber composites that displayed high tensile and flexural strengths, low electrical resistivity, and high electromagnetic interference

shielding effectiveness. The patent called for the inclusion of carbon fibers in proportions ranging from 0.2% to 2% by weight.

Since the early 1980s the cement industry has blended coal-derived fly ash into concrete as an admixture to extend the quantity of product at a reduced cost (U.S. 4268316). Fly ash used in this manner must meet the requirements set forth in ASTM C618, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete." The requirement of particular importance is the carbon content of the fly ash as measured by loss on ignition (LOI). Fly ash materials with excessively high carbon content (greater than 6% by weight) have not been used by the concrete industry and are considered a waste material that is disposed of in a landfill. However, the use of high-carbon fly ash can reduce the electrical resistance of concrete. In 2002, Ramme et al. (U.S. 6461424) of We Energies were granted a patent for the use of high-carbon fly ash material in concrete to produce electrically conductive concrete. Fly ash material with LOI greater than 12% by weight (and more preferably 30% or greater) is required for conductive formulations. A second patent by Ramme et al. (U.S. 6821336) incorporated carbon fibers in conjunction with high-carbon fly ash, while a third patent by Ramme et al. (U.S. 7578881) describes the use of spent activated carbon sorbent and carbon fibers in electrically conductive concrete formulations.

4.17.2.2.3 Applications

In 1999, the National Research Council of Canada developed and patented conductive concrete formulation (Pye et al. [U.S. 6503318]). Researchers looked at using carbon fibers in concrete formulations to improve its structural integrity. The resulting concrete mix retained its strength after the addition of the carbon fibers and gained the ability to conduct electricity evenly throughout the matrix. A 20-by-80-foot conductive concrete pad was constructed at the National Research Council facility in Ottawa to test the conductive concrete formulation. Up until the time this article was published, the pad had remained free of ice and snow for the first three years of testing.

In March 2003, the first conductive concrete bridge in the world was constructed by the Nebraska Department of Roads in cooperation with the University of Nebraska. The bridge was located on Highway 77, 15 miles south of Lincoln, Nebraska. Formulation of the

concrete was modified to include steel fibers in the mix to increase the conductivity of the concrete. A three-phase, 600 A and 208 V AC power source from a nearby power line was used to energize the conductive concrete. Electrical power was turned on by the controller when the temperature of the slab was below 40 °F and turned off when the temperature was above 55 °F, in order to keep the bridge deck ice-free (Nebraska Department of Roads, 2004).

Electromagnetic shielding and grounding is a passive use of conductive concrete. Applications may include electrical grounding for buildings and towers. Metals are usually used for this purpose. However, the use of conductive concrete to diminish the volume of metal required is attractive for cost reduction. Static charge dissipation is needed for structures that come in contact with sensitive electronic devices. Electrically conductive concrete materials are also attractive for electromagnetic interference (EMI) shielding due to interference of wireless devices. Shielding is particularly needed for underground vaults containing transformers and other electronic equipment relevant to power and telecommunication industries.

4.17.2.2.4 Concrete Formulations

Cured concrete is considered to be a good electrical insulator, possessing a specific resistivity of around 100 ohm-m. Moist concrete has electrolytes present and tends to have a slightly lower resistivity in the range of 2–10 ohm-m. The ability of moist concrete to conduct electricity is likely attributed to the movement of dissolved ions. The movement of electricity through conductive elements such as carbon fibers, high-carbon fly ash, steel shavings, etc., can improve the conductive path in concrete.

The objective of these tests was to determine whether the use of high-carbon TOXECON™ ash to formulate electrically conductive concrete was a viable option for reuse of this material. ADA-ES designed, prepared, and tested several conductive concrete formulations containing both high-carbon fly ash and carbon fibers. As a cooperative effort with the We Energies patent holder Bruce Ramme, ADA-ES developed conductive concrete formulations to test the PAC-laden TOXECON™ ash for enhancing the electrical properties of concrete.

ADA-ES prepared a number of concrete formulations in which the amount of fly ash, carbon fiber, and water content were varied. Fly ash used in the formulations was characterized for mercury content using U.S. EPA Method 7473 ("Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry") and analyzed for carbon content using ASTM D7348-07 ("Standard Test Methods for Loss on Ignition (LOI) of Solid Combustion Residues"). While the methodologies of the analysis are the same, for the purposes of this report, unburned carbon produced in the combustion process in the boiler will be referred to as "UBC" and the fraction of the LOI value that comes from PAC injection will be referred to as "LOI." For most of these tests, the contribution of UBC was very low in both amount and electrical conductivity. Table 4-143 shows the range of formulations tested. These values are the percentage of each item in the wet concrete mixture.

Table 4-143. Conductive Concrete Formulation Ranges.

Name	Minimum (wt %)	Maximum (wt %)
Cementitious Material		
Cement	7	12
Class C Fly Ash	3	10
Aggregate		
Coarse (Rock)	37	47
Fine (Sand)	29	36
Electrical Elements		
Carbon Fiber	0	1
Carbon from Fly Ash	0	4
Water	7	10

Formulations were made to meet the standard Department of Transportation (DOT) 4500 psi design specification. The levels of fly ash replacement varied, and a standard local blend of coarse and fine aggregate was used. The water–cement ratios tested in the various formulations ranged between 0.35 and 0.65. When calculating water–cement ratio, it was

important to take into account all of the cementitious material (cement plus fly ash). By weight, 0% to 1% was composed of carbon fiber elements. These concentrations were selected based on information provided by the patents holders. The more carbon fiber added, the more conductive the concrete becomes.

4.17.2.2.5 Cylinder Formation

Each formulation was prepared using a standard concrete mixer typically used on small-scale construction projects. Test samples were prepared by pouring wet concrete into 4-inch diameter by 8-inch long cylindrical plastic containers. These cylinders were the same ones often used in the concrete industry for compressive strength testing. After the concrete cured in the containers, the plastic was removed. Copper plates were attached to the ends of the concrete cylinders using a conductive adhesive developed by ADA-ES. Commercial wire glue was tested initially, but the cylinders did not adhere to the plates reliably. For the adhesive to work properly, it was important that it have the properties of low electrical resistance and the ability to bond both a smooth copper plate and the uneven and pocked surface of the concrete cylinders. ADA-ES thoroughly tested its adhesive to ensure it could pass charge effectively. From each of the end plates, wires were attached to allow connection to the cylinder to either AC or DC power sources or a signal generator for high-frequency tests (Figure 4-272).

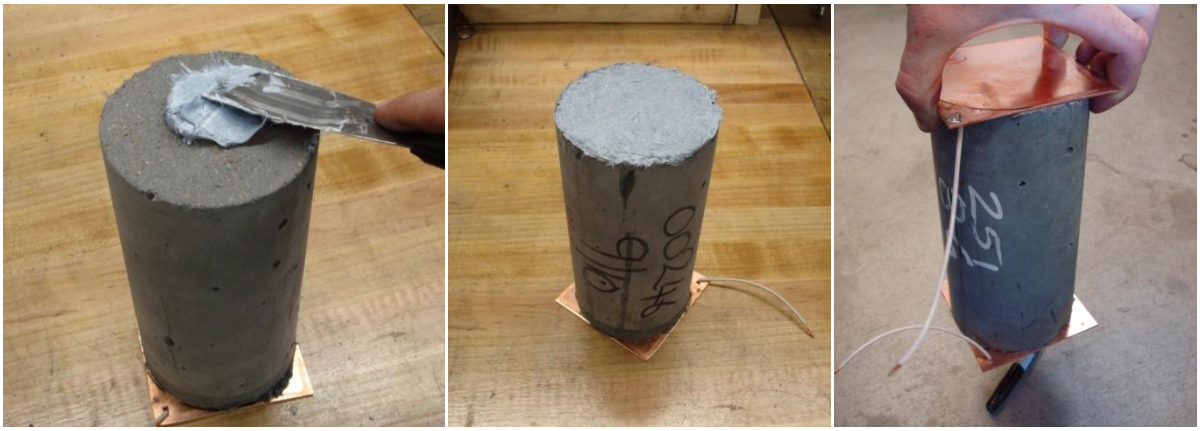


Figure 4-272. Conductive Adhesive.

4.17.2.2.6 Direct Current and Alternating Current Testing

Concrete cylinders were tested for electrical properties using direct current (DC) and alternating current (AC). As depicted in Figure 4-273, the DC tests used a standard direct current power supply connected in series to the test cylinder. During testing, voltage was increased incrementally during which the voltage and current levels were recorded (Figure 4-274). In a similar manner, the AC voltage was incrementally increased using an AC variac. Current and voltage drop across the cylinder were measured at each applied voltage. For the AC tests will be held at 60 Hz. Using Ohm's Law (voltage and current relationship), the resistance and specific resistance for each formulation was calculated and plotted from the DC and AC data.

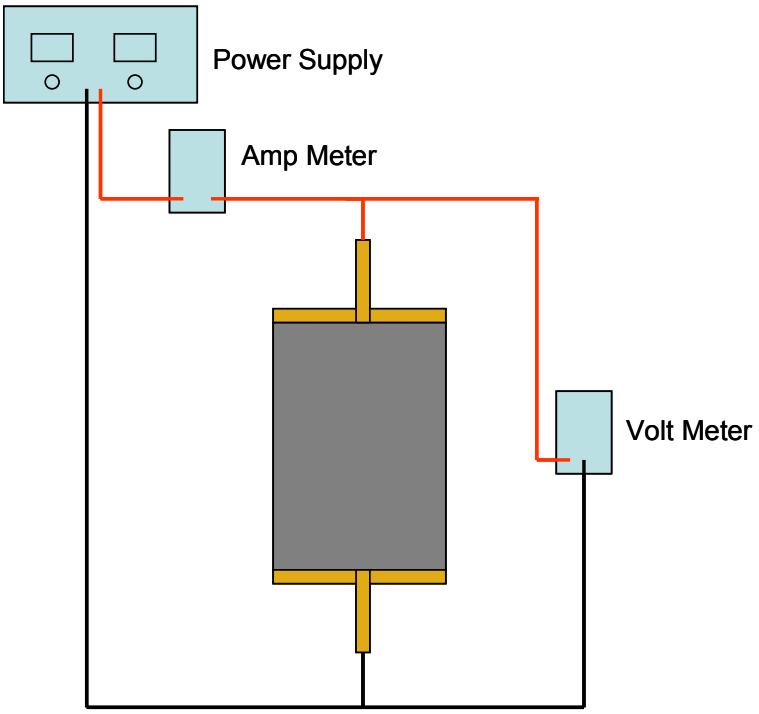


Figure 4-273. Electrical Test Wiring Schematic.

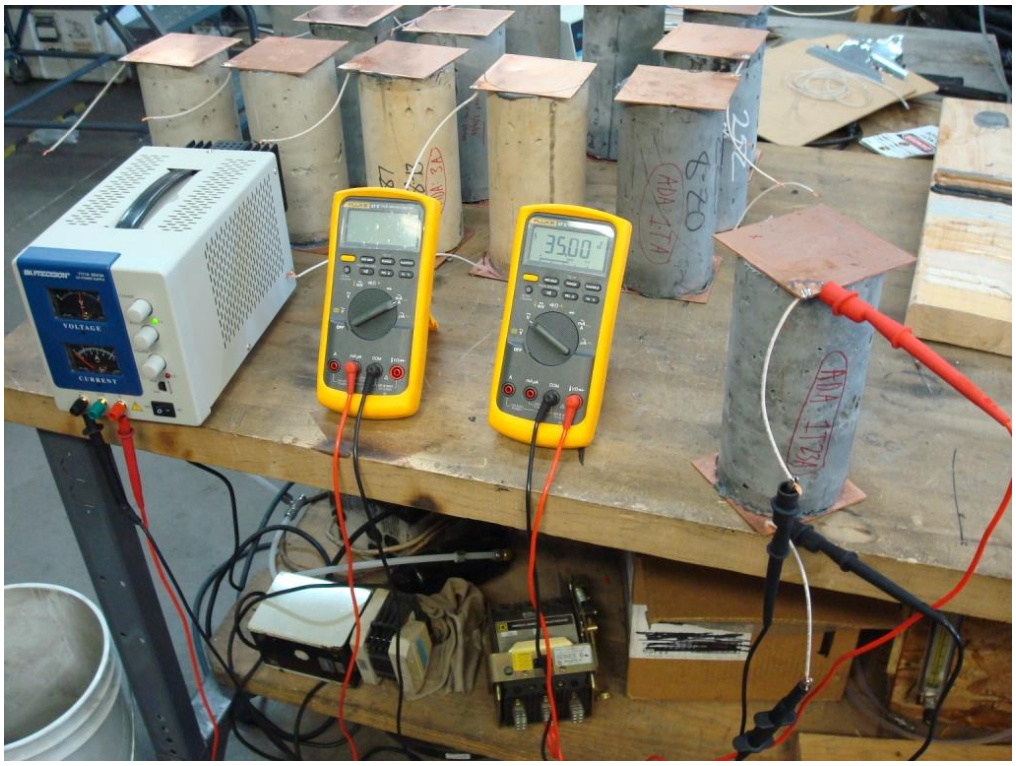


Figure 4-274. DC Electrical Test Set-Up.

The resistance and specific resistance of each formulation was calculated from the test data. Resistance was calculated using Ohm's Law. Ohm's Law states that an applied voltage and resulting current are related by a proportionality constant or resistance. Specific resistance expressed as ohm-cm takes into account electrode geometry, current path, as well as the length of the concrete test cell.

Equation 1. Ohm's Law $$R = \frac{V}{I}$$

Equation 2. Specific Resistance $$\rho = \frac{R_S * A}{l}$$

R is resistance; ohm

V is applied voltage; volts

I is the resulting current; amps

ρ is the specific resistance; ohm-m

A is the area of electrode; m^2

l is the distance between electrodes; m

4.17.2.2.7 High-Frequency Tests

Concrete specimens were tested for electrical properties using alternating currents through a wide range of frequencies. The purpose of this regimen was to investigate the charge-carrying capacity of the concrete under varying frequency, similar to what might occur during a lightning strike. During these tests, a signal generator was connected to the various concrete specimens. The frequency was varied on an incremental basis. At each increment, the voltage of both the concrete sample and the test circuit were recorded. The test circuit had a known resistance value and was calibrated with a known high-ohm load (precision resistor) in place of the concrete sample (Figure 4-275). The purpose of adding a precision resistor in series with the cylinder was to decrease the potential error introduced at higher frequencies. Using the voltage and current relationships, the resistance and specific resistance for each formulation was calculated and plotted.

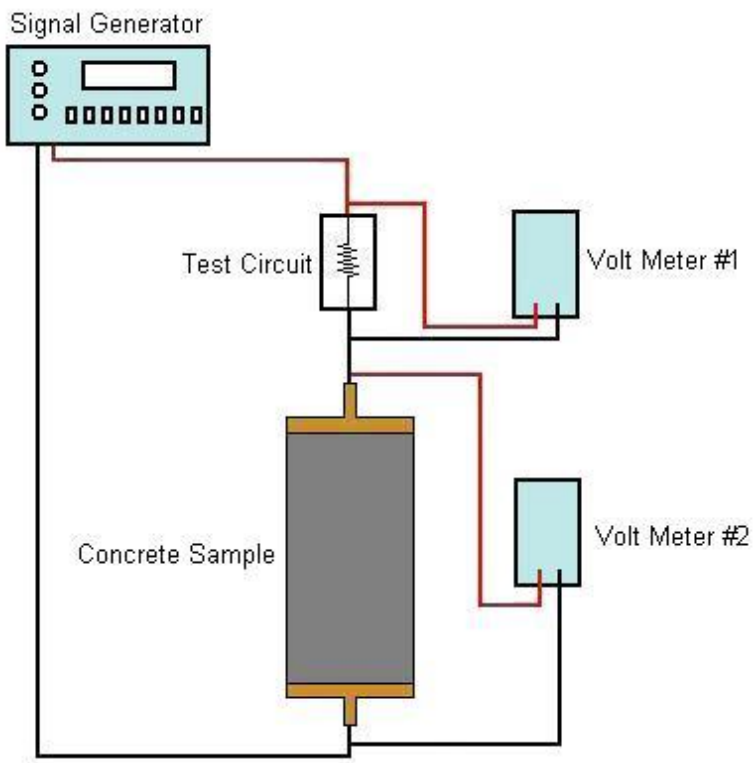


Figure 4-275. High-Frequency Test Wiring Schematic.

Typically, impedance is measured in high-frequency testing. Impedance is a measurement of opposition to an alternating current. Impedance expands on the concept of resistance in AC

circuits, describing the amplitude of the voltage and current as well as the phase. Because ADA-ES did not have an oscilloscope on hand, and the electrical properties of the concrete cylinders were unknown and it was not well understood how the cylinders would behave at high frequencies, ADA-ES decided to calculate the impedance/resistance of the concrete using Equation 3.

The resistance and specific resistance of each formulation was calculated from the test data. Resistance was calculated using Kirchhoff's Current Law, which states that all elements in series have identical currents. Because the current was constant in the total circuit, the resistance of the test circuit was known, and the voltage readings from the concrete sample and test circuit were known, a proportionality was established between the concrete sample resistance and the test circuit resistance. Once the resistance of the concrete sample was obtained, the specific resistance was expressed in terms of ohm-m. This measurement takes into account electrode geometry and current path length of the conductivity cell.

Equation 3. Proportionality Equation using Kirchhoff's Current Law

$$\boldsymbol{R_s = \frac{V_s * R_c}{V_c}}$$

Equation 4. Specific Resistance

$$\boldsymbol{\rho = \frac{R_s * A}{l}}$$

$\boldsymbol{R_s}$ is resistance of the concrete sample; ohm

$\boldsymbol{R_c}$ is resistance of the test circuit; ohm

$\boldsymbol{V_s}$ is voltage of the concrete sample; volts

$\boldsymbol{V_c}$ is voltage of the test circuit; volts

$\boldsymbol{\rho}$ is the specific resistance; ohm-m

$\boldsymbol{A}$ is the area of electrode; m^2

$\boldsymbol{l}$ is the distance between electrodes; m

4.17.2.2.8 Test Results

Concrete resistivity correlated well to the water-cement ratio, the amount of conductive elements such as carbon fibers, and the amount of fly ash used in the formulation. These correlations were proved to be relatively similar for the various tests run on the concrete

using DC, AC, and high frequency. In general, these results indicated that the conductive concrete formulations would be a viable option for EM grounding applications.

4.17.2.2.8.1 DC and AC Results

Table 4-144 shows the proportionality between the DC and AC resistances and the water-cement ratio of the concrete. From this relationship it was noted that the response of the AC and DC current were similar. Measurement data from the DC and AC tests are shown in Figure 4-276 and Figure 4-277. While the results of both graphs show the same general trend, the data collected during DC testing shows better correlation than the AC test results. As previously mentioned, Figure 4-276 also shows that the addition of carbon fibers lowers the resistance of the concrete cylinder (sample ITA-CF).

Table 4-144. Thirty Percent LOI W/C Ratio versus Resistance Data.

Mix No.	Mix Date	Fly Ash Source	Fly Ash Replacement %	LOI %	W/C Ratio	DC Resistance (Ω)	AC Resistance (Ω)
1TF	8/12/2008	TOX	28.4	30	0.39	8,891	6,997
1TG	8/13/2008	TOX	28.4	30	0.42	7,435	5,811
1TA	6/25/2008	TOX	28.4	30	0.5	5,971	8,079
1TA-CF	7/22/2008	TOX	28.4	30	0.53	2,661	2,431
1TD	7/31/2008	TOX	28.4	30	0.54	5,738	4,678

Notes: TOX denotes PIPP TOXECON™ ash.

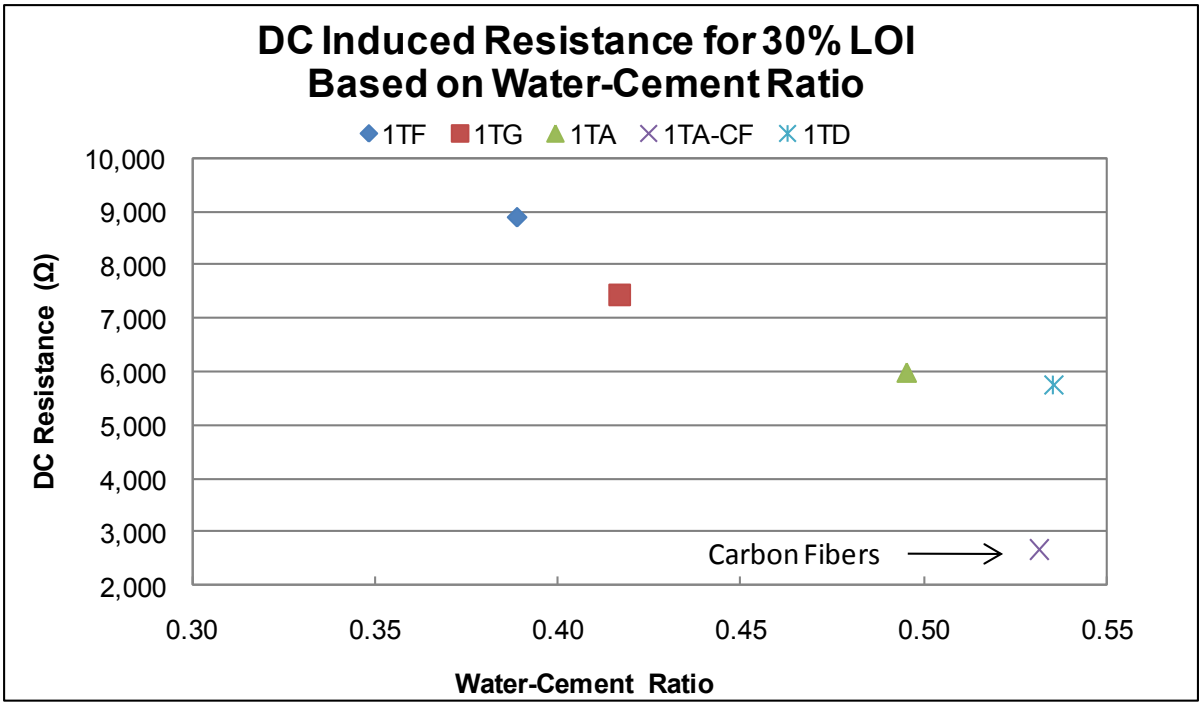


Figure 4-276. W/C Ratio versus DC Resistance.

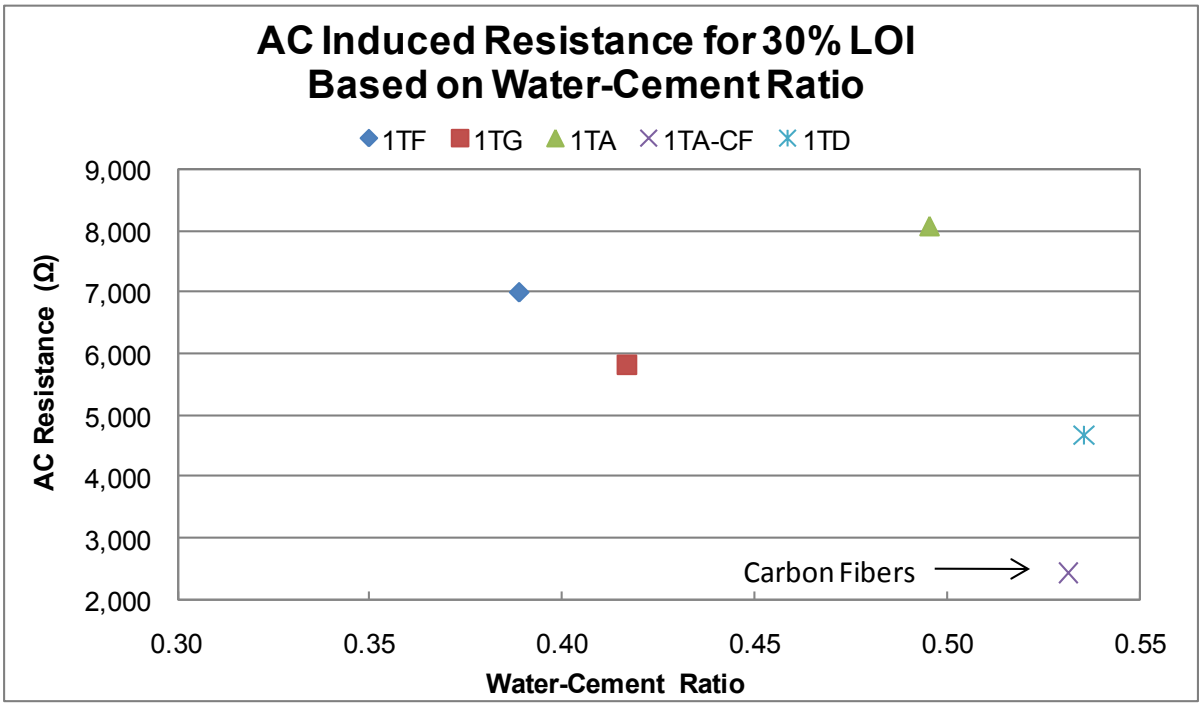


Figure 4-277. W/C Ratio versus AC Resistance.

To further illustrate the effect of water present in the concrete and its effect on resistivity, when concrete has finished hydrating and has cured to 90% of its final strength

(approximately 28 days) the sample becomes much less conductive. This effect was clearly observed in the data presented in Table 4-145. Three cylinders were tested for resistance in September 2008 and again in July 2009. The cylinders were stored at room temperature.

As concrete cured, it tended to lose water from its internal pores, thereby increasing its overall electrical resistance. While pure water and air are both considered to be insulators, water with dissolved salts from the concrete chemicals, fly ash, and PAC pass charge easily. Since current follows the path of least resistance, as concrete cured and free water was taken up in the hydration reaction, the conductive pathways were reduced. This resulted in a dramatic increase in the resistance as shown in Table 4-145. From the time these cylinders were initially tested in September 2008 to when they were retested in July 2009, the resistance increased dramatically. The change in resistance can be attributed to the cylinders losing moisture because they were maintained in a relatively dry environment.

The trend in resistance in this table shows a steady increase with respect to voltage for the tests done in July. This can be largely attributed to the fact that the current level is nearly zero, making the resistance value very high, and introducing error in the calculation. This low current does illustrate the fact that as water leaves the concrete, the concrete become less conductive, but the resistance values are approximations only. This effect could be a problem in dry environments such as deserts where background moisture is low.

It should also be noted that the carbon fiber samples performed better in both cases. Maximizing the particle-to-particle contact of conductive elements such as carbon particles and carbon fibers is essential in passing a charge effectively. Carbon fibers also help bridge the inevitable micro-cracks in the concrete matrix, thereby decreasing the overall resistance.

Table 4-145. Moist Concrete versus Dry Concrete.

September 2008

Sample:	ADA #	1T23A
Voltage (V)	Current (mA)	Resistance (Ω)
5.0	0.70	7,143
10.0	1.39	7,194
15.0	2.08	7,212
20.0	2.77	7,220
30.0	4.14	7,246
40.0	5.48	7,299
50.0	6.80	7,353
60.0	8.13	7,380
	Average	7,268

July 2009

Sample:	ADA #	1T23A
Voltage (V)	Current (mA)	Resistance (Ω)
5.0	0.02	250,000
10.0	0.01	1,000,000
15.0	0.01	1,500,000
20.0	0.01	2,000,000
30.0	0.00	30,000,000
40.0	0.00	40,000,000
50.0	0.00	50,000,000
60.0	0.00	60,000,000
	Average	26,854,167

September 2008

Sample:	ADA #	1TF
Voltage (V)	Current (mA)	Resistance (Ω)
5.0	0.48	10,417
10.0	1.03	9,709
15.0	1.63	9,202
20.0	2.25	8,889
30.0	3.52	8,523
40.0	4.79	8,351
50.0	6.05	8,264
60.0	7.25	8,276
	Average	8,774

July 2009

Sample:	ADA #	1TF
Voltage (V)	Current (mA)	Resistance (Ω)
5.0	0.02	250,000
10.0	0.01	1,000,000
15.0	0.01	1,500,000
20.0	0.01	2,000,000
30.0	0.00	30,000,000
40.0	0.00	40,000,000
50.0	0.00	50,000,000
60.0	0.00	60,000,000
	Average	28,729,167

September 2008

Sample:	ADA #	1T23A-
Voltage (V)	Current (mA)	Resistance (Ω)
5.0	0.63	7,937
10.0	1.33	7,519
15.0	2.02	7,426
20.0	2.75	7,273
30.0	4.24	7,075
40.0	5.76	6,944
50.0	7.28	6,868
60.0	8.79	6,826
	Average	7,147

July 2009

Sample:	ADA #	1T23A-CF
Voltage (V)	Current (mA)	Resistance (Ω)
5.0	0.03	166,667
10.0	0.03	333,333
15.0	0.03	500,000
20.0	0.03	666,667
30.0	0.04	750,000
40.0	0.05	800,000
50.0	0.05	1,000,000
60.0	0.06	1,000,000
	Average	728,472

There also seems to be a relationship between the resistance of the concrete and the amount of Class C (non-carbon) fly ash in the formulation (Figure 4-278). These samples were made using the ESP ash from PIPP and contained a consistent concentration of UBCs. Concrete resistance was plotted against the other major variable, W/C ratio. This figure suggests that a higher fly ash replacement results in higher resistance of the concrete. This trend is expected based on the higher resistivity of the fly ash when compared to that of cement.

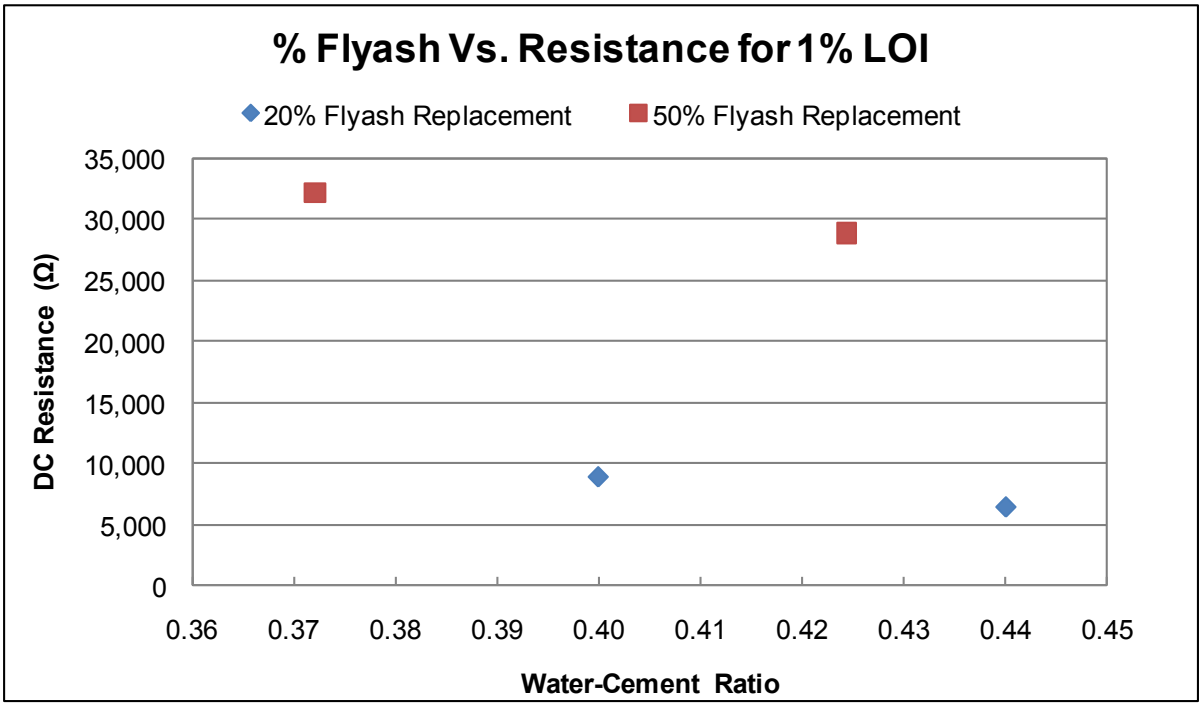


Figure 4-278. Percent Fly Ash Replacement to DC Resistance, Units 7–9 Ash.

4.17.2.2.8.2 High Frequency Results

It was originally anticipated that a 10Ω precision resistor in the test circuit would be sufficient setting up the proportionality between the concrete cylinder and the test circuit as laid out in Equation 3. After a number of tests, it was observed that this resistance was not great enough to achieve the clarity desired for these tests. The first set of results, with a 10Ω precision resistor, is shown in Figure 4-279. The same measurements, shown with a 100Ω precision resistor, are shown in Figure 4-280. As seen by the difference between these figures, the signal clarity increased greatly with the 100Ω precision resistor.

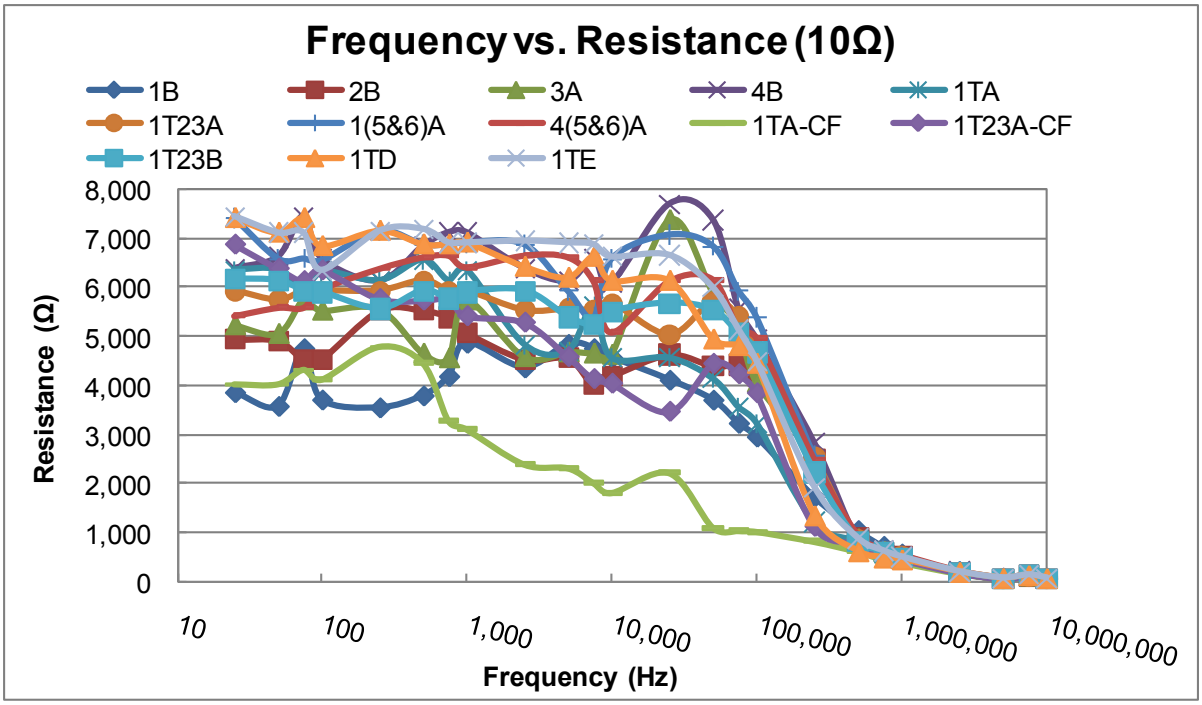


Figure 4-279. Frequency versus Resistance for a 10Ω Test Circuit.

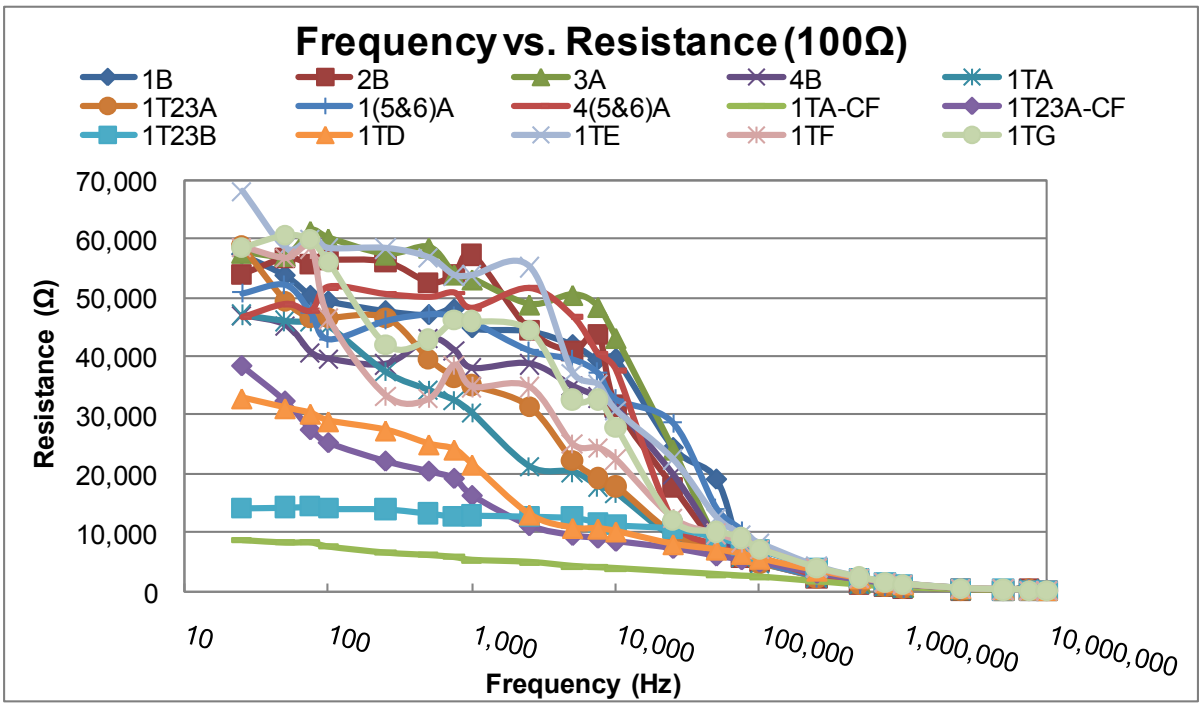


Figure 4-280. Frequency versus Resistance for a 100Ω Test Circuit.

Since a multimeter was used in lieu of an oscilloscope, it was not possible to achieve as high a frequency as would have otherwise been possible. It should be noted that this multimeter

model has an accuracy of only ± 2% from 1 kHz to 20 kHz (AC voltage). Above 20 kHz, the unit is not rated because the manufacture does not test its multimeters above this frequency.

Kirchhoff's Current Law states that all elements in series have identical currents. Therefore, it can be determined that when the current begins to change, the impedance of the measuring device is not sufficiently high enough to measure the voltage across the concrete cylinder. By plotting the current versus a frequency, it can be seen where the current begins to change, thereby making the data less accurate (Figure 4-281 and Figure 4-282).

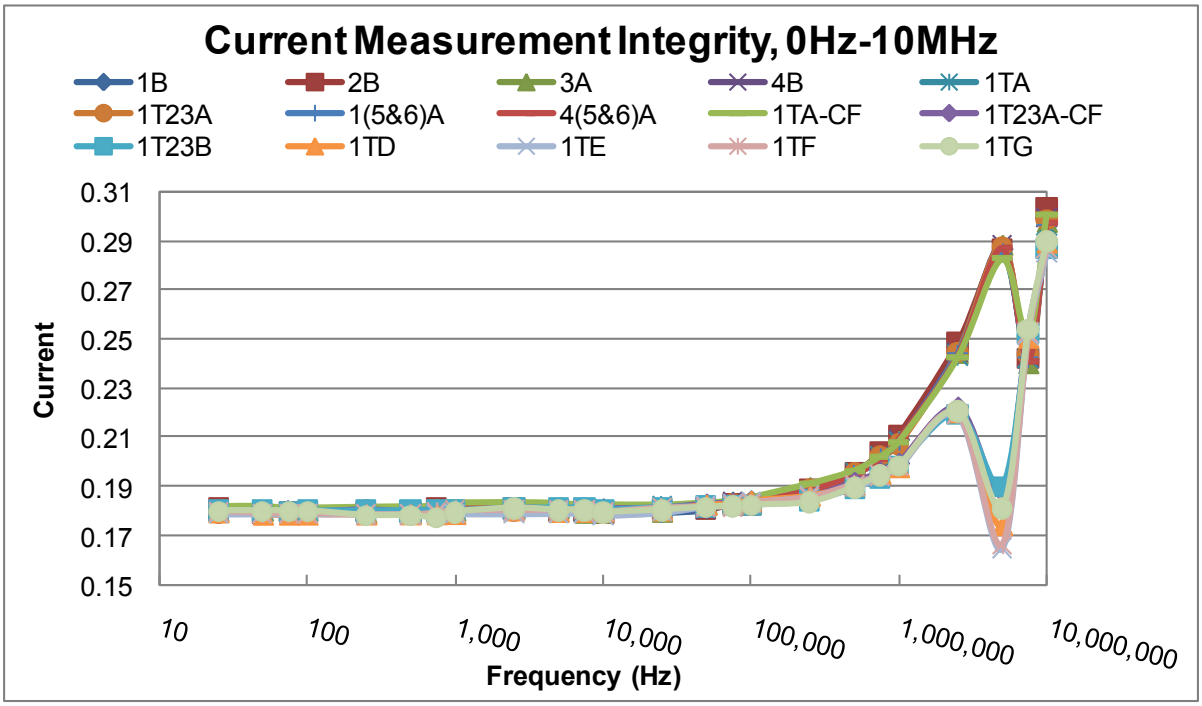


Figure 4-281. System Calibration/Measurement Integrity.

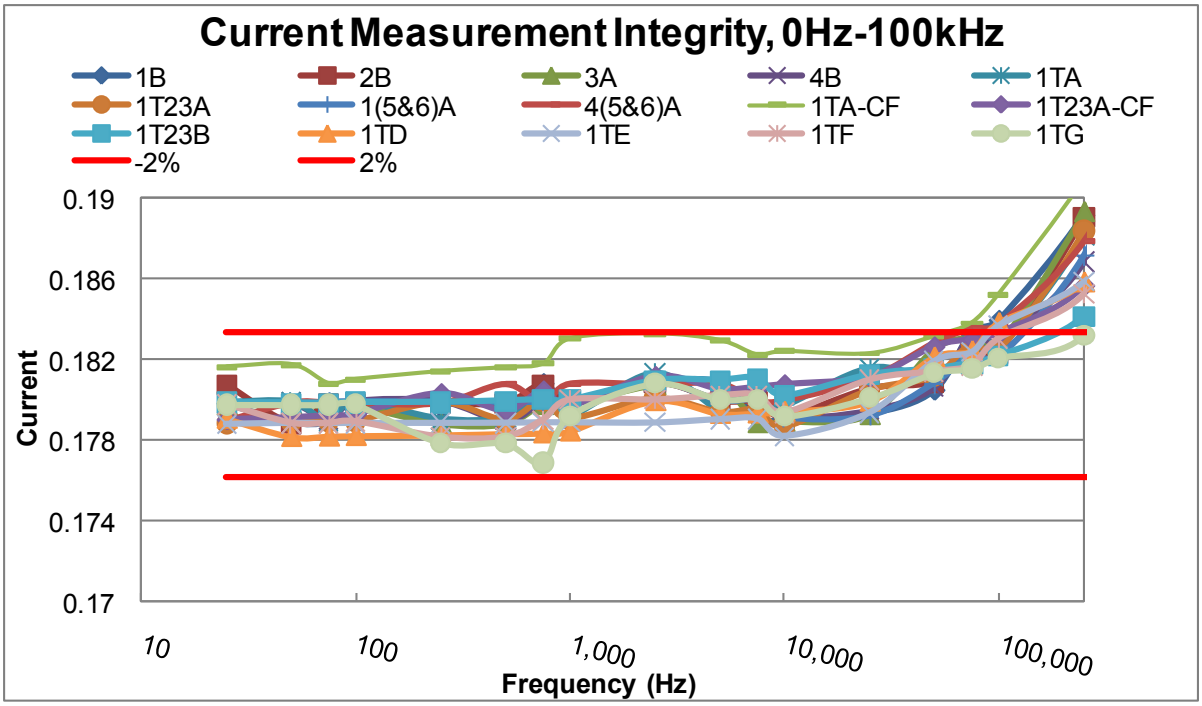


Figure 4-282. System Calibration/Measurement Integrity with ± 2% Error Band.

It can be seen that the current begins to change at about 25 kHz to 50 kHz, but does not leave the ± 2% error band until about 100 kHz. Because the multimeters used for this measurement have a ± 2% error up to 20 kHz, it was decided to use 20 kHz as the upper threshold for valid data. This upper frequency threshold in combination with a 100Ω test circuit provided a clear and accurate data set, and can be seen in Figure 4-283.

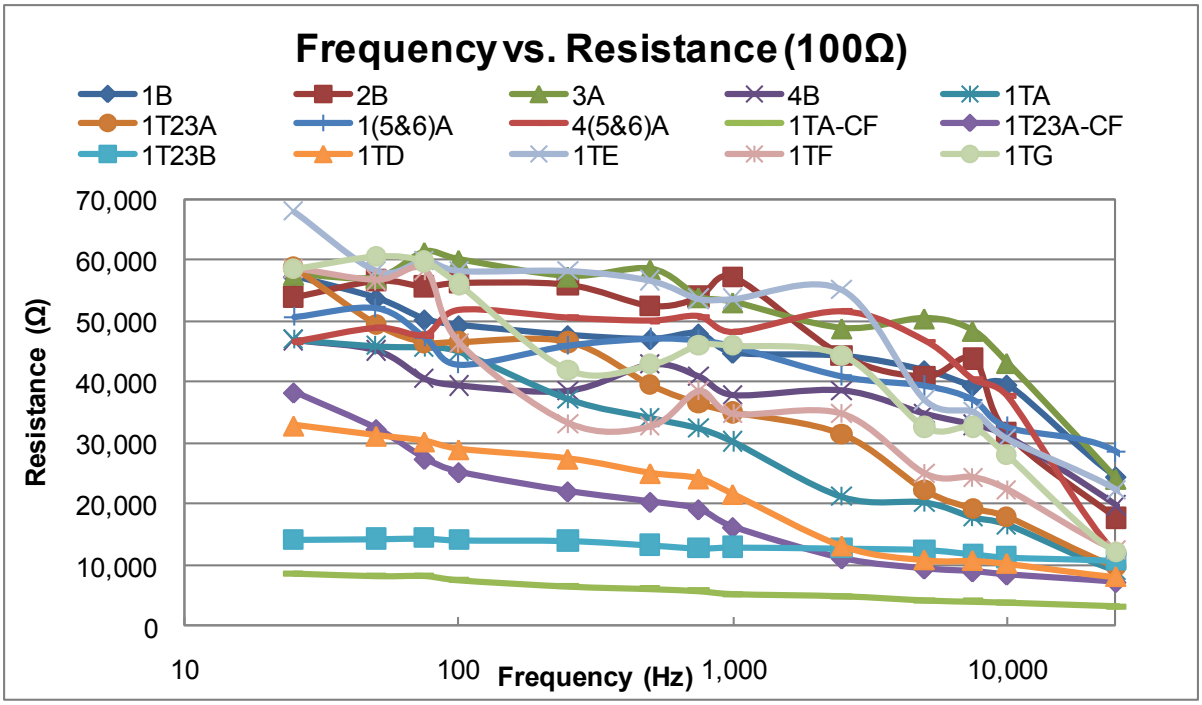


Figure 4-283. Frequency versus Resistance for a 100Ω Test Circuit 0 Hz–25 kHz.

There were a couple of items of interest that were observed during high-frequency testing. Many of the correlations made during the DC and AC tests were repeated in the high-frequency test. These observations included the correlation between resistance and water cement ratio, as well as the fly ash replacement percentage to the overall resistance. It can also be seen that as frequency increases the resistance or impedance decreases. These trends are shown in the following graphs.

Results from cylinders made with low-carbon ash from the ESPs are shown in Table 4-146 and Figure 4-284. The samples do not show any noticeable correlation between water-cement ratio and resistance or fly ash replacement to overall resistance. This might be due to the age of the samples. If the hydration process has completed and the samples have dried, it has been shown that water-cement ratio has less effect. It can also be seen that the impedance does not significantly change until above 10 kHz.

Table 4-146. High-Frequency 1.0% LOI.

Mix No.	Mix Date	Fly Ash Source	Fly Ash Replacement %	LOI %	W/C Ratio
4B	6/18/2008	ESP Units 7–9	50.0	1.0	0.37
1B	6/10/2008	ESP Units 7–9	20.0	1.0	0.40
3A	6/18/2008	ESP Units 7–9	50.0	1.0	0.42
2B	6/17/2008	ESP Units 7–9	20.0	1.0	0.44

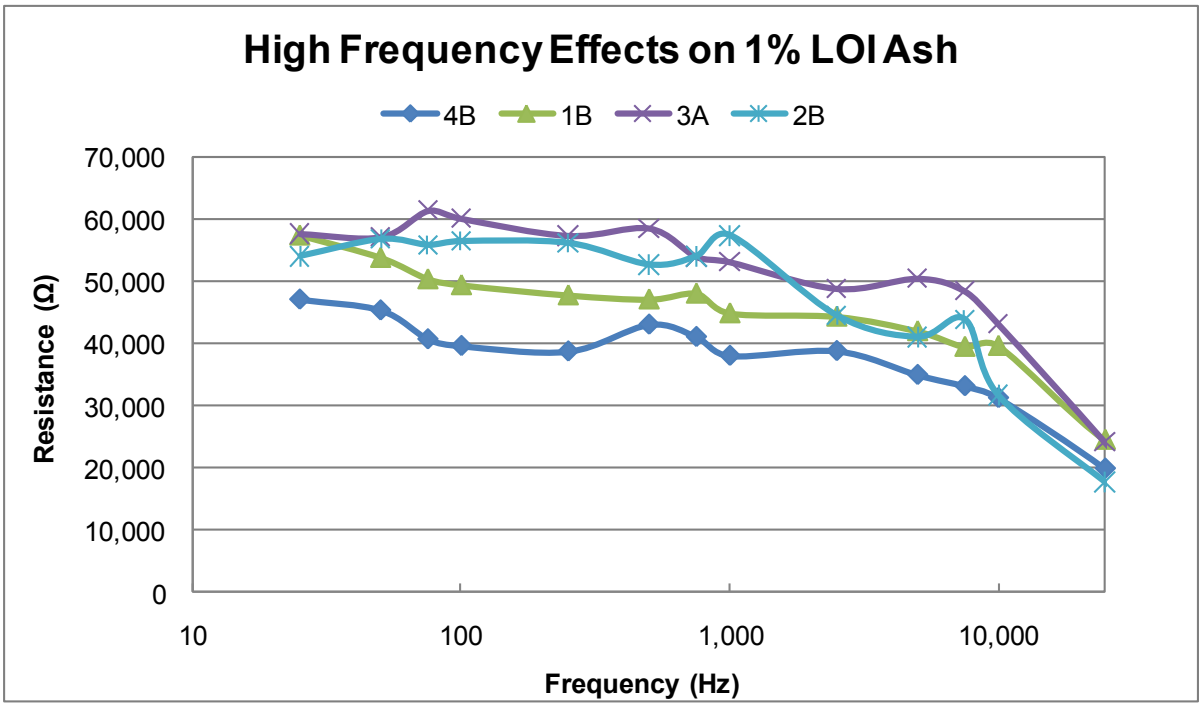


Figure 4-284. High-Frequency 1.0% LOI.

The following samples were created with 23% LOI fly ash from either the TOXECON™ blend or the Class F fly ash from Units 5 and 6. In Table 4-147 and Figure 4-285, the data show that as frequency increased the resistance of the samples decreased. The samples also showed significant correlations with fly ash replacement and W/C ratio to the overall resistance. The W/C ratio varied as well. In general, the data are very similar to the DC and AC tests. In Figure 4-285, the red square symbol is the carbon fiber concrete sample and the (purple) 'X' symbol is a sample that has the lowest fly ash replacement value while

maintaining a high W/C ratio. The light blue star symbol is the sample with the highest W/C ratio but also has the highest fly ash replacement, which is why it had poor resistance values.

Table 4-147. High-Frequency 23.0% LOI.

Mix No.	Mix Date	Fly Ash Source	Fly Ash Replacement %	LOI %	W/C Ratio
1T23A	7/9/2008	TOXECON™	25.7	23.0	0.37
1(5 and 6)A	7/15/2008	Units 5 and 6	28.5	23.0	0.38
1T23A-CF	7/22/2008	TOXECON™	25.7	23.0	0.40
1T23B	7/30/2008	TOXECON™	25.7	23.0	0.57
4(5 and 6)A	7/16/2008	Units 5 and 6	56.6	23.0	0.69

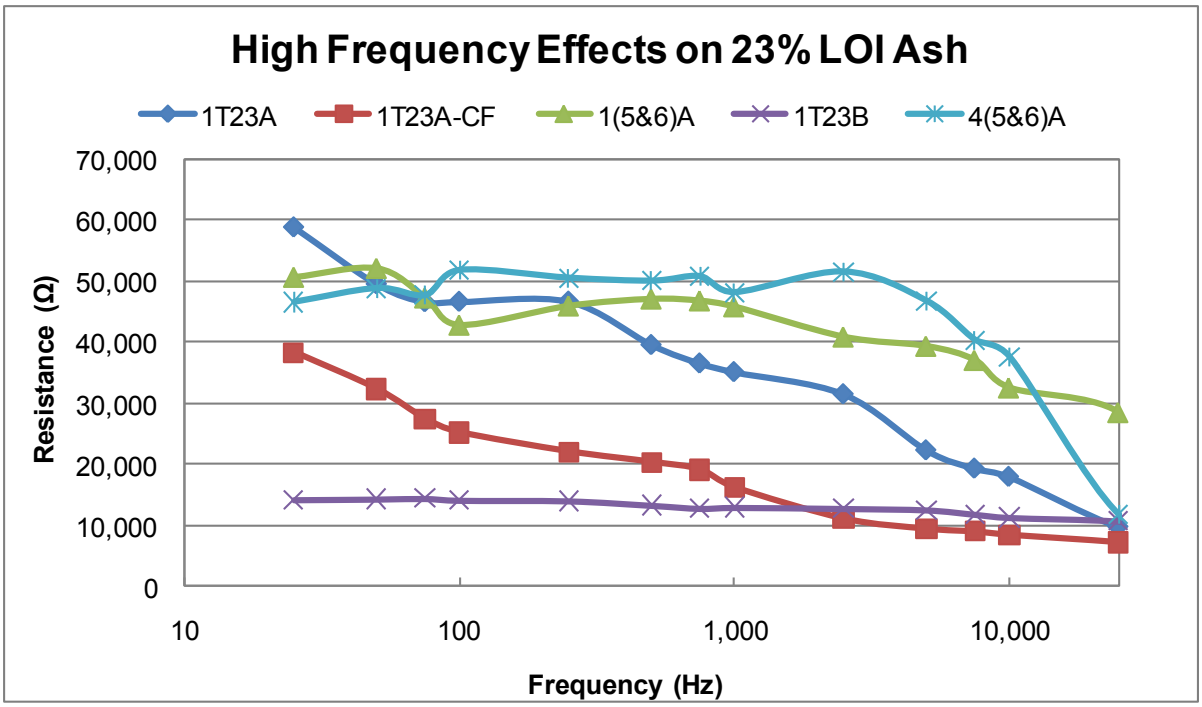


Figure 4-285. High-Frequency 23.0% LOI.

The following results were from concrete samples made with 30% LOI fly ash from the TOXECON™ baghouse at a 28.4% cementitious replacement. The only variables were the frequency and the W/C ratio. The data represent the general correlations between resistance and W/C ratio. The carbon fiber sample with the red squares again has the best resistance at any given frequency. It can also be noted that as the frequency increases, the resistance of

the samples decreases. As observed in Table 4-148 and Figure 4-286, this is a fairly linear relationship.

Table 4-148. High-Frequency 30.0% LOI.

Mix No.	Mix Date	Fly Ash Source	Fly Ash Replacement %	LOI %	W/C Ratio
1TF	8/12/2008	TOXECON™	28.4	30.0	0.39
1TG	8/13/2008	TOXECON™	28.4	30.0	0.42
1TA	6/25/2008	TOXECON™	28.4	30.0	0.50
1TA-CF	7/22/2008	TOXECON™	28.4	30.0	0.53
1TD	7/31/2008	TOXECON™	28.4	30.0	0.54

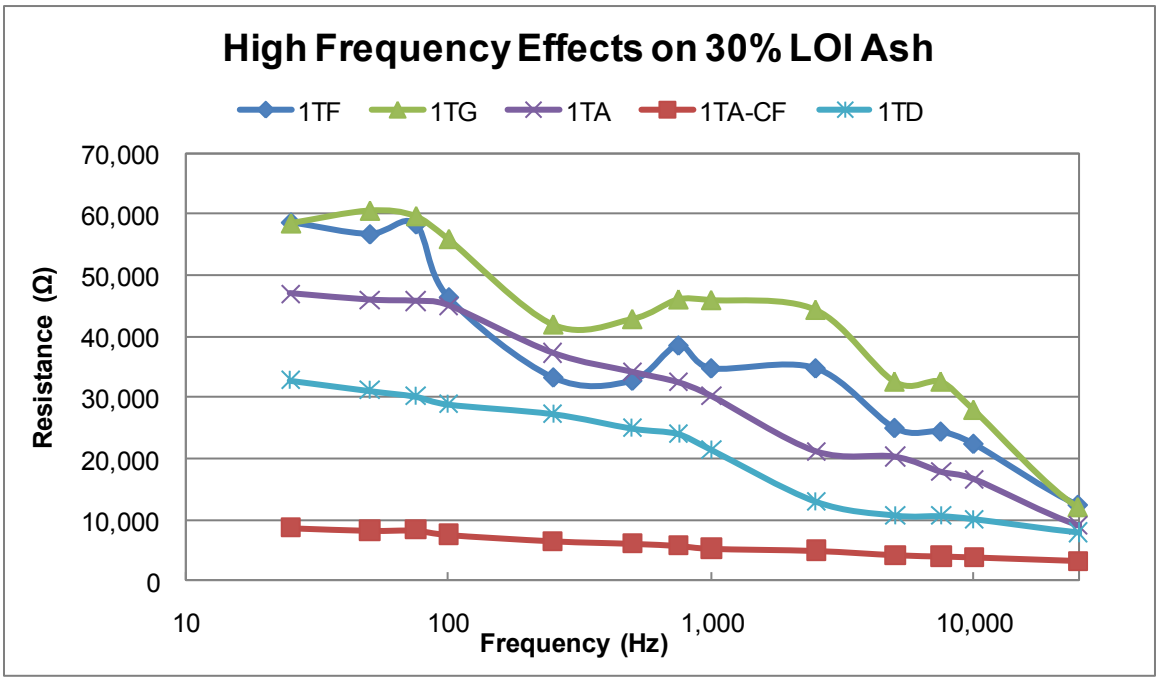


Figure 4-286. High-Frequency 30.0% LOI.

4.17.2.2.8.3 High-Frequency Testing Recommendations

After completing all high-frequency tests and reviewing the data, it became clear that a different circuit setup would have provided better information. The purpose of adding a precision resistor in series with the cylinder was to decrease the potential error introduced through impedance at higher frequencies. A Fluke multimeter was used in lieu of an oscilloscope. This setup was used because directly measuring the resistance of the concrete

cylinder was not possible with the equipment available. As noted earlier, this multimeter model had an accuracy of only ± 2% from 1 kHz to 20 kHz (AC voltage). Above 20 kHz, the unit was not rated since the manufacturer did not test their multimeters above this frequency. Accuracy decreases in measuring voltage as frequency increases because of the affect of increasing internal impedance in the multimeter.

To avoid this effect, a circuit setup as depicted in Figure 4-287 is recommended. This circumvents the challenge of impedance being generated in the multimeter by measuring current rather than voltage, which allows more accurate measurements. However, using a high-impedance device such as an oscilloscope is most certainly the best option.

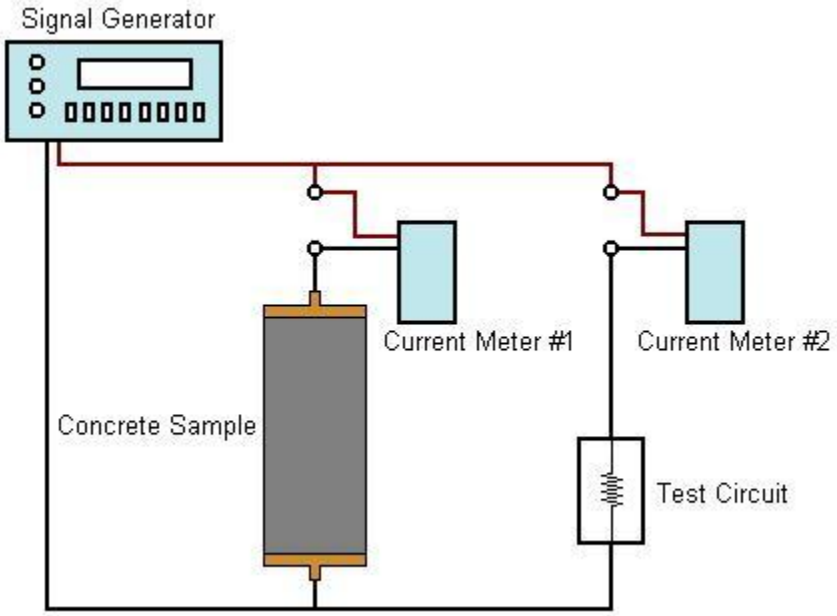


Figure 4-287. Alternate High-Frequency Test Circuit Setup.

Kirchhoff's Voltage Law could be used in place of Kirchhoff's Current Law. Kirchhoff's Voltage Law states that all elements in parallel have identical voltages. This allows a proportionality to be created with resistance and current. This new proportionality is shown in Equation 5.

Equation 5. Proportionality Equation using Kirchhoff's Voltage Law.

$$\boldsymbol{R_s} = \frac{(\boldsymbol{V_s} * \boldsymbol{R_c})}{\boldsymbol{V_c}}$$

$\boldsymbol{R_s}$ is resistance of the concrete sample; ohm

$\boldsymbol{R_c}$ is resistance of the test circuit; ohm

$\boldsymbol{V_c}$ is voltage of the test circuit; volts

$\boldsymbol{V_s}$ is voltage of the concrete sample; volts

While both circuits can be used to gain useful data about the concrete's response at high frequencies, the alternate circuit setup shown in Figure 4-287 is less prone to introducing error. The best configuration is to use the alternate high-frequency test circuit setup with an oscilloscope because this introduces the least amount of error due to impedance.

In addition, it should be noted that lightning is an anomaly. It is an electrical discharge, which suggests it has direct current characteristics, but it also has several discharges in rapid succession that yield a high-frequency alternating current response. Lightning also has a very high voltage, which was not modeled in any of these tests for safety reasons. Modeling a lightning strike is extremely difficult, and could not be performed reliably or safely in the laboratory setting available for these tests.

4.17.2.2.9 Photovoltaic Power Source for Conductive Concrete

A photovoltaic (PV) power system with battery storage was investigated as a renewable power source for the heated bridge deck application. The reason behind using a PV system was to minimize or eliminate the power required directly from the grid. This would also allow the technology to be used in remote locations. Another reason PV was considered was because, at the time, renewable portfolio standards were a major topic of discussion, so the installation of PV in combination with backup grid sourcing of power may have been attractive to the Federal Highway Administration and/or state agencies.

Calculations were performed to determine the necessary number of PV solar cells and batteries using commercially available technology, as well as the associated costs. Two scenarios were analyzed, one was a concrete pad in Michigan and the other was a bridge

overlay in Colorado. For equipment and cost comparison purposes, both scenarios used the same surface area as the University of Nebraska's test. Climate differences were taken into account by limiting the number of sun-hours per day. According to rockygrove.com, Michigan averages 2.5 sun-hours per day during the winter months, while Colorado averages 5 sun-hours per day. The reduced number of hours during each day that the PV system can use for energy production causes an increase in the number of solar panels needed.

The details of the solar panels and batteries used in the analysis are displayed in Table 4-149.

Table 4-149. Solar Panel and Battery Specifications used for Analysis.

Unit	Solar Panel	Battery
Peak Watts	205	
Amps	8	41
Volts	27	8
Dimensions	60" x 40" x 1.5"	30" x 11" x 18"
Amp Hour	NA	820
Price Each	$900	$1,550

Table 4-150 shows the details of this analysis and comparison between the two scenarios. For a conductive concrete bridge in Michigan designed to heat the pad either 12 or 48 hours per week, the capital cost of a PV system with battery storage was $1,334,000 for a 12-hour-per-week system or $5,339,000 for a 48-hour-per-week system. For a conductive concrete bridge overlay designed to heat the overlay either 12 or 48 hours per week, the capital cost of a PV system with battery storage was $1,000,000 for a 12-hour-per-week system or $4,000,000 for a 48-hour-per-week system. The cost and the number of batteries used for power storage was the same at both sites since both scenarios were designed to have the same number of days for power storage and power required. The difference in costs and amount of equipment came from the number of solar panels needed. Since Michigan has fewer sun-hours per day on average than Colorado, more solar panels are needed to capture the same amount of energy from the sun.

Table 4-150. Conductive Concrete Cost Comparison.

Load	Concrete Pad		Bridge Overlay	
Location	Michigan		Colorado	
Sun Hours per Day – Winter (1)	2.5		5	
Concrete Foot Print (sq. ft.)	3,276		3,276	
Power Required (kW)	177		177	
Battery Days of Storage	5		5	
In-Service Hours per Week	12	48	12	48
Total kWh/day	379	1,516	379	1,516
Kilowatt Storage Required	1,895	7,581	1,895	7,581
Number of Solar Panels Required	740	2,959	370	1,479
Number of Batteries Required	238	953	433	1,734
Cost of Solar Panels	$669,000	$2,678,000	$335,000	$1,339,000
Cost of Batteries	$665,000	$2,661,000	$665,000	$2,661,000
Total Cost	$1,334,000	$5,339,000	$1,000,000	$4,000,000

The costs of a PV system to heat a conductive concrete pad outweighed the benefits of using a renewable energy power source, not to mention the extraordinary amount of land space that the solar panels and batteries would have required.

4.17.2.2.10 Conclusion – Conductive Concrete Testing

ADA-ES's testing demonstrated that concrete with high-carbon fly ash was able to conduct electricity; however, it was observed that the concrete's specific resistivity was highly dependent on several other factors including W/C ratio, quantity of ash present in concrete, and amount of conductive elements added, such as carbon fibers. The data suggest that concrete can be a good conductor under certain conditions, but if these conditions are not met, it becomes a poor conductor. Some of the issues are:

- Concrete resistance is highly dependent on W/C ratio, and the higher the W/C ratio the better the concrete conducts electricity. This can be a problem for concrete used in structural applications because as the W/C ratio increase, the strength decreases.

- Concrete resistance is also dependent on the amount of fly ash used. As more fly ash is used (either Class C or F), the resistance increases. Further testing is required to determine whether the additional Class C fraction in the TOXECON™ ash can offset the conductive characteristics of the carbon.

- As the concrete cures and dehydrates over time, the resistance increases even if carbon fibers are present. This means that unless the concrete has the continued ability to remain moist, even while it is being heated through electrical resistance, it will dry out and become a poor conductor.

One of the primary applications of this technology is to create heated concrete pads for road or other municipal applications such as sidewalks. ADA-ES assessed the equipment cost to heat a conductive concrete bridge overlay using photovoltaics. The cost was estimated between $1,000,000 and $4,000,000, depending on the number of hours per week that the overlay had to be heated. This is a prohibitively high cost for a single bridge overlay and does not take into account the land required for the panels and associated equipment. Some of this cost could be reduced if the equipment was able to return power to the grid during warm periods, although that analysis was not performed.

The EM grounding application requires no additional energy input and, in fact, disperses energy. This has immediate applications for grounding buildings and towers that are frequently damaged during lightning events. There were no field sites available to test this application under the current program. Because of this, ADA-ES began investigating other uses of TOXECON™ ash in structural concrete.

4.17.2.3 Structural Concrete

4.17.2.3.1 Introduction and Background

ADA-ES investigated a second beneficial use application for the high-carbon TOXECON™ sorbent/ash material as a partial replacement for cement in concrete production. ADA-ES developed and tested structural concrete formulations requiring air entrainment admixtures (AEAs) using the sorbent/ash material with high (as much as 30%) LOI. The adverse impact of powdered activated carbon (PAC) on AEAs in concrete mix designs has been the major

barrier to using PAC-laden fly ash. Even small amounts of PAC (1–2% LOI increase) in ash have been shown to have a significant effect on the AEA.

The utilization of fly ash in concrete represents a major beneficial reuse because this coal combustion by-product reduces the energy needed to produce cement; it reduces the use of portland cement in concrete and therefore, the overall cost of preparing concrete; and it improves the workability of concrete without causing dramatic changes in the rate of set and/or development of early/ultimate strength. ADA-ES also assessed different options for utilizing concrete made with PAC-laden ash.

ADA-ES employed an experimental approach that combined a specific batch design approach (developed by ADA-ES) with a foam-based Air Entrainment Admixture (AEA) that was modified specifically for this application by Miracon™ Technologies, Inc. This experimental approach tested mixtures involving fly ash containing < 1% LOI to as much as 30% LOI (supplied by PAC). A successful field demonstration using TOXECON™ sorbent/ ash material (30% LOI) to make a large concrete pad at the Presque Isle plant was initiated in June 2009.

4.17.2.3.2 Test Procedure

4.17.2.3.2.1 Concrete Mix Design Development

ADA-ES prepared 1.3 ft^3 concrete batches in the laboratory using formulations that varied the amount of cement, fly ash, LOI in ash, water/cement ratio (W/C ratio), and commercial admixtures using a variable speed mixer. The coarse and fine aggregate were from a local Colorado supplier and were kept constant for all of the tests. Local Marquette, Michigan sources of coarse and fine aggregate were used in the Presque Isle field demonstration concrete.

Various commercial admixtures were tested for their effectiveness in stabilizing air content in the batches as well as for other purposes such as reducing the water demand, retarding the set time, changing the plastic viscosity of the concrete, and stabilizing the slump characteristics. Workability of wet concrete is measured by performing a slump test following the ASTM C143 test standard. Slump is measured by filling an “Abrams cone”

with a sample of fresh concrete, then slowly removing the cone. The slump is a measurement of how much the cone of wet concrete "slumps" or settles.

These commercial admixtures can be broken down into a number of different groups; low, mid, and high range water reducers, viscosity modifying agents, and retarders, as seen in Table 4-151. The dosages of these admixtures are given in ounces per 100 pounds of cementitious material, which is typical in the industry. These commercial admixtures and other chemical compounds were tested with the goal of mitigating PAC's effect on AEA.

Table 4-151. Admixture Formulation Ranges.

Name	Min (oz/100 lb cement)	Max (oz/100 lb cement)
Admixtures		
Low Range Water Reducers	0	8
Mid Range Water Reducers	0	14
High Range Water Reducers	0	45
Viscosity Modifying Agents	0	18
Retarders	0	4
Air Entraining Agents		
AEAs (overall)	0	128
Miracon*	0	77
*cubic foot of Miracon foam per yard of concrete		

Most of the concrete mixtures were made to meet the minimum standard Department of Transportation (DOT) 28-day, 4500 psi design specification. Some formulations exceeded the 6000 psi design specification, while others were targeted as low as 1500 psi. The variations in ultimate strengths achieved were due to varying the amount of cement, water, and admixtures. This was done to gauge the effect that PAC had on durability and strength of the concrete.

The w/c ratios tested in the various formulations ranged between 0.30 and 0.70. When calculating the w/c ratio, it was important to take into account all of the cementitious material because of Class C fly ash's ability to harden similar to cement when the dry fly ash is mixed

with water. ADA-ES also had to account for the additional liquid that accompanied the high amounts of AEA required in some mixtures. Table 4-152 shows a range of formulations tested. These values are the percentage of each item in the wet concrete mixture.

Table 4-152. Structural Concrete Formulation Ranges.

Name		Min	Max
Cementitious Material			
	Cement	8%	17%
	Class C Fly ash	2%	9%
Aggregate			
	Coarse (Rock)	37%	44%
	Fine (Sand)	30%	36%
Water			
	Design Water	5%	11%
		% of Total Weight	

4.17.2.3.2.2 Equipment and Methods

All tests consisted of a mixing phase, performed at 20 rpm, simulating the mixing speed maintained in a ready-mix truck, followed by a "transit speed" phase at 4–5 rpm for 60 to 90 minutes, simulating the speed used during transit to a job site. The initial mix design tests used the 60-minute transit mixing time. All later tests used the 90 minute transit time due to the discovery that PAC, unlike unburned carbon normally present in fly ash, continued to react over long periods of time with the water and chemicals in the wet concrete.

The mixing was done in a variable speed concrete mixer as seen in Figure 4-288. Cylinders for compressive strength testing were made by pouring the various concrete mixes into standard 4" x 8" long cylindrical containers following the ASTM C192 procedure. The concrete cylinders were capped and placed in a water tank to cure overnight. After the concrete was cured, typically within 24 hours, samples were delivered to independent laboratories such as CTL Thompson in Denver, Colorado, for compressive strength testing,

Hardened Air Void (HAV) testing, which provides a prediction of freeze/thaw durability, and Rapid Chloride Permeability tests (RCP).

Figure 4-288. Variable-Speed Concrete Mixer.

Air content of the cured cylinders was measured using two methods. The HAV test was performed on select samples due to cost, and was done by an independent laboratory. The on-site method measured the air content in the wet concrete. This was useful for dosage adjustments and monitoring the stability of the air in the concrete. These air measurements were taken with a Forney type B air meter, as seen in Figure 4-289. The measurements made with the air meter conformed to ASTM C231 standards for entrained air measurements and used the principle of Boyle's Law to determine the air content. The air meter base had a volume capacity of 0.25 ft^3 (0.0075 m^3). ASTM C231 requires a capacity at least 0.20 ft^3 (0.006 m^3).

Figure 4-289. Forney Type B Air Meter.

The air meter base described above was also used to determine mix design sample unit weight (lb/cubic foot of wet concrete), which is an important value for estimating air content at a job site. Weight was determined on a digital scale which read to the nearest hundredth of a pound with capacity to read up to 100 pounds.

4.17.2.3.3 Test Results

4.17.2.3.3.1 Laboratory Tests

ADA-ES began testing high LOI ash (30%) in the concrete mixes. Because of PAC's ability to absorb many of the admixtures and AEAs added to concrete, these initial tests were unsuccessful in generating durable concrete. A numbers of methods were attempted to mitigate the effect that PAC had on these chemical additives. One of these was Miracon™ Technologies, Inc. original foam AEA, which had shown success in generating stable air in concrete containing fly ash with high levels of unburned carbon. Miracon™ AEA performed better than other AEAs tested but still failed to generate stable entrained air within the concrete mixtures. Results from these tests were shared with Miracon™ who then attempted

to develop a more robust AEA to cope with the PAC. ADA-ES began testing mix designs using low LOI (2–5%) sorbent / ash material. At lower LOI, the effect of the PAC was not as aggressive and it was easier to achieve successful formulations.

ADA-ES attempted to block the pore structure of the sorbent / ash material that was believed to be "soaking up" admixtures and AEA by using various chemical additives. All of these experiments decreased the concrete mix's compressive strengths and/or did not allow for stable entrained air. ADA-ES also tried using TOXECON™ ash to create a coarse aggregate to be used in concrete. This material, when incorporated into the wet concrete mix, subsequently decreased overall strength, and still adversely impacted the action of liquid AEAs. Pore structure blockage was therefore rejected as a possible solution.

Miracon™ developed a second generation air entraining foam in fourth quarter 2008 that was tested on a low-LOI ash replacement formulation. Miracon™ recommended a specific admixture "cocktail" to be added with its foam AEA for optimal performance. Initial tests showed that the AEA was more stable after initial mixing, so a field test was scheduled for January 2009. A more detailed explanation of this work is provided in the subsection titled "Field Testing – Sky Ute Sand and Gravel."

The lab tests using the new formulation exhibited an important correlation between the slump and entrained air. The formulation used in these tests resulted in a mixture that showed a rapid slump change with mixing time. As slump decreased the concrete became drier. As the concrete became drier, it became a less suitable environment for entrained air. Furthermore, if the AEA was foam-based such as Miracon™ AEA, the entrained air would not have the ability to regenerate if the concrete was dried out then rewetted. This discovery allowed ADA-ES to develop a new formulation for the foam-based AEA that would provide a more stable slump with time, thereby producing more stable air. The effect of slump change on entrained air can be seen in Figure 4-290.

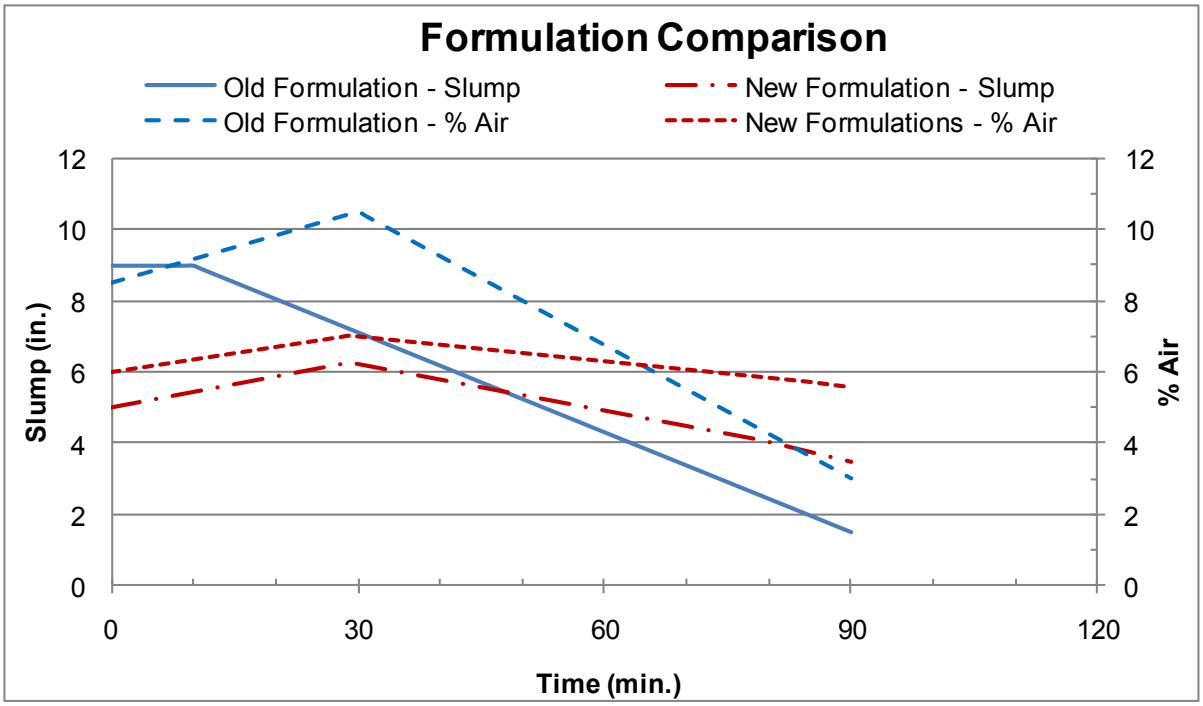


Figure 4-290. Correlations between Slump and Percent Air in Concrete.

Once a successful formulation was created for low LOI ash replacement concrete, it was modified to accommodate high LOI ash. The initial modification was done using foam index values for the low and high LOI ash. A foam index tests provides an indication of how much AEA is required for additives to concrete such as carbon-containing ash. Typically higher carbon levels in ash result in higher AEA usage, measured as a higher foam index. A foam index number was recorded at the given low and high LOI values, and was used to scale up the AEA and other admixture dosage levels. The admixture levels were then fine-tuned through testing.

Initial tests using high LOI ash as cement replacement failed because it was thought that the concrete could not maintain stable entrained air. After a number of unsuccessful trials, HAV tests were run to evaluate the difference between the air meter reading on the wet concrete and the final air content in the cured concrete. As can be seen in Figure 4-291 the high LOI ash replacement air meter readings, the green squares, were reading falsely low. The air meter was calibrated and readings were taken using the ASTM C231 method. The resulting difference between the HAV readings and the air meter readings was attributed to 'Phantom Air', or air that is present but cannot be read or gauged using an air meter. Because of this

finding, the ASTM C138 technique (unit weight measurement) was used for subsequent air measurements. Using this method, air present in wet or plastic concrete was determined using the sample's unit weight and theoretical yield. With these two pieces of information an approximation could be made about the actual air content. This technique was used during the field test at PIPP, providing a more accurate method for measuring air.

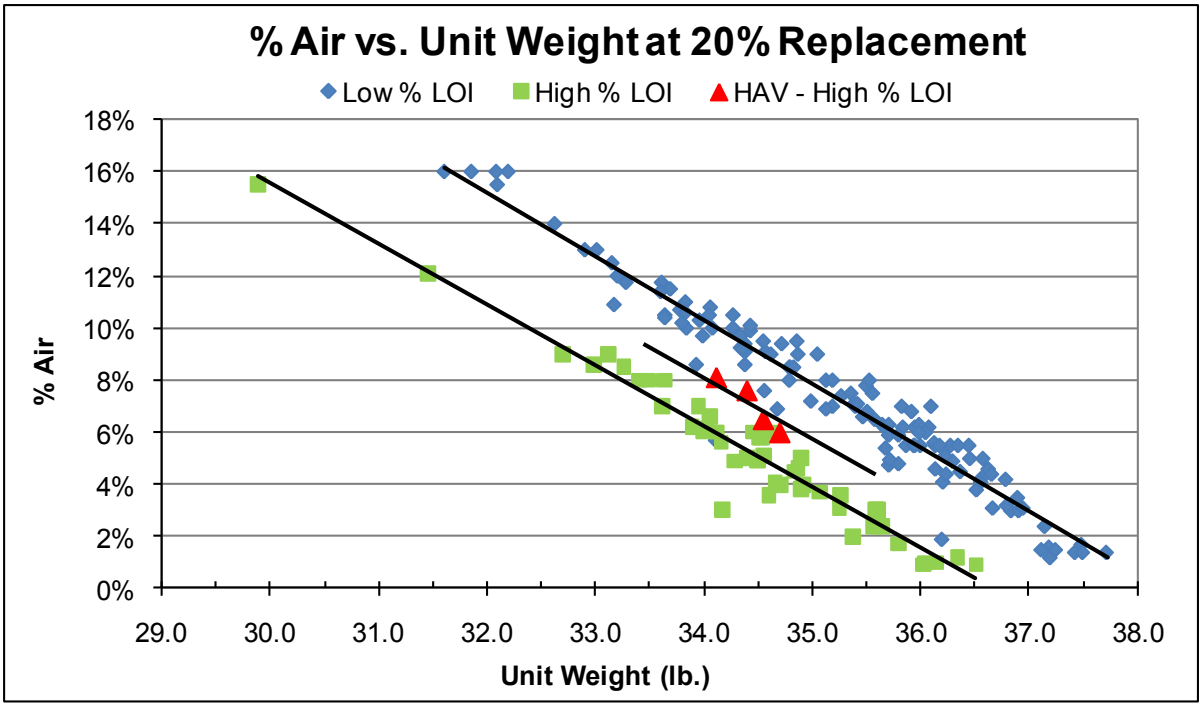


Figure 4-291. Percent Air versus Unit Weight at 20% Cementitious Replacement.

Using the HAV data and the ASTM C138 method for determining gravimetric air content in plastic concrete, a successful formulation was finally developed for high LOI ash at 20% cementitious replacement. Figure 4-292 shows a comparison of compressive strength results using Micro-Air®, a liquid AEA, and Miracon™ foam AEA. The ash LOI varied from 0.7% (control), 5%, and 30% using 20% cement replacement. The amount of AEA was normalized to the amount used in control batches. The 5% LOI ash tests showed very good strength for both Micro-Air® and Miracon™, but the AEA usage varied significantly. Miracon™ required no increase in dosage, while the Micro-Air required 6x the amount needed for the control batch. The 30% LOI tests with Miracon™ required 7–12x more Miracon than the control, compared to a test with Micro-Air® that required up to 250x more, which was not shown on the graph. The air content was stable for 90 minutes. The w/c ratio

varied in the tests, and was the major factor in strength variability between the batches (Figure 4-293). The legend in this figure also shows the measured air content in the concrete, which varied from 4% to 7% and can have an effect on strength values. Higher air content generally results in lower strength concrete.

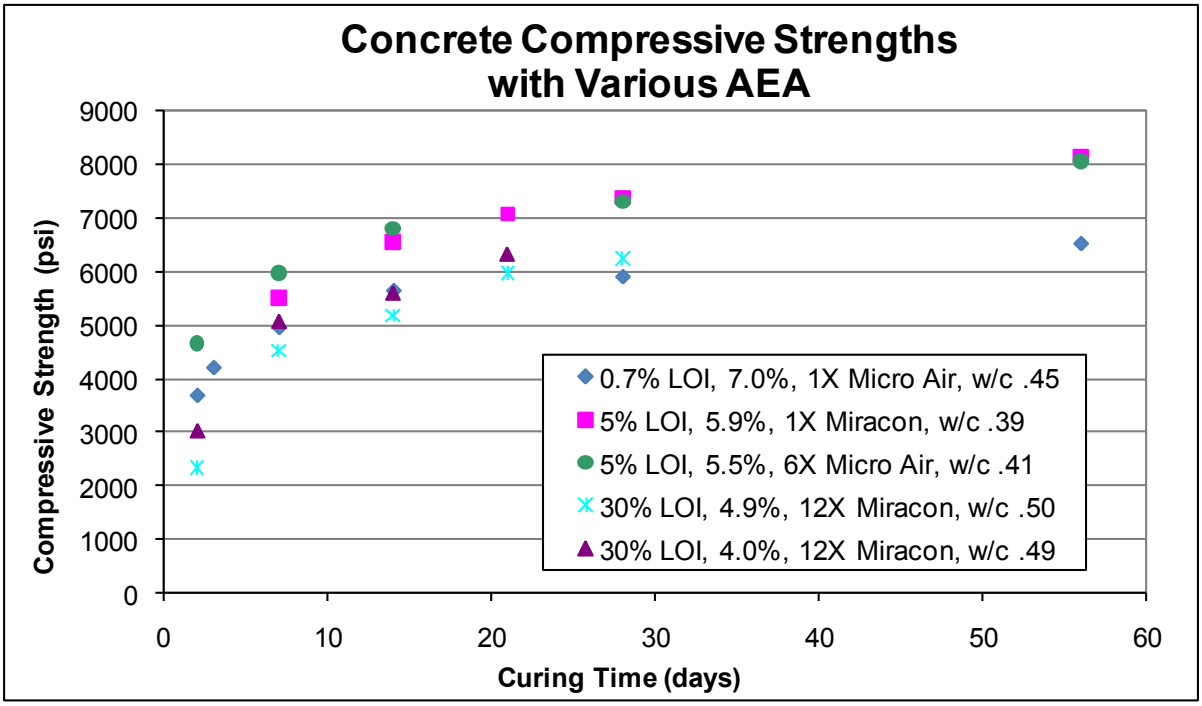


Figure 4-292. Laboratory Concrete Compressive Strength Results.

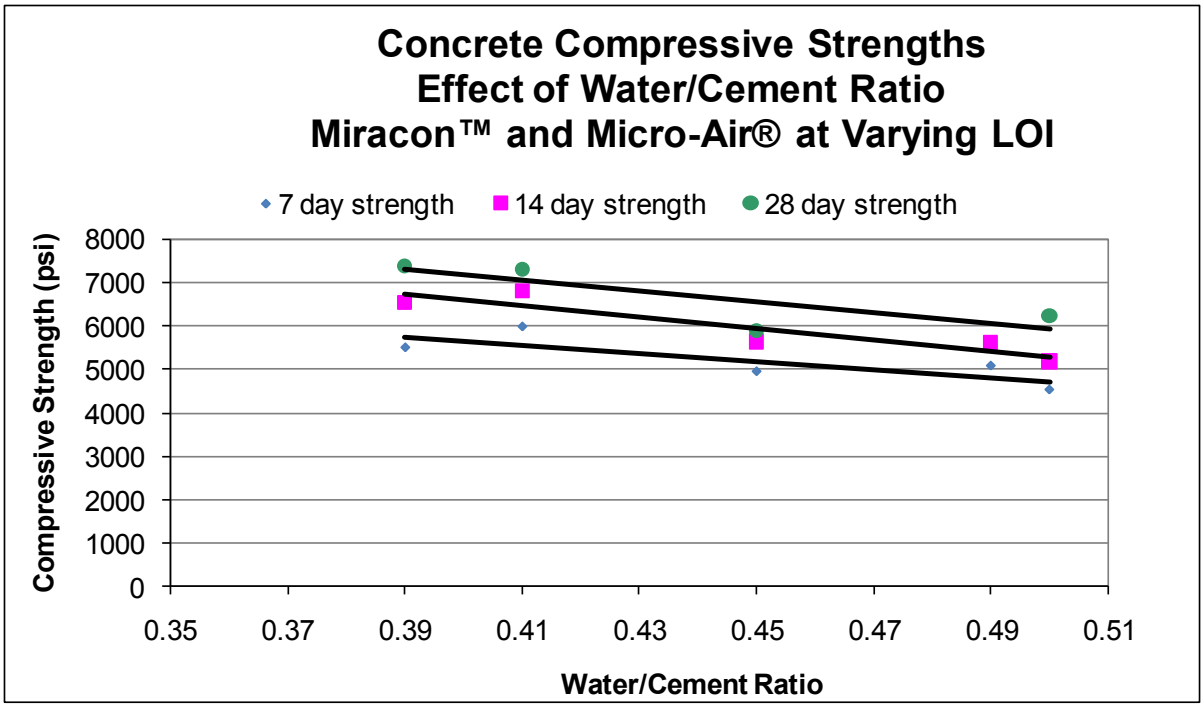


Figure 4-293. Effect of w/c Ratio on Concrete Strength.

HAV tests on select test batches at 5% and 30% LOI showed good air void size and spacing, which is correlated with freeze/thaw durability. In preparation for a second field test at PIPP, the formulation was adjusted to meet design specification for the test pad. These adjustments included lowering the cementitious ash replacement from 20% to 10%,which still resulted in a total ash replacement of 18% (10% cementitious Class C ash and 8% PAC); increasing the cement and decreasing the water content to increase the strength, and adjusting the admixtures to balance these changes into a stable formulation.

4.17.2.3.3.2 Field Testing – Sky Ute Sand and Gravel

The first field test using the new foam-based AEA and batch design was performed in the first week of January 2009 at Sky Ute Sand and Gravel in Farmington, New Mexico. Two drums of TOXECON™ ash were shipped to the site for testing. The ash was blended with water in order to minimize dusting and to allow exact additions of the ash to the truck as seen in Figure 4-294. The batch size for these field tests was 4 cubic yards. This was considered the minimum amount that could be used in a truck and still have representative mixing.

Figure 4-294. TOXECON™ Ash Added during Concrete Mixing at Sky Ute Sand and Gravel.

A 2% LOI blend had sufficient air content (5.6%) and slump (6”) so cylinders were made for compressive strength testing. Figure 4-295 shows the strength data through 28 days. The strength at 28 days was very good and was well above the targeted level of 4500 psi. The HAV data showed a reduction in the air content (to 3.8% from 5.6%) indicating that the air may not have been stable during curing. This issue was addressed with a new admixture formulation that was used in the second field test at Presque Isle.

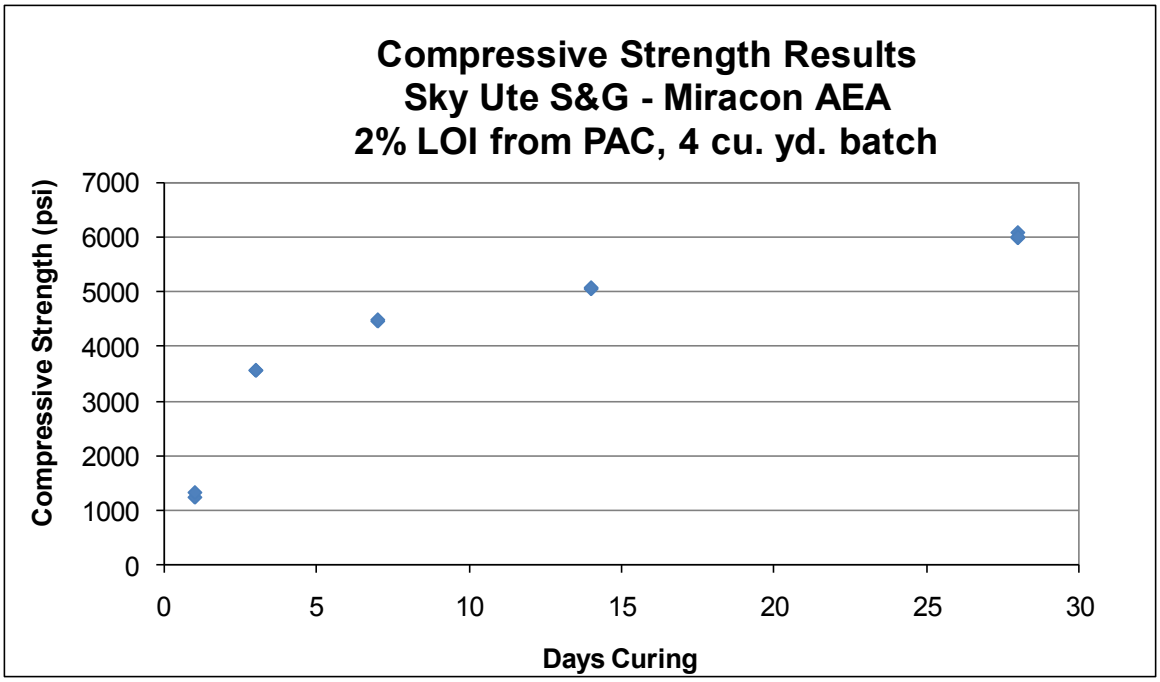


Figure 4-295. Compressive Strength Data—Field Test at Sky Ute Sand and Gravel.

4.17.2.3.3.3 Field Testing – Presque Isle Power Plant

A new batch design was tested and finalized before the field test at PIPP. This batch design addressed some of the issues observed during the first field test. The second field test was a full-scale demonstration of the combined technology to generate high-strength, durable concrete using a 30% LOI ash at 18% cement replacement. The TOXECON™ sorbent / ash material was used in the concrete to make a 30’ x 50’ x 1’ concrete pad designed for freeze/thaw durability and high strength (6000 psi) so that it could withstand heavy equipment use.

The push wall and footer were installed in May 2009 using standard low-carbon concrete. This was done to assure that both footer and push wall would have sufficient time to cure before the high-carbon concrete was placed. Excavation and subsequent backfilling around the footer and wall were needed before the supporting steel for the pad could be installed. Figure 4-296 shows the completed push wall and steel for support of the pad.

Figure 4-296. Completed Push Wall and Support Steel for High-Carbon Concrete Pad.

Once the push wall and steel installation was complete, the high-carbon concrete pad was poured in June 2009. Ash from the TOXECON™ silo was loaded into a 1550-gallon poly tank using the dry unloader as seen in Figure 4-297. The ash was then transported to Fraco Concrete Products, Inc., the ready mix plant in Marquette where the concrete batching was performed.

Figure 4-297. Unloading Dry TOXECON™ Ash for Concrete Preparation.

Because of the dusty nature of the material, possible variability in LOI within layers of the sorbent / ash material, and difficulty delivering the exact amount of material into each truckload, water was added to the tank and a slurry formed. The dry ash was tested for LOI and moisture so that an exact amount of ash equivalent to a 30% LOI dry ash blend could be dispensed into each truck. The dry ash from the silo was 42% LOI, so low-carbon ash from the plant's ESP was added to each truckload of concrete to "dilute" the high-carbon slurry to form the equivalent of a 30% LOI ash. The final combined ash and material replaced 18% of the cement in each concrete batch (truckload). The actual cementitious replacement value was 10% due to the fact that only a little over half of the final ash blend had cementitious and pozzolanic properties. The other 8% by weight was PAC.

After the water was added to the dry TOXECON™ material at Fraco, a TM 2000 series pneumatic mixer from Pulsair Systems Inc. was used to create the slurry. The Pulsair mixer sends pulses of high-pressure air into the liquid to break up solids and keep them in suspension.

Test batches (4 cubic yards each) were made to test the batch design and Miracon™ AEA at full-scale conditions. The first batch was too dry and would not hold the air so it was discarded. The second batch was within specifications so it was transported to PIPP and placed in the drainage area between the pad and the settling pond as seen in Figure 4-298. The wet concrete had good workability and showed no unusual properties compared to standard low-carbon concrete.

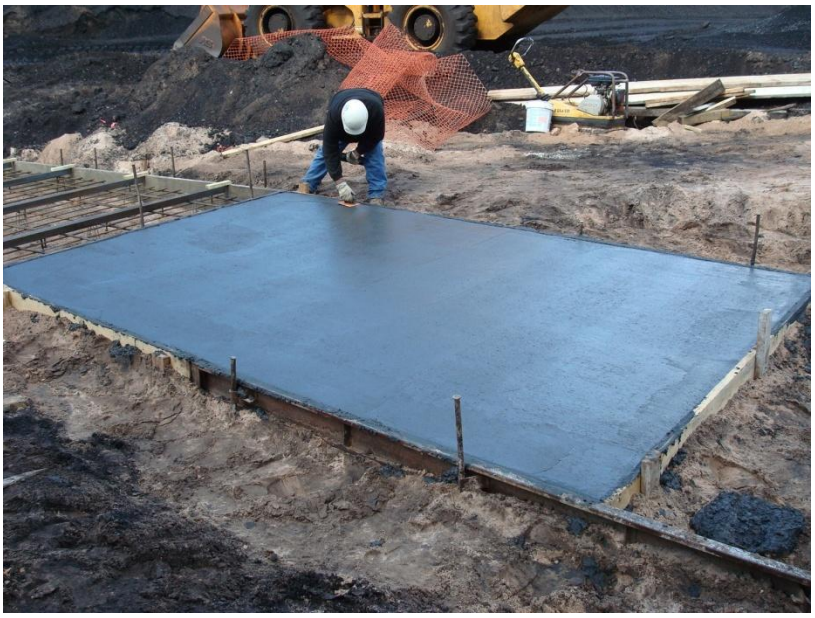


Figure 4-298. First Successful High-Carbon Concrete Placement.

The following day, a third four-yard batch was generated and placed in the drainage area. Two nine-yard batches were then generated to complete the drainage area as seen in Figure 4-299. All batches for the drainage area, except for the first one, were successful.

Figure 4-299. Completion of the Drainage Area with High-Carbon Concrete.

On Thursday, June 4, the large pad was poured using seven nine-yard truckloads of concrete. Batch #2 showed high slump, which resulted in high air due to entrapment. This may have been due to residual water in the truck. All other truckloads showed air and slump within

specifications. The pad was completed by 6:00 p.m. Thursday and covered with plastic to prevent shrinkage cracking. Figure 4-300 shows the pad the next morning after the forms had been removed.

Figure 4-300. Completed High-Carbon Concrete Pad; June 5, 2009.

Concrete samples from each truckload were taken for testing compressive strength, air void characteristics, and rapid chloride permeability. Figure 4-301 shows the results from compressive strength testing through 56 days. The average compressive strength for the pad was 6646 psi at 28 days, which exceeded the design specification of 6000 psi. One batch (#2) showed air content above specifications, resulting in lower strength for that truckload of material. The average compressive strength for the pad was 6690 psi at 56 days, indicating that there was not significant strength increase after 28 days.

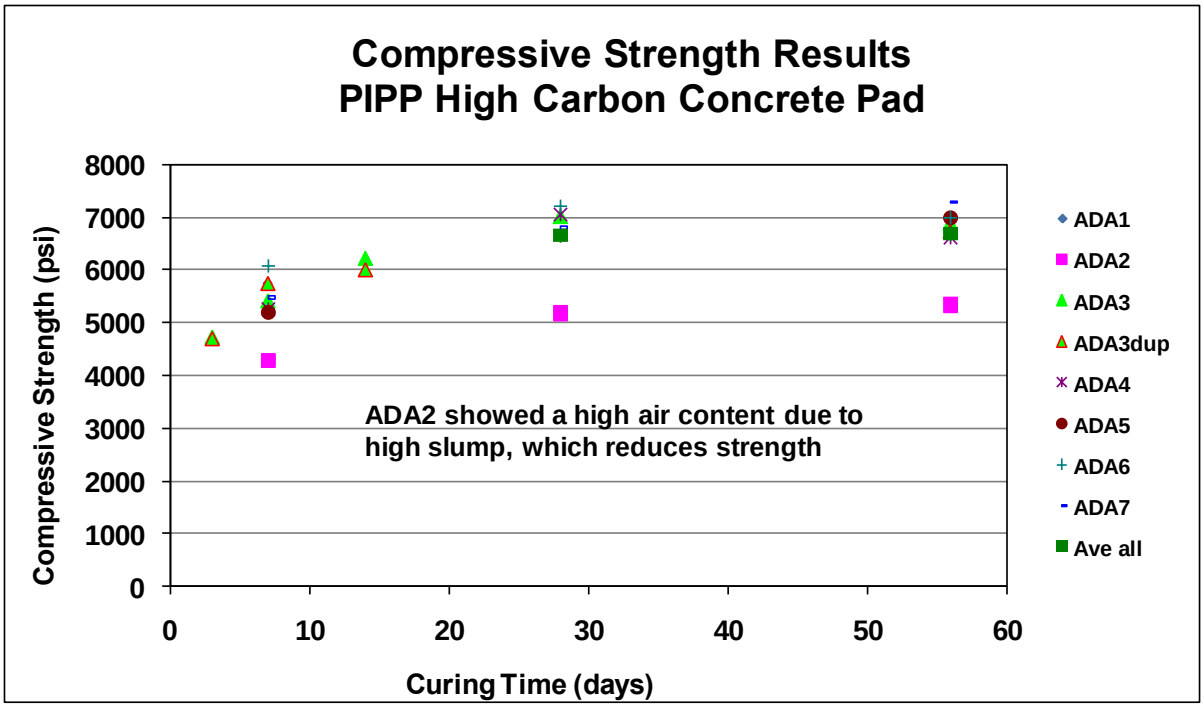


Figure 4-301. Compressive Strength Results for High-Carbon Concrete Pad.

Once the compressive strength results showed that the pad achieved design specifications, the plant began to use it for bottom ash dewatering. Figure 4-302 is a picture from September 2009 showing the ash pile and drainage area. There were no visual indications of problems with the pad.

Figure 4-302. High-Carbon Concrete Pad used for Bottom Ash Dewatering.

Two cylinders from two truckloads were sent for HAV analysis and two for Rapid Chloride Permeability testing. One cylinder sent for HAV testing was from the high air batch (#2) and the other was from batch #3, which had the lowest air content. Table 4-153 provides the results of these tests. The HAV air content was significantly lower in batch #3 than the value from the field. The HAV value from batch #2 was also lower. The average air content measured in the field was 4.8%, which was within the target range. The spacing factor measurement was excellent for batch #2, but was out of range for batch #3. The larger air bubbles seen in batch #3 were not typical compared to previous HAV results from laboratory batches.

Table 4-153. Hardened Air Void Results from PIPP Field Test.

Parameter	Batch #2	Batch #3	Target
Air Content – field (%)	10.3	4.6	4–8%
Air Content – HAV (%)	9.9	3.2	4–8%
Spacing Factor (inch)	0.004	0.010	<0.008
Specific Surface (in^2/in^3)	702	639	>600

Rapid chloride permeability testing was performed on two cylinders (batches #5 and #7) from the field test at PIPP. This test is used to determine the resistivity of concrete, which is then correlated to permeability. Low permeability is preferred for most applications. The cylinders were cured in a temperature and humidity controlled fog room (as were the cylinders for HAV). The cylinders were tested in general conformation with ASTM C1202 "Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration." The results showed high chloride ion penetrability at 6280 and 6890 coulombs. This result was not surprising due to the conductive nature of activated carbon particles. Tests conducted in the ADA-ES laboratory in 2008 on high-carbon concrete showed an increase in electrical conductivity compared to low-carbon concrete. What is unknown at this time is the actual effect of the increased conductivity on the life of the concrete. It is acknowledged in the industry that the presence of ionic species and other additives can affect the Rapid Chloride Permeability test while not affecting the actual permeability of the concrete. Also, these

particular samples represent the extreme end of PAC-containing ash in concrete applications. More typical ash with 1–2% LOI would likely not see this effect.

4.17.2.3.3.4 Concrete Leaching Results

Concrete samples were tested using EPA Method 1311 Toxicity Characteristic Leaching Procedure (TCLP) and EPA Method 1312 Synthetic Precipitation Leaching Procedure (SPLP). Four concrete samples were crushed and sieved to Number 6 aggregate size (3/4" to 3/8") according to ASTM C33 "Standard Specifications for Concrete Aggregates." This size was chosen because it is common for concrete reused as an aggregate. A low-carbon concrete made using ESP ash from PIPP was used as the control. A low-PAC concrete at 1.5% LOI was tested to represent a probable concrete that would result from utilities injecting PAC upstream of the primary particulate control device. Two high-carbon samples at 30% LOI at 18% (pad) and 36% ash replacement (lab sample) were also tested. As described previously, the 18% ash replacement consisted of 10% cementitious ash replacement with the additional 8% as PAC. ADA-ES had performed several successful tests in the lab at twice this ash replacement level (20% cementitious, 16% PAC), so one of these samples was also chosen for testing.

The leachate from the concrete tests was analyzed for the following: arsenic, barium, beryllium, boron, cadmium, total and hexavalent chromium, lead, manganese, mercury, molybdenum, selenium, silver, vanadium, fluoride, bromide, and sulfate. Table 4-154 shows the results for mercury, total chromium, and bromide. For all samples tested, mercury and chromium were well below the TCLP criteria for a hazardous waste. Also, the concrete samples containing high levels of PAC showed no detectable leaching of mercury while the low-carbon control showed a very small amount of leachable mercury. PAC-containing concrete showed a reduction in leachable chromium when compared to the low-carbon controls. Hexavalent chromium showed the same trend as total chromium (not shown). Because the PAC used in the TOXECON™ baghouse was brominated, the bromide levels in the leachate were tested. All concrete samples showed very little bromide in the leachate.

Table 4-154. Concrete Leaching Results.

Sample		Mercury (ng/L)	Total Chromium (ug/l)	Bromide (mg/l)
TCLP Criteria		200,000	5,000	
0.7% LOI concrete – 20% ash replacement (Control)	SPLP	9.8	46.5	0.92
	TCLP	ND	75.0	ND
1.5% LOI concrete – 20% ash replacement	SPLP	ND	23.0	1.2
	TCLP	9.7	42.0	ND
30% LOI concrete – 20% ash replacement (Lab sample)	SPLP	ND	ND	0.66
	TCLP	ND	ND	1.40
30% LOI concrete – 10% ash replacement (Pad sample)	SPLP	ND	ND	0.36
	TCLP	ND	ND	ND

4.17.2.3.4 Conclusion

ADA-ES developed a new approach to using PAC-containing ash for structural concrete under the CCPI project conducted at PIPP. This method utilized the combination of a specific batch design (developed by ADA-ES) with a foam-based AEA that was modified specifically for this application (developed by Miracon™ Technologies, Inc.). This combined technology was tested on concrete mixtures with ash containing <1% to as much as 30% LOI from PAC. A successful field demonstration using 30% LOI ash to make a large concrete pad at the Presque Isle plant was completed in June 2009.

Leaching tests on concrete samples showed a reduction in leached mercury and chromium from the high PAC samples, although all samples were well below the TCLP reporting criteria. All samples showed that only a very small amount of bromide was leachable.

4.18 Task 18: Revise Design Specifications, Prepare O&M Manuals

As discussed in Task 14, final O&M manuals were received for most major equipment and the operator training program was all completed by the end of the fourth quarter of 2005.

4.19 Task 19: Reporting, Management, Subcontracts, Technology Transfer

Routine financial and technical progress reports were prepared and submitted as required in the Financial Assistance Reporting Requirements Checklist. Project and subcontract

management functions were also performed under this task. Numerous technology transfer activities occurred under this project.

4.19.1 Reporting

The following quarterly reports, which are required by this Cooperative Agreement, were submitted to the DOE each quarter since the beginning of the program (2Q04 through 3Q09):

- Quarterly Technical Progress Report
- Quarterly Financial Status Report
- Quarterly Federal Assistance Program/Project Status Reports

Topical Reports were also submitted on the following topics:

- Performance and Economic Assessment of Trona-Based SO_2/NO_x Removal at the Presque Isle Power Plant
- Test Report for Emissions Testing – Presque Isle Power Plant

Additional Reports were also submitted on the following topics:

- Preliminary Public Design Report, May 15, 2006
- A Construction Plan was prepared and submitted to NETL (1Q05)
- Communication Plan delivered (2Q05)
- A draft test bag test plan was prepared and issued (2Q05)
- A sorbent screening test report was issued (2Q05)
- A draft test bag layout was prepared and issued (3Q05)
- The draft test plan was submitted to DOE for review (4Q05)
- A test bag layout was prepared and issued (4Q05)
- The yearly Repayment Report was delivered (1Q06)

- The Test Plan was revised and submitted (2Q06)
- The yearly Repayment Report was delivered (1Q07)
- The yearly Repayment Report was delivered (1Q08)
- The yearly Repayment Report was delivered (1Q09)

4.19.2 Management

Team Meetings

- Weekly conference calls were held each Tuesday throughout the project period. Notes from these calls were distributed to the project team.
- DOE Kickoff Meeting (3Q04). Provided background and a status of the project. Held at DOE Morgantown with DOE, We Energies, C&B, and ADA-ES in attendance.
- A site visit August 2005 included We Energies, ADA-ES, DOE, and Cummins & Barnard; Marquette WLUC-TV Channel 6 conducted interviews on the project.
- A site visit in November 2005 included We Energies, ADA-ES, DOE, and Cummins & Barnard. ADA-ES prepared a short presentation on the mercury CEM for DOE.
- Made a presentation at the Presque Isle Celebration on April 21, 2006.

DOE/NETL Communications

- An Environmental Health and Safety Approvals letter was prepared and delivered to NETL (4Q04).
- A Continuation Application was prepared and submitted to NETL; it was approved in December 2004.
- A Budget Period 1 Review Meeting was held on February 23, 2005.
- A presentation was made at DOE/NETL Mercury Control Technology R&D Program Review Meeting in July 2005.

- Presented a paper at the DOE/NETL Mercury Control Technology Conference in December 2006.
- Presented at the DOE/NETL Mercury Control Technology Conference in December 2007.
- Discussed the project with GAO in November 2008.
- In January2009, a six-month, no-cost extension was requested by We Energies and approved by DOE, extending the project to September 30, 2009.

4.19.3 Technology Transfer

Conferences and Meetings

- A technical presentation about the project was given to the Clean Coal Generation meeting in Denver, Colorado, on September 8, 2004.
- A project presentation was made to the UP Economic Development Association Annual Meeting in Iron Mountain, Michigan (4Q04).
- Team members attended the EPRI CEM User's Group Meeting (2Q05).
- Team members participated in a mercury control panel discussion at AWMA's 98th Annual Conference and Exhibition (2Q05).
- Presented at the Reinhold FF/ESP Conference (3Q05).
- A poster presentation was made at the Air Quality V Conference, September 2005, in Arlington, Virginia.
- A presentation was made to the Subbituminous Energy Coalition in September 2005.
- A presentation was made at the EPRI baghouse workshop in October 2005.
- A poster and a presentation were given at the Clean Coal and Power Conference in November 2005.
- A presentation was made at the POWER-GEN Conference in December 2005.

- A presentation was made at the EUEC conference in Tucson in January 2006.
- Attended the EPRI CEM Users Group Conference in May 2006.
- Presented a paper at the Electric Power Conference in May 2006.
- Presented a paper at the A&WMA Annual Conference in June 2006.
- Attended Reinhold's "APC Roundtable" in July 2006.
- Presented a paper at the MEGA Symposium in August 2006.
- Presented at the American Coal Council PRB Coal Users Conference in August 2006.
- Presented a poster at the 8th International Mercury as a Global Pollutant Conference in August 2006.
- Gave a workshop at Coal-Gen in August 2006, with ESP and baghouse design in a high-carbon environment as the topic.
- Presented at the Thermo Super Group Meeting in September 2006.
- Presented a paper at the Symposium on Western Fuels in October 2006.
- Presented a paper at POWER-GEN International in November 2006.
- Presented a paper at the EUEC in January 2007.
- Gave a presentation at the Thermo Super Group Meeting in March 2007.
- Presented at the Electric Power Conference, EPRI CEM Users Group, and Air and Waste Management Association Conference in May 2007.
- Presented at the UARG-EPRI Meeting in April 2007.
- Presented an overview of mercury control technology for the Wisconsin DNR (3Q07).
- Presented at the Reinhold Conference in July 2007.
- Presented at the Coal Gen Conference in August 2007.

- Presented at the Thermo Super Group Meeting in September 2007.
- Presented at the American Coal Ash Conference in September 2007.
- Presented two papers at the AQVI Conference in September 2007.
- Participated in an EPA training session on Method 30A and the experiences at Presque Isle (4Q07).
- Attended the Emissions Marketing Association Meeting in November 2007.
- Presented at the EUEC in January 2008.
- Presented at the AWMA in June 2008.
- Attended the Concrete Technology Forum in May 2008.
- Presented at the MEGA Symposium in August 2008.
- Attended an American Coal Ash Association meeting in September 2008.
- Presented at the EPRI Fabric Filter Conference in November 2008.
- Attended an American Coal Ash Association meeting in October 2008.
- Presented on five topics relating to the demonstration at the EUEC in February 2009.
- Presented at the EPRI Advisors meeting in March 2009.

Media

- Conducted two interviews with Marquette WLUC-TV Channel 6, one of which was a 10-minute slot on "The Ryan Report" (4Q04).
- An interview was given to Marquette WLUC-TV Channel 6 (1Q05).
- Two interviews were given to a Marquette TV station (Channel 6) (2Q05).
- Articles about the project appeared in a Detroit labor magazine and in the Market Mining Journal (2Q05).

- National Public Radio broadcast a news segment concerning this project (4Q06).
- Participated in a webcast through McIlvaine concerning the TOXECON™ facility (1Q07).
- Participated in a McIlvaine webcast (3Q07).
- Participated in a McIlvaine webcast (4Q07).
- Presented during a McIlvaine webcast in April 2008.
- Presented at the McIlvaine Hot Topic Hour in January 2009.

Site Visits

- A presentation and site visit was arranged for the Michigan Department of Environmental Quality (4Q04).
- Conducted a tour of the CEMs for the Michigan Department of Environmental Quality on April 20, 2006.
- Conducted an additional tour for MDEQ on June 28, 2006.
- Conducted a tour for EPA representatives on May 18, 2006.
- Conducted a tour for Associated Press reporter and photographer on May 18, 2006.
- Conducted tours for Wisconsin Public Service and Wyandotte Corporation on June 29, 2006.
- Conducted tours for the following groups in 3Q06:
  - Thunder Bay Generating Station
  - Neill & Gunter
  - DTE
  - Consumer Energy
  - BW&L

- AEP
- MSSP
- FTC&H
- Environmental Testing Services
- EON US
- Louisville Gas & Electric

- Conducted a tour of the TOXECON™ system for the Southern Company, 4Q06

- Gave a tour of the facility to representatives from the following in 2Q07:
  - Marquette Range Engineers
  - Michigan DNR
  - Michigan DEQ
  - Basin Electric Power Cooperative
- Gave a tour of the facility to representatives from the following in 3Q07:
  - Tucson Electric
  - Alliant Energy
  - Consumers Power
  - S&L
  - Gray Corp.
  - Midwest Generation
  - Norit Americas
  - NRG Energy
  - Ash Grove Cement

- FL Smith
- University of North Dakota EERC
- Michigan Tech
- ETS
- Nebraska Public Power District
- Southern Company

- Gave a tour of the facility to representatives from the following in 4Q07:
  - Avondale Partners
  - Lazard Capital Markets
  - Perella Weinberg Partners
  - Pritchard Capital Partners
  - Sidoti & Co.
  - Wedbush Morgan Securities
  - Strategic Energy
  - RBC Dain Rausher
  - Canaccord Adams
  - Thomas Weisel
  - Hopewell Capital
  - White Pine Power
  - Otter Tail Power
  - Marquette Range Engineering Club

- Gave a tour of the facility to representatives from the following: 1Q08.
  - Dominion Energy, Inc.
  - Norit Americas
  - Electric Energy

Awards

- We Energies received a 2004 Award of Excellence from Operation Action U.P. (1Q05).
- We Energies received the Superior Watershed Partnership 2006 Corporate Conservation Award recognizing the TOXECON™ project as a significant accomplishment in environmental and Great Lakes protection (1Q07).
- We Energies received the Technology Transfer Award from EPRI (1Q09).

Journals

- A paper was accepted for publication in the *Fuel Processing Technology* journal (2Q09).

5.0 ENVIRONMENTAL PERFORMANCE

5.1 Impact of the Environment

The TOXECON™ installation has demonstrated measurable reductions in particulates and certain chemical species of interest. The process showed >90% mercury removal from the flue gas at Presque Isle Power Plant for 30 of the 34 months during the testing period of this project. Particulate emissions were reduced by at least 85% during steady state operation, and significantly reduced during startup of the boilers based upon plant operator experience. The particulates that were removed were the smaller ash particles that exited the HESPs.

The HBr mass balance showed an increase in gas-phase bromine in the flue gas due to brominated PAC injection. The baghouse was able to remove some metallic species in significant amounts, primarily selenium, manganese, chromium and nickel.

5.2 Waste Streams and their disposal

Approximately 200 lb/hr of PAC/ash material from the TOXECON™ baghouse is disposed of in the plant dry landfill. Results of TCLP and SPLP tests are given in Section 4.15.5.2.

Samples of PAC/ash mixture from the baghouse were analyzed for mercury content and Loss on Ignition (LOI). The ash at Presque Isle had a measured LOI of less than 1%, so the LOI in the PAC/ash mixture from the baghouse hoppers was primarily due to the PAC contribution. Figure 5-1 shows the mercury loading in the mixture during several injection periods. The mercury loading increased as the LOI (PAC fraction) increased, which is expected. Typically the mercury loading fluctuated between 35–80 ppm. The loading on the DARCO® Hg carbon used in 4Q07 seemed to perform much better than earlier in the year or in 2007. The mechanism of increased mercury removal and loading is not understood at this time.

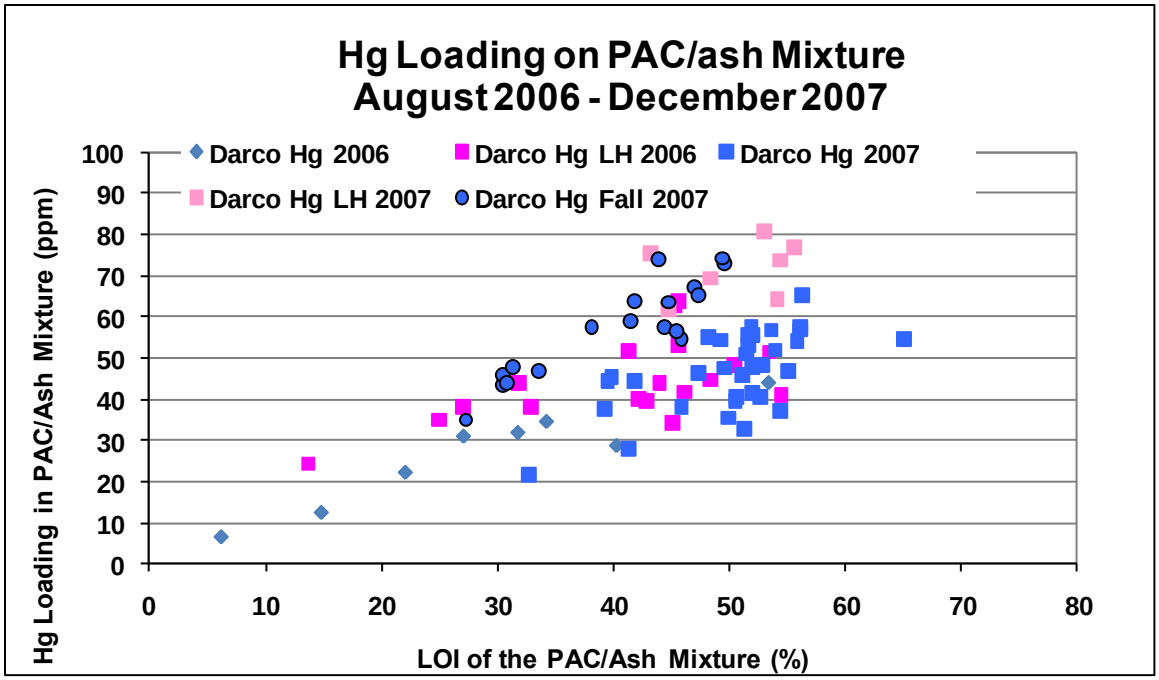


Figure 5-1. Mercury Loading on the PAC/Ash Mixture.

Figure 5-2 shows the mercury loading on just the PAC fraction in the mixture. This was back-calculated using a PAC LOI of 75% for DARCO® Hg and 74% for DARCO® Hg-LH (measured) and assuming that the ash contribution to the LOI was nominal. This assumption may not be accurate during the ESP detuning tests, due to a change in the ESP performance.

At low injection rates, the loading on the halogenated carbon was higher than the non-halogenated, although except for two data points, this was not a large difference. At higher injection rates, the loading for all of the test periods was similar, with the halogenated averaging slightly higher. The loading on the halogenated carbon during 2007 and non-halogenated in 4Q07 was consistently higher than the previous year. In fact, the loading on the non-halogenated carbon in 4Q07 was very similar to the halogenated carbon used during the summer in 2007.

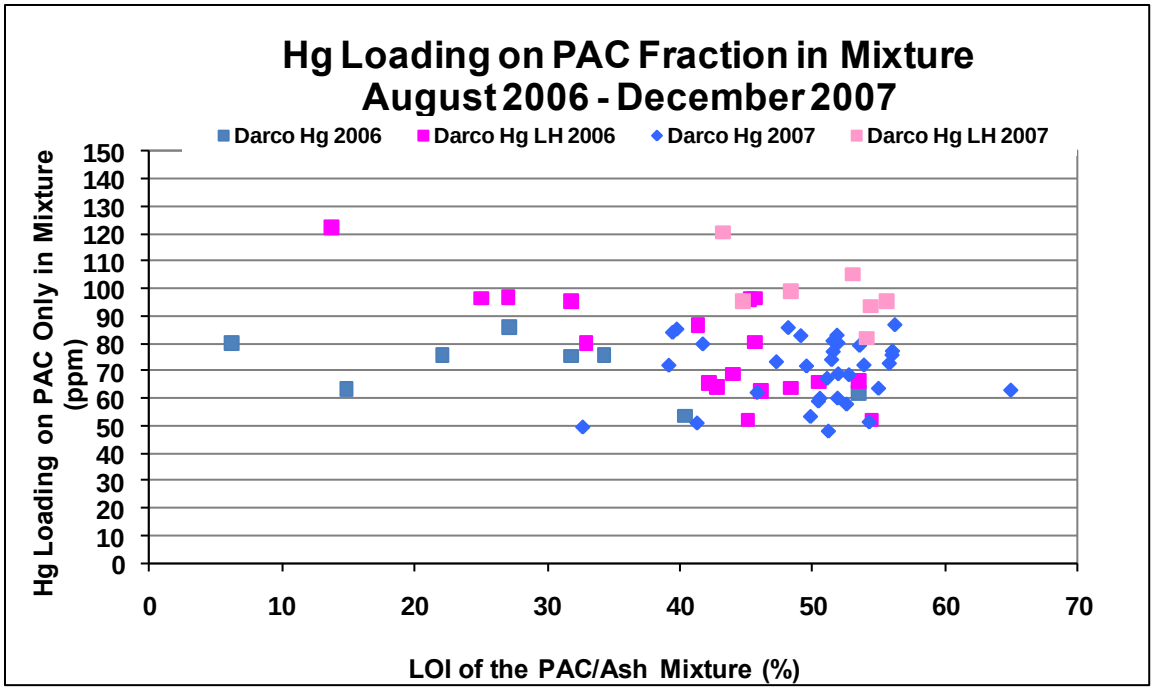


Figure 5-2. Mercury Loading on the PAC Fraction of the Baghouse Mixture.

One of the tasks on this project showed four separate methods for beneficial reuse of this PAC/ash material. Further development of these technologies is needed before they can be commercialized. There are no other waste streams from the TOXECON™ installation.

5.3 Potential Environmental Concerns

There were no potential environmental concerns identified on this project.

6.0 ECONOMICS

The economics presented in this report represent a commercial embodiment of the technology. The economics are presented with sufficient detail to allow interested parties to do a preliminary assessment of the cost of applying the TOXECON™ technology to their particular situation.

The final capital costs for the TOXECON™ project were $34 million (in 2005 dollars) and the detailed breakdown is available in the Public Design Document (We Energies, 2009). The remainder of the section will provide additional information regarding projected costs for a commercial unit, which might be at a different site and have a different capacity, and incorporate changes to the process design.

This installation was a retrofit application that represents higher costs than would be required for a new plant application. However, it is felt that new plant applications of the TOXECON™ technology as demonstrated at this site are unlikely. This is because hot-side ESP installations on units burning PRB coal are no longer being considered. The application of retrofits using TOXECON™ technology is expected to continue. As a result, retrofit costs are not specified separately but are assumed to be included in any future installation of TOXECON™ technology at a facility similar to the Presque Isle Power Plant.

6.1 Economic Parameters

In this section the costs associated with the TOXECON™ technology are based on actual long-term operating experience. It is important to note that variations in mercury control effectiveness will vary from site to site, and even at the same site at different times as has been shown by the documented results from the TOXECON™ project. The cost projections in this section are based on estimated average removals derived from extensive test data obtained over the 3+ years of operation. Although there are additional benefits of TOXECON™ beyond removal of mercury, these benefits are not included in this section.

The assumptions used in preparing the economic analysis are documented in Table 6-1.

Table 6-1. Economic Analysis Parameters.

Item	Units	Value Used
Cost of debt	%	6.06
Cost of equity	%	10.75
Debt/total capital	%	50
Income tax rate	%	40
Debt rate of return	%	3.0
Equity rate of return	%	9.0
Project rate of return	%	12.0
Depreciation rate	%	3.0
Annual capital carrying charge	%	15.0
Inflation rate	%	2.5
Discount rate (with inflation)	%	7.5
Escalation of raw materials above inflation	%	0
Asset life	Years	30
Year for cost presented in this report	-	2009
Capacity factor	%	84
Generating capability	MW	270
AFUDC rate	%	8.94
CWIP AFUDC	%	100

6.2 Estimated Process Capital Costs

A list of major equipment items supplied as the original construction for the TOXECON™ project is given in Table 6-2.

Table 6-2. Major Equipment List.

Item No.	Item Name	Number		Vendor
		In Use	Spare	
1	Baghouse	1	0	Wheelabrator
2	Electrical Equipment	n/a	n/a	Various
3	Controls (including Enclosure)	n/a	n/a	Emerson
4	Air Compressor/Dryer	1	1	Sullair
5	ID Booster Fans	3	0	Fläkt-Woods
6	Ash System	1	0	United Conveyor
7	PAC System	1	0	Norit
8	Dampers	n/a	n/a	Wahlco
9	Expansion Joints	n/a	n/a	PAPCO
10	Ductwork and Structural Steel	n/a	n/a	Merrill, Cives
11	Mercury Continuous Emissions Monitors	2	0	Thermo Electron

The original installed costs were in 2005 dollars. These have been adjusted to current year dollars using the inflation rate defined in Table 6-1 and are shown in Table 6-3. The estimated total installed equipment cost is $38,240,756 using 2009 dollars. These cost figures include the costs of retrofitting the process to an existing power plant.

Table 6-3. Major Equipment Costs – 2009 Dollars.

Item No.	Item Name	Total Cost
1	Baghouse	$21,247,342
2	Electrical Equipment	$1,363,020
3	Controls (Including Enclosure)	$644,915
4	Air Compressor/Dryer	$265,546
5	ID Booster Fans	$2,620,329
6	Ash System	$1,362,335
7	PAC System	$787,945
8	Dampers	$1,432,123
9	Expansion Joints	$221,714
10	Ductwork and Structural Steel	$6,801,333
11	Mercury Continuous Emissions Monitors	$1,494,153
ESTIMATED TOTAL INSTALLED COSTS		**$38,240,755**

Total capital requirement is calculated as shown in Table 6-4.

Table 6-4. Total Capital Requirement.

Area No.	Total Installed Equipment Cost	$\$10^6$	$/KW
600	Fuel gas processing and handling system	38.2	142
(A)	Total Process Capital (sum of process areas)	38.2	142
(B)	General Facilities		
(C)	Engineering and home office fees		
(D)	Project contingency		
(E)	Total Plant Cost (A+B+C+D)	38.2	142
(F)	Allowance for funds during construction	3.4	13
(G)	Total Plant Investment (E+F)	41.7	154
(H)	Royalty allowance		
(I)	Preproduction costs		
(J)	Inventory capital		
(K)	Initial catalyst and chemicals		
(L)	Subtotal Capital (G+H+I+J+K)	41.7	154
(M)	Cost of construction downtime		
(N)	Total Capital Requirement (L+M)	41.7	154

6.3 Projected O&M Costs

The operating and maintenance (O&M) costs, subdivided into fixed and variable components are provided in Table 6-5. These values are based on actual project expenditures associated with long-term, ongoing operation. This does not include costs associated with testing, technology demonstration, or other costs not directly related to standard utility practice. These costs are in 2009 dollars. The operation is assumed to target an average 90% mercury removal level on a long-term basis.

Table 6-5. Operating and Maintenance Costs.

Fixed O&M Costs	Units	Quantity	$/Unit	$/Year
Operating labor	Person hr/yr	450	63.44	28,548
Maintenance labor	Person hr/yr	309	61.61	19,037
Maintenance material	$/yr			262,112
Administration/support labor	Person hr/yr	500	89.35	44,675
			Subtotal Fixed Costs	**354,372**
Variable Operating Costs	**Units**	**Quantity**	**$/Unit**	**$/Year**
Sorbents				
Powdered activated carbon	lb	535,907	1.034	554,231
Utilities				
Electric power	kWh/hr	3000	0.02	452,724
Waste disposal charges				
Dry solids (trucked-landfill)	Tons/yr	500	81.50	41,765
			Subtotal Variable Cost	**1,048,720**
TOTAL O&M COST (FIXED + VARIABLE)				**1,403,092**

6.4 Summary of Performance and Economics

The primary goal of this project was to reduce mercury emissions from three 90-MW units (Units 7, 8, and 9) that burn Powder River Basin (PRB) coal. Although there are additional benefits of TOXECON™ beyond removal of mercury, the economic analysis of this project will be restricted to cost of mercury removal.

The main long-term co-benefit of the TOXECON™ process is the reduction in particulate matter (PM) emissions. With full-load conditions and all three units directed to the baghouse, Table 6-6 shows typical PM emissions with and without TOXECON™. Test data for PM was not taken at reduced unit loads and it is unknown if the PM reduction varies with boiler load. There is no inherent control of PM capture other than good baghouse operation and maintenance.

Table 6-6. PM Environmental Performance.

TOXECON™ PM Environmental Performance			
	Uncontrolled	**Controlled**	**% Reduction**
Particulates (lb/hr)	117	17	85.5

Table 6-7provides a summary of key parameters used to analyze the economic performance of the project. These values represent normal operation of the plant during the term of the DOE project.

Table 6-7. Summary of Performance and Cost Data.

TOXECON™ Summary of Performance and Cost Data		
Plant Attributes	**Units**	**Value**
Plant capacity	MW	270
Normal full load	MW	255
Power produced, net	10^9 kWh/yr	1.667
Capacity factor	%	74
Coal feed	10^6 tons/yr	1.12
Mercury emissions uncontrolled	lb/hr	0.0170
Mercury emissions uncontrolled	µg/m³	6.0
Mercury emissions uncontrolled	lb/GWH	0.067
Mercury emissions uncontrolled	lb/yr	110

The value for the uncontrolled mercury emissions varies greatly. What is given in the table is felt to be a representative value and is based on stack testing done in November 2008. As an indication of the degree of variance of uncontrolled mercury emissions, Figure 6-1 provides an example of typical data.

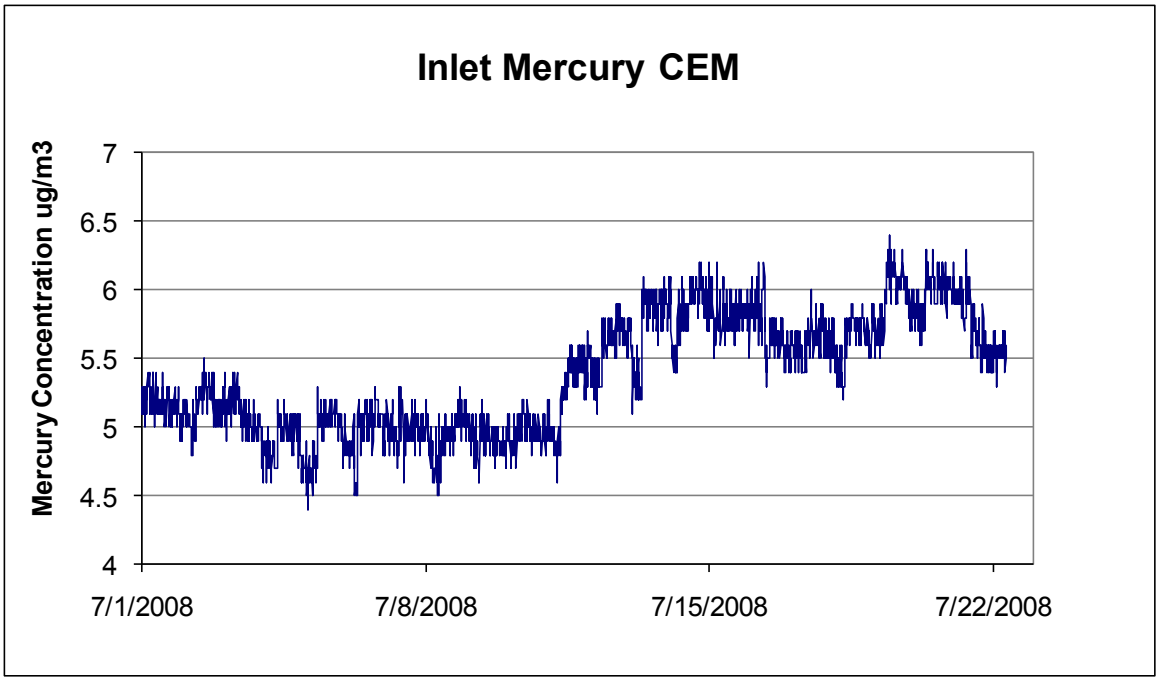


Figure 6-1. Inlet Mercury CEM Data Variation.

The bases for the cost estimates are summarized in Table 6-1, Table 6-4, Table 6-5, and Table 6-7. This analysis uses a plant size of 255 MW because that is the normal full load operation of the plant. The average operating conditions for the plant would result in 110 lb/hr of mercury being emitted if the TOXECON™ system were not installed. Removal effectiveness varies by the rate of PAC injection used. A graph of the parametric test results that were used in this analysis is shown in Figure 6-2 and Figure 6-3. As mercury removal is varied, the only cost items that vary are PAC and waste disposal.

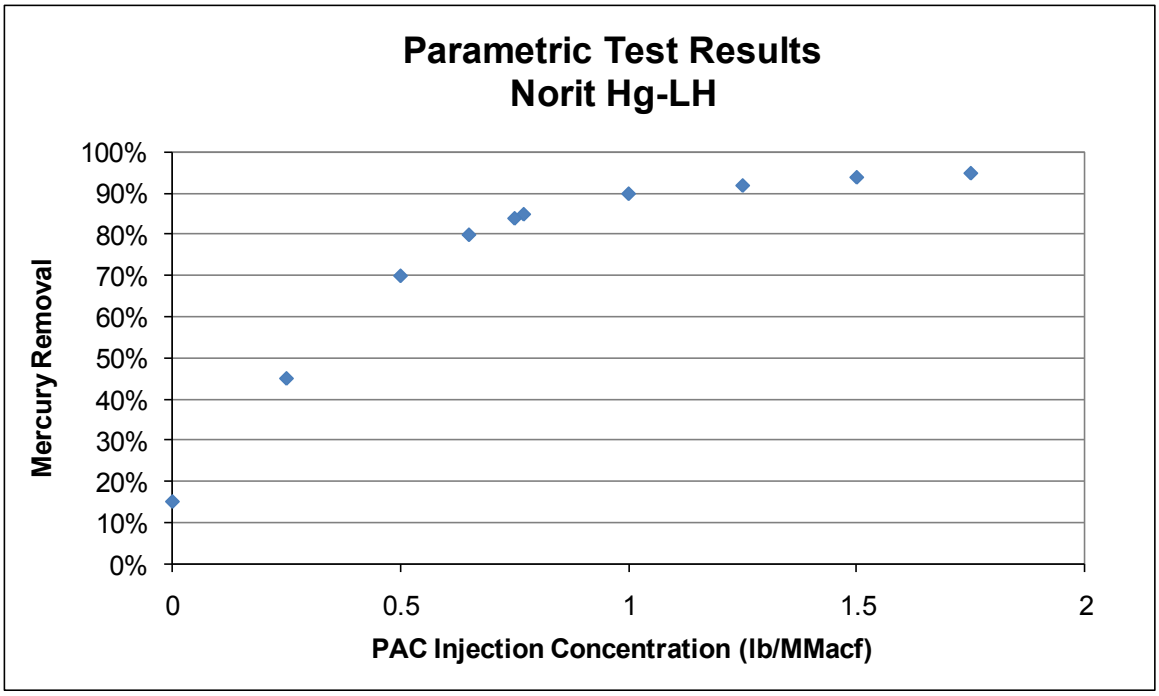


Figure 6-2. Mercury Removal Test Results for Norit Hg-LH.

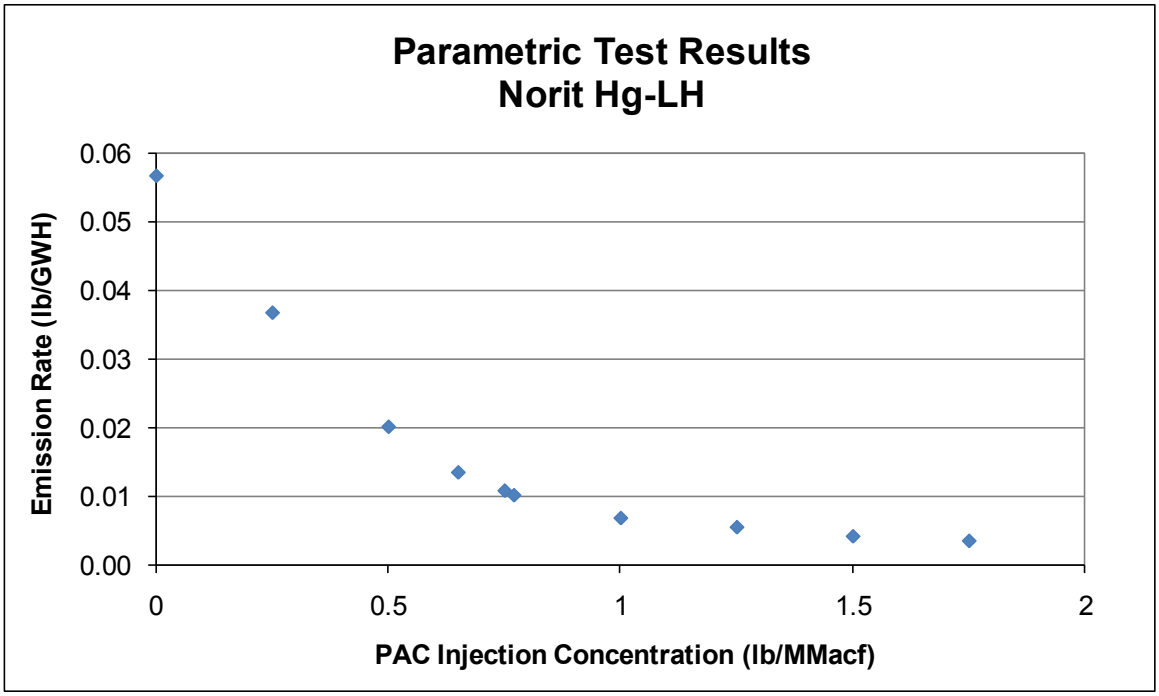


Figure 6-3. Mercury Emission Rate Test Results for Norit Hg-LH.

Capital equipment costs are amortized using a capital recovery factor of 0.15. A constant dollar analysis is used. The annualized capital cost in 2009 dollars is $6,248,922.

The economics at varying mercury removal rates are shown in Table 6-8.

Table 6-8. Cost of Mercury Removal – $/Pound.

	$/Pound of Mercury Removed			
Mercury Removal Rate	**80%**	**85%**	**90%**	**95%**
Capital Charge	$71,087	$66,906	$63,189	$59,863
Fixed O&M Cost	$4,031	$3,794	$3,583	$3,395
Variable O&M Cost	$8,783	$8,860	$9,442	$12,264
Total Cost	**$83,902**	**$79,560**	**$76,214**	**$75,522**

7.0 MARKET ANALYSIS

7.1 Market Drivers

The Environmental Protection Agency (EPA) and the U.S. Congress are considering the degree to which mercury emissions from coal-fired power plants in the United States should be reduced. Multiple approaches have been considered and several rounds of data collection have been initiated. A high control threshold (i.e., > 70%) is expected to be required.

Based on a recent proposed legal settlement agreement filed in the U.S. District Court for the District of Columbia on October 23, 2009, regulatory disposition is expected no later than November 16, 2011 (epa.gov, 2009). Meanwhile, several individual states have promulgated mercury specific regulations in the absence of a federal rule (4cleanair.org). The legal and ethical requirements to control mercury emissions from coal-fired power plants now conspire to mandate consideration of highly effective control technologies.

7.2 Applicability of the TOXECON™ Technology

Control of mercury emissions from coal-fired boilers is primarily achieved by leveraging existing controls used to remove particulate matter (PM), sulfur dioxide (SO_2), and nitrogen oxides (NO_x). The introduction of activated carbon injection and the enhancement of sorbents through the addition of a halogen species can further leverage the existing PM control equipment. When favorable conditions exist, the presence of properly functioning PM control equipment allows for mercury speciation to be encouraged towards the oxidized state and its physio-chemical capture on a highly reactive carbon; the degree of overall collection of fly ash and injected activated carbon in the existing PM control equipment correlates to the capture efficiency.

Coal characteristics and plant configuration may dictate the effectiveness of certain mercury control methods and the suitability of specific methods of mercury emissions control. In circumstances where the singular use of activated carbon for mercury control is determined inappropriate, few commercially viable alternatives remain: wet flue gas desulfurization and TOXECON™. Wet flue gas desulfurization is appropriate where SO_2 control is of primary

interest, but at an installed cost of over $140 per kilowatt there can be little argument made for the use of wet flue gas desulfurization for mercury emissions control independent of the need to control sulfur emissions (eia.doe.gov).

Conversely, TOXECON™ is a technology that is integrated into the electricity generating units existing air pollution control approach in order to enhance mercury control. TOXECON™ is a process in which powdered activated carbon for mercury control is injected upstream of or into a baghouse installed downstream of the existing primary particulate control device. While TOXECON™ can be installed wherever a primary particulate control device exists, and there are arguments for doing so, TOXECON™ remains the sole option in cases where the primary particulate control device is ill suited for capturing mercury and high levels of mercury removal are desired. Specifically, those units configured with hot-side electrostatic precipitators (HESPs) are consigned to employ TOXECON™ for mercury control when control schemes greater than 70% are desired.

The HESPs are so named due to their placement with respect to the air preheater; the control device is positioned on the hot side of the air preheater. HESPs operate at temperatures up to 800 ºF (Bustard and Durham, 2005) as compared to the typical cold-side ESP operating temperature of 250 ºF to 400 ºF. The elevated operating temperatures of the HESPs make for a challenging environment in which to capture mercury on activated carbon.

TOXECON™ may be the viable mercury control choice for certain units burning western coals, but TOXECON™ may be the only mercury control choice for coal-burning units equipped with HESPs as the sole method for particulate control.

7.3 Market Potential

There is over 335GW of coal-fired generation operating in the United States (U.S. DOE, 2008). Less than 10% of the coal-fired generating capacity in the United States remains configured with the HESP design (U.S. EPA, 2005). A 1990 study showed 150 HESPs were built in the United States between 1935 and 1990 (iea-coal.org.uk), but many have been converted to cold-side operation or retired. Recently, power plants equipped with HESPs have been represented as about 18 GW of electricity generating capacity (netl.doe.gov).

In addition to those plants equipped with hot-side electrostatic precipitators, TOXECON™ may have application at power plants burning bituminous coals with cold-side electrostatic precipitators (81GW) and plants burning western subbituminous coals with cold-side electrostatic precipitators (68GW) (www.netl.doe.gov/publications/factsheets/project/Proj224.pdf). The potential of applying sorbents targeting SO_2 and NO_X further enhances TOXECON™'s attractiveness for improved environmental control at units such as these.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The specific objectives of this project were to demonstrate the operation of the TOXECON™ multi-pollutant control system and achieve the following:

- *90% mercury removal from flue gas through activated carbon injection.*
  - This objective was met during 30 of the 34 months of long-term testing. One of the months that did not meet the criteria was due to alternative PAC testing, which bypassed the main PAC injection equipment. The other three months did not meet the criteria due to operational issues with the outlet CEM.
- *Evaluation of the potential for 70% SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection.*
  - The goal of 70% SO_2 removal was achieved when injecting 5926 lb/hr of trona. This corresponds to an average normalized stoichiometric ratio (NSR) of 1.02. The highest removal was 74.1% with PAC injection at 3.8 lb/MMacf.
  - There was very little reduction in NO_x during the test period. In addition, the effect of a side reaction, where NO is oxidized to produce NO_2, was observed on one test day when PAC injection was turned off. This indicates that there is some conversion of NO to NO_2, but not enough to measure on the stack NO_x CEMs and considerably below the target of 30% reduction. The NO_2 level from the conversion was high enough to be visible and cause an increase in opacity of almost 3%. On days with simultaneous injection of PAC and sodium sorbents, the opacity increased by a maximum of 0.75% with no visible plume.
  - Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. This effect was seen every day that trona was injected. When trona injection was discontinued, mercury removal slowly recovered over a ten hour period to the pre-test level of > 90%. On the last two days of testing, PAC injection was increased to attempt to regain the > 90% removal rate. Test conditions and schedule did not allow sufficient time to achieve this target rate while injecting trona. An estimate of the required PAC is 3X the pre-trona test rate.

- *Reduced PM emission through collection by the TOXECON™ baghouse*
  - The main long-term co-benefit of the TOXECON™ process was the reduction in particulate matter (PM) emissions. With full load conditions and all three units directed to the baghouse, inlet particulate was 117 lb/hr and outlet was 17 lb/hr, which was 85% reduction.
- *Recovery of 90% of the mercury captured in the sorbent*
  - Two thermal desorption methods were successful in removing mercury from the TOXECON™ PAC/ash material. The first method utilized the "air slide" technology patented by We Energies and licensed by United E & E. This is a patented technology (U.S. Patent 7217401, Mercury Removal from Activated Carbon and/or Fly Ash). Sorbent and/or fly ash with affixed mercury compounds is exposed to heated flowing air until the sorbent reaches a temperature of at least 700 ºF (372 ºC).
  - The second technology used microwave energy to selectively heat the PAC particles, thereby saving on energy costs. This technology was demonstrated under this project by UP Steel.
  - In addition, ADA-ES developed a new approach to using PAC-containing ash for structural concrete. This method utilized the combination of a specific batch design (developed by ADA-ES) with a foam-based AEA that was modified specifically for this application (developed by Miracon™ Technologies, Inc.). This combined technology was tested on concrete mixtures with ash containing < 1% to as much as 30% LOI from PAC. A successful field demonstration using 30% LOI ash to make a large concrete pad at the Presque Isle plant was completed in June 2009. Leaching tests on concrete samples showed a reduction in leached mercury and chromium from the high PAC samples, although all samples were well below the TCLP reporting criteria. All samples showed that only a very small amount of bromide was leachable.

- *100% availability for utilization of fly ash collected in the existing electrostatic precipitator.*
  - Throughout the demonstration project, the ash from the existing ESPs was not affected by the TOXECON™ process, resulting in 100% beneficial utilization.
- *Demonstration of a reliable, accurate mercury CEMS suitable for use in the power plant environment.*
  - At the beginning of the CCPI project, several mercury analyzers were commercially available for ambient and laboratory mercury measurements but they were not designed to operate in a power plant environment in an automated fashion to produce reliable and accurate data continuously over long periods of time. In December 2005 two commercial Thermo Mercury Freedom™ CEMs were installed at the inlet and outlet of the baghouse. These systems were monitored remotely and provided mercury removal data for the demonstration project. A significant development effort was undertaken during this project to develop a commercial CEM for mercury.
- *Successful system integration and optimization of TOXECON™ operation for mercury and multi-pollutant control.*
  - The TOXECON™ baghouse and associated equipment was successfully integrated into plant operations. The equipment and operation of the system were upgraded and optimized during the demonstration project.

In addition to successfully meeting the objectives of the project, several other issues were addressed on this project. Early in the testing phase of the project, hopper fires occurred due to auto-ignition of the PAC/ash mixture. After extensive laboratory testing to understand the mechanism and operational changes at the plant, several recommendations were made to help minimize the risk of overheating high carbon ash in hoppers:

9.0 BIBLIOGRAPHY

1. http://www.4cleanair.org/
2. Berry, M., N. Irvin, L. Monroe, J. Bustard, C. Lindsey, P. Brignac, T. Taylor, R. Schlager, S. Sjostrom, T. Starns, R. Chang, and A. O'Palko (2004). "Field Test Program for Long-Term Operation of a COHPAC® System for Removing Mercury from Coal-Fired Flue Gas," presented at US EPA/DOE/EPRI Combined Power Plant Air Pollutant Control Symposium: The Mega Symposium, Washington, D.C., August 30–September 2.
3. Bustard, C.J. (2003). "Field Test Program to Develop Comprehensive Design, Operating, and Cost Data for Mercury Control Systems: Final Site Report for Pleasant Prairie Power Plant Unit 2, Sorbent Injection into a Cold-Side ESP for Mercury Control." Topical Report No. 41005R12, U.S. DOE Cooperative Agreement No. DE-FC26-00NT41005, May.
4. Bustard, C.J. (2004). "Full-Scale Evaluation of Mercury Control by Injecting Activated Carbon Upstream of ESPs and Fabric Filters," presented at the Air & Waste Management Association, Rocky Mountain States Section, 2004 Technical Fall Conference, Denver, CO, September 30.
5. Bustard, C.J. and M. Durham (2005). Air Pollution Control Equipment New Technology Acceptance Process," presented at the AWMA 97th Annual Conference & Exhibition, Indianapolis, June.
6. Bustard, C.J., M. Durham, C. Lindsey, T. Starns, K. Baldrey, C. Martin, S. Sjostrom, R. Slye, S. Renninger and L. Monroe (2001). "Full-Scale Evaluation of Mercury Control with Sorbent Injection and COHPAC® at Alabama Power E.C. Gaston," presented at the A&WMA Specialty Conference on Mercury Emissions: Fate, Effects, and Control and The US EPA/DOE/EPRI Combined Power Plant Air Pollutant Control Symposium: The MEGA Symposium, Chicago, IL, August 20–23.
7. Bustard, C.J., T. Grubb, R. Merritt, S. Sjostrom, R. Chang, A. Casey, K. Turchi, and R. Jeanes (2001). "TXU Big Brown COHPAC® Performance Improvement with High Permeability Fabric," presented at A&WMA Specialty Conference on Mercury Emissions: Fate, Effects and Control and the US EPA/DOE/EPRI Combined Power

Plant Air Pollutant Control Symposium: The MEGA Symposium, Chicago, IL, August 20–23.

8. Durham, M.D. (2003). "Field Test Program to Develop Comprehensive Design, Operating and Cost Data for Mercury Control," presented at the DOE/NETL Mercury Control Technology R&D Program Review Meeting, Pittsburgh, PA, August 12.
9. EPRI Project Report number ADA4352002F01, March 1994.
10. EPRI Project RP 3083-05 Final Report (Mohave Pilot Tests), April 1996.
11. EPRI Project #TR-110867, "Assessing Air Pollution Control Options at the Hudson Station of Public Service Electric and Gas," August 1998.
12. http://www.eia.doe.gov/cneaf/electricity/epa/epat5p3.html
13. http://www.epa.gov/EPA-AIR/2009/October/Day-28/a25992.htm
14. http://www.iea-coal.org.uk/site/ieacoal_old/clean-coal-technologies-pages/electrostatic-precipitators-esp?
15. http://www.netl.doe.gov/publications/factsheets/project/Proj224.pdf
16. Government Accountability Office (2005). "Emerging Mercury Control Technologies Have Shown Promising Results, but Data on Long-Term Performance Are Limited," report to Congressional Requesters, GAO-05-612, May.
17. McKenna, J. D. and J. H. Turner. 1989. "Fabric Filter-Baghouses I. Theory, Design, and Selection." Roanoke, VA: ETS.
18. Sjostrom, S., T. Ebner, T. Ley, R. Slye and R. Chang (2002). "Evaluation and Comparison of Novel, Low-Cost Sorbents for Mercury Control," presented at the Nineteenth Annual International Pittsburgh Coal Conference, September 23–27.
19. U.S. Department of Energy EIA, (2008). "Existing Generating units in the United States by State, Company and Plant, Preliminary."
20. U.S. Environmental Protection Agency, (2005). "Control of Mercury Emissions from Coal Fired Electric Utility Boilers: An Update," Air Pollution Prevention and Control Division, National Risk Management Research Laboratory, Office of Research and Development, February 18.
21. We Energies (2009). "TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers: Public Design Report."

Appendix A. Gaston COHPAC® Testing

APPENDIX A

FULL SCALE TOXECON™ TESTING AT E.C. GASTON UNIT 3

Table of Contents

1.0 Full-Scale TOXECON™ Testing at E.C. Gaston Unit 3 1-4
1.1 Baseline Tests 1-7
1.2 Optimization Tests 1-8
1.3 Long-Term Tests 1-9
1.4 Low-Load Tests 1-11
1.5 Pilot-Scale TOXECON™ Testing 1-13

List of Tables

Table 1-1. Optimized Activated Carbon Injection Settings. 1-9

Table 1-2. Comparison of Flue Gas Characteristics for High and Low Flow Conditions.. 1-12

Table 1-3. Results Summary from Low Load Tests, November 2003. 1-13

List of Figures

Figure 1-1. Mercury Removal with Activated Carbon Injected Upstream of COHPAC® at Alabama Power Plant Gaston, Spring 2001..... 1-4

Figure 1-2. COHPAC® Cleaning Frequency in Pulses/Bag/Hour as a Function of ACI Concentration. Measurements Made During Parametric Tests, March 2001..... 1-5

Figure 1-3. Inlet and Outlet COHPAC® Mercury Concentrations, Boiler Load, and ACI Rates; Plant Gaston, 2001..... 1-6

Figure 1-4. Performance Data for Unit 3B COHPAC® During Long-Term Testing, 2003. . 1-10

Figure 1-5. Daily and Weekly Averages of Inlet and Outlet Mercury Concentrations and Mercury Removal from July 19 through November 23, 2003..... 1-11

Figure 1-6. Mercury Removal in TOXECON™ Tests on Bituminous and PRB Coals..... 1-14

1.0 FULL-SCALE TOXECON™ TESTING AT E.C. GASTON UNIT 3

DOE/NETL began supporting full-scale evaluations of sorbent injection for mercury control in 2000. The first site tested in 2001 was Alabama Power's E.C. Gaston Station Unit 3 (Bustard, et al., 2001). In this short-term test, activated carbon was injected upstream of a COHPAC® fabric filter. COHPAC®, also an EPRI technology, is a fabric filter installed downstream of the existing particulate control device and is used to capture particles escaping from the primary particulate control device; however, with COHPAC® there is no sorbent injection for control of toxic species. Although this unit was designed as a COHPAC® fabric filter, when ACI was added, the test was actually similar to the TOXECON™ configuration.

Figure 1-1 presents the results from parametric tests, which evaluated mercury removal at different PAC concentrations. The tests showed that 90% mercury removal could be achieved at relatively low injection concentrations (<3 lbs/MMacf); however, they also showed that baghouse cleaning frequency increased proportionally with injection rate (Figure 1-2).

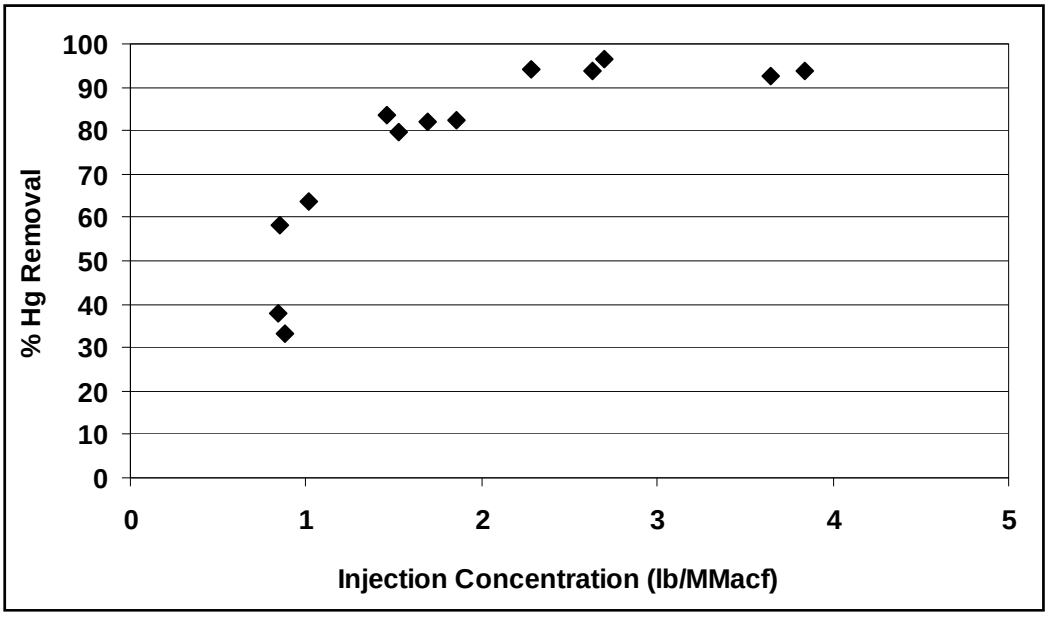


Figure 1-1. Mercury Removal with Activated Carbon Injected Upstream of COHPAC® at Alabama Power Plant Gaston, Spring 2001.

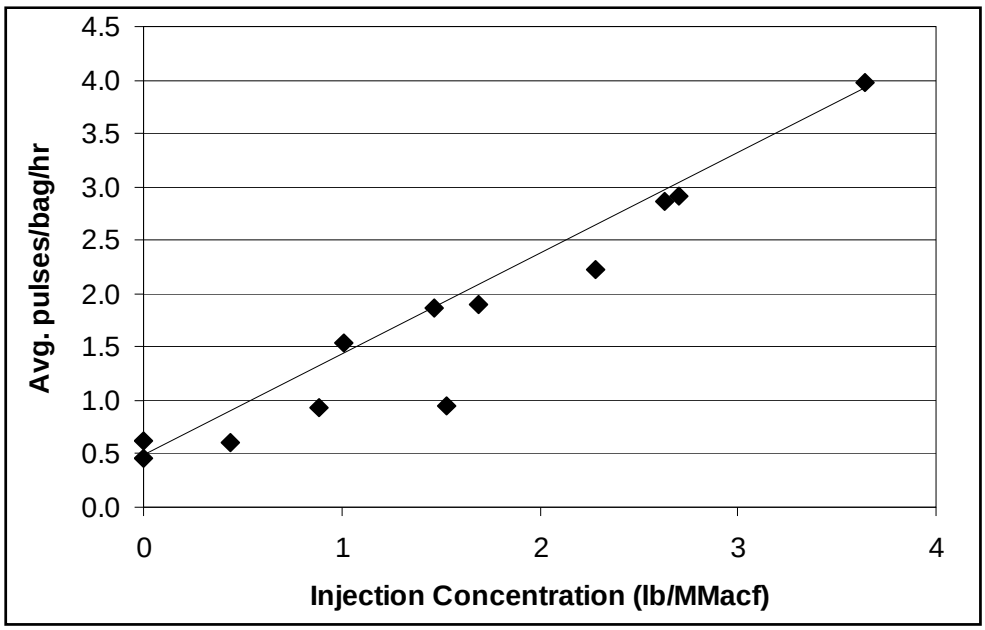


Figure 1-2. COHPAC® Cleaning Frequency in Pulses/Bag/Hour as a Function of ACI Concentration. Measurements Made During Parametric Tests, March 2001.

Based on these results, a two-week injection test was conducted at an injection concentration of 1.5 lbs/MMacf, which was the highest injection rate possible without significantly impacting cleaning frequency. Figure 1-3 presents inlet and outlet mercury concentrations, boiler load, and carbon injection rate for a portion of the two-week test. Also shown in this graph are the results from Ontario Hydro mercury measurements.

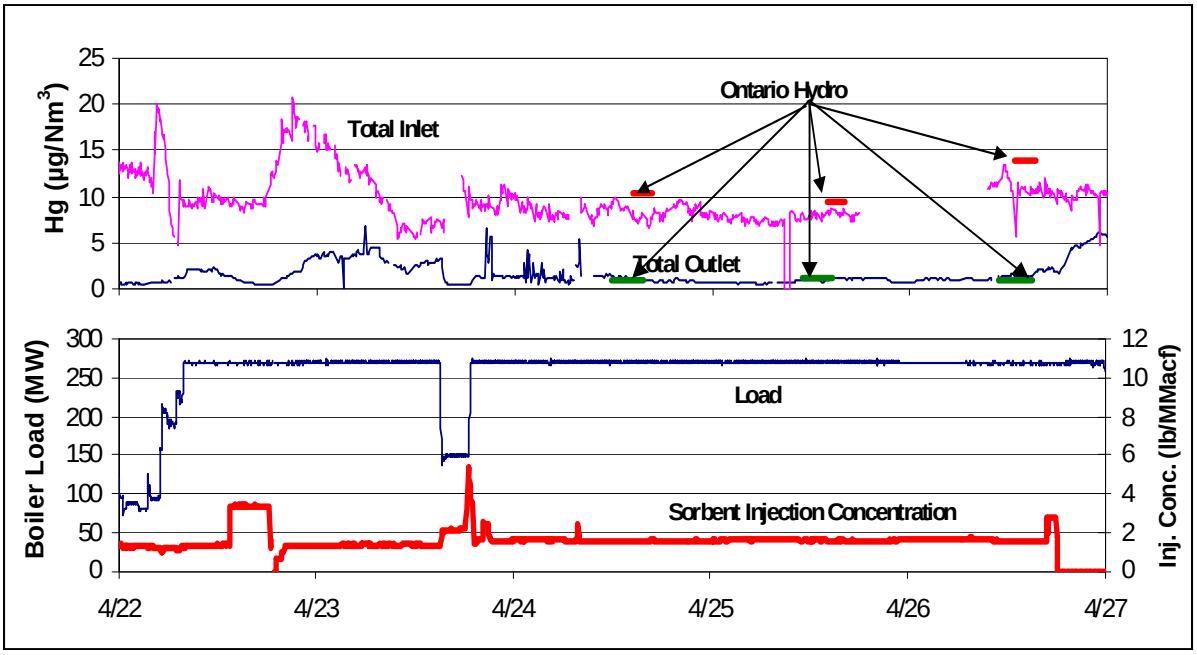


Figure 1-3. Inlet and Outlet COHPAC® Mercury Concentrations, Boiler Load, and ACI Rates; Plant Gaston, 2001.

The results from this 2001 field test program at Gaston provided a good indication of the capability (high mercury removal) and limitations (high cleaning frequency) of the COHPAC® configuration modified as a TOXECON™ configuration for controlling mercury. However, the tests were performed for a limited amount of time (<200 hours of continuous operation) and did not allow for a thorough operational analysis of the use of this technology for mercury control. The tests also suggested that designing the baghouse for a lower A/C ratio might allow carbon injection at a rate consistent with high removals without excessive pressure drop or excessive cleaning frequency.

In the fall of 2002, NETL selected ADA-ES to conduct a long-term evaluation of ACI into the COHPAC® fabric filter at the Gaston Station (Berry, et al., 2004). The overall objectives of this yearlong mercury control program were to assess the operational impacts to COHPAC® and the ability to effectively control mercury over varying operational and seasonal conditions.

The test program was designed with three test periods plus a short-term test evaluating performance at a lower A/C ratio. The purpose of each test is described below:

- Baseline: Testing in this period was dedicated to understanding fabric filter operation and mercury removal with no carbon injection.
- Optimization: The tests in 2001 showed that carbon injection directly impacted fabric filter cleaning frequency (Bustard, et al., 2001). This period was included to find a carbon injection scheme that achieved the highest mercury removal within the operational limits of the system.
- Long-Term Testing: Operate continuously at optimized injection conditions.
- Low A/C Test: Obtain operating data at an A/C ratio deemed appropriate for a TOXECON™ fabric filter.

1.1 Baseline Tests

In the follow-on tests, COHPAC® cleaning frequency and native mercury removal (removal of vapor-phase mercury by the carbon in fly ash) were very different from what was seen during the 2001 tests. Cleaning frequency was much higher than expected, and was above the target maximum cleaning frequency of 1.5 pulses/bag/hour (p/b/h), which was used during the two-week test in 2001. There were times when the fabric filter was cleaning continuously at 4.4 p/b/h.

In the earlier tests, there was virtually no mercury removal at baseline conditions. In this second round of tests, mercury removal varied between 0 and 90%, and was dependent on inlet mass loading.

The difference in performance was caused by substantially higher particulate mass loading exiting the HESP and entering the fabric filter. Hot-side ESP performance was evaluated and suggested that the HESP was operating within design conditions for the type of ash being collected and without any flue gas conditioning. So, although the HESP was performing within design specifications, there was a much higher amount of ash exiting the unit, creating an inlet loading greater than the design conditions for the COHPAC® fabric filter.

In order to understand the high inlet loading to the COHPAC® unit, Loss on Ignition (LOI) tests were performed on the ash. The LOI is an indication of the carbon content in the ash, which can affect the native mercury uptake. A high LOI can also adversely affect the performance of ESPs, allowing more particles to escape the unit. The LOI of the ash in the first baseline tests was 11%, while the second baseline tests showed an LOI of 17.4% (Bustard, et al., 2003). This increase in LOI could have been a factor in both the high inlet loading to the COHPAC® unit and the intermittent high native mercury removal.

Hamon Research-Cottrell was brought in to inspect the HESP in an effort to determine why there was a high particulate loading entering the COHPAC® unit. Power levels were found to be extremely low in all fields of the HESP, which may have been caused by the high carbon/low resistivity ash. Low power levels could also directly reduce capture efficiency. Also, two chambers fields were out of service, which could also negatively impact capture efficiency (Bustard, et al., 2003). Several other factors may have contributed to the creation of low resistivity ash such as coal type and/or boiler operations, but no definitive source was identified.

1.2 Optimization Tests

Because of the highly variable baseline conditions and the already poor performance of the fabric filter, the ability to inject activated carbon was severely limited. To overcome this, an injection scheme was implemented that balanced the need to decrease carbon injection during times when inlet loading to the fabric filter was high and increase carbon injection when inlet loading and mercury removal were low. A signal from a particulate monitor measuring COHPAC® inlet mass loading was used to control ACI. The control settings can be seen in Table 1-1. When inlet loading was less than 0.07 gr/acf, the injection rate was set to either 16 or 20 lbs/hr (0.52 or 0.66 lbs/MMacf). When inlet loading was higher, between 0.07 and 0.14 gr/acf, the injection rate was lowered to 10 lbs/hr (0.35 lbs/MMacf). When inlet loading was greater than 0.14 gr/acf, the baghouse was often in a state of continuous cleaning and carbon injection was turned off. Removal efficiency was not significantly impacted at the lower ACI rates because the natural loading and mercury removal efficiency were higher.

Table 1-1. Optimized Activated Carbon Injection Settings.

Ash Inlet Loading (gr/scf)	Ash Inlet Loading (gr/acf)	Carbon Injection Concentration (lbs/MMacf)	Carbon Injection Rate (lbs/hr)	Carbon Injection Rate (gr/acf)
<0.1	<0.07	0.52 or 0.66	16 or 20	0.0036–0.0046
0.1–0.2	0.07–0.14	0.35	10	0.0025
>0.2	>0.14	0	0	0

1.3 Long-Term Tests

Figure 1-4 presents a snapshot of data during long-term testing. Inlet and outlet total vapor-phase mercury, calculated mercury removal, carbon injection concentration, baghouse cleaning frequency, and inlet mass loading are presented. During this period, inlet mass loading varied from 0.03 gr/acf to 0.19 gr/acf and carbon injection concentration can be seen to adjust to these changes. For most of this period the baghouse was in continuous clean, even when carbon injection was turned off. Mercury removal varied between 50 and 98%, with an overall average of 90%.

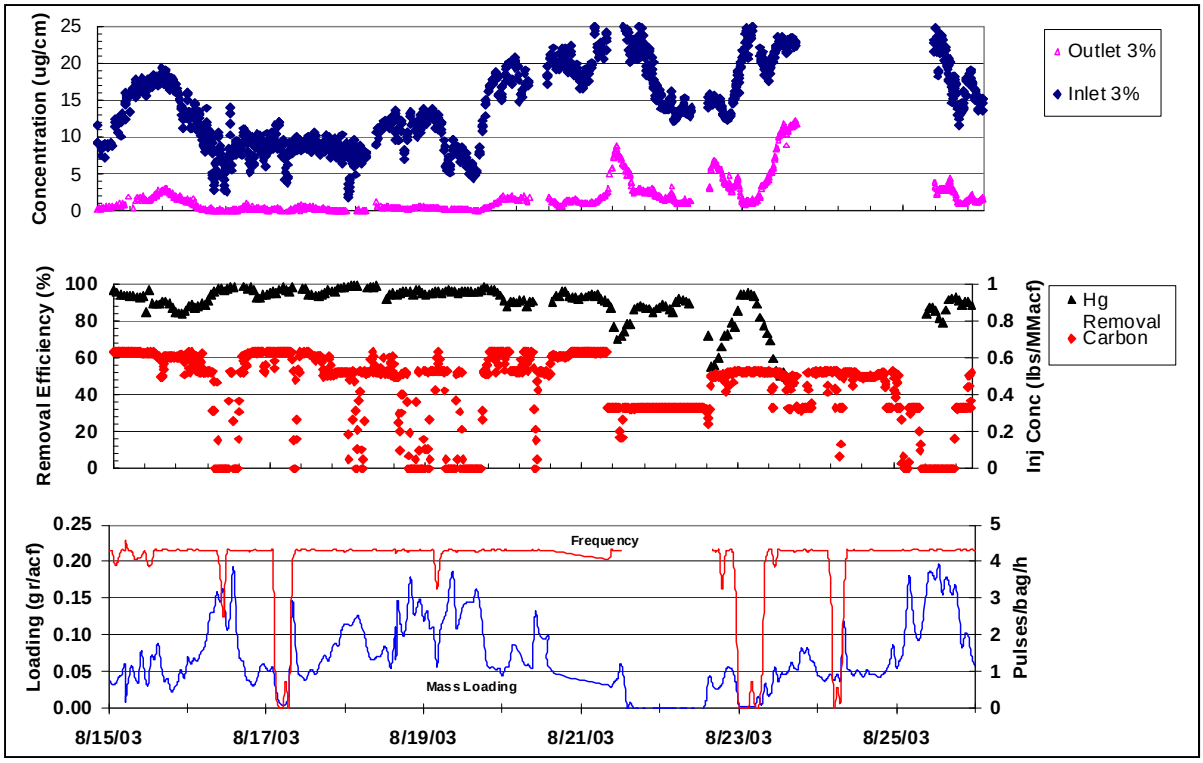


Figure 1-4. Performance Data for Unit 3B COHPAC® During Long-Term Testing, 2003.

Average daily and weekly inlet and outlet mercury concentrations and mercury removal efficiencies for a four-month period are presented graphically in Figure 1-5. The average inlet mercury concentration was 14.3 μg/Nm^3, with daily average concentrations varying between nominally 5.1 to 25.6 μg/Nm^3. The average outlet mercury concentration for the same period was 2.1 μg/Nm^3, with daily average concentrations varying between 0.24 and 6.2 μg/Nm^3. Average mercury removal was 85.6%, with a minimum daily average of 63.5% and a maximum daily average of 98.1%. The maximum carbon injection concentration was 0.66 lbs/MMacf, and at times carbon injection was turned off. The average injection concentration was 0.55 lbs/MMacf, which was much lower than what was needed in the 2001 test to obtain similar removal efficiencies (Bustard, et al., 2001).

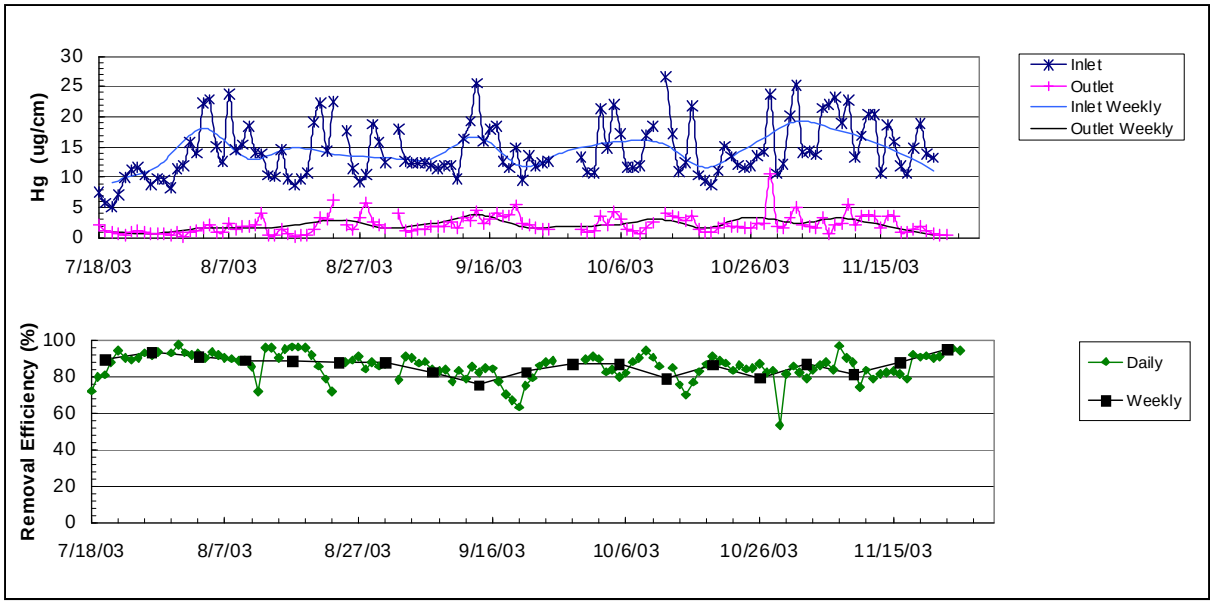


Figure 1-5. Daily and Weekly Averages of Inlet and Outlet Mercury Concentrations and Mercury Removal from July 19 through November 23, 2003.

It is believed that the higher removal efficiencies obtained at lower carbon injection concentrations than predicted in the earlier tests occurred because there was significant carbon on the bags from the higher baseline mass loading entering the baghouse. The COHPAC® hopper ash had a relatively high carbon content with LOI between 15 and 30%.

1.4 Low-Load Tests

Throughout these tests, the higher than expected mass loading into COHPAC® limited the quantity of carbon that could be injected. Although the test plan and injection logic was altered to accommodate these real-life conditions, the question of how this information could be used in the design of TOXECON™ systems was left virtually unanswered.

One thing that was clear from these tests was that the A/C ratio was too high to inject sufficient carbon to achieve 90% mercury control. A new TOXECON™ baghouse would have to be designed at a lower A/C ratio. One way to overcome the operating limitations at this site was to operate at low load/lower flow for an extended period. While at these conditions, carbon injection could be increased and performance data could be tracked. The primary objectives of these short tests were to 1) determine the injection concentration

necessary to achieve 90% removal, and 2) determine the impact of carbon injection on cleaning frequency at this lower A/C ratio. An educated estimate of the ideal A/C ratio was about 6.0 ft/min.

Alabama Power was able to schedule an extended period of low load operation for Gaston Unit 3. Full load at Gaston was nominally 270 MW. The flow rate was split into two baghouses so that at full load the flow into 3B baghouse is nominally 520,000 acfm. In November 2003, Unit 3 was operated at 195 MW for a 72-hour block of time. ADA-ES measured the flow rate into Unit 3B at 375,000 acfm using a mass flow meter. Table 1-2 summarizes the differences in key variables at these two load conditions.

Table 1-2. Comparison of Flue Gas Characteristics for High and Low Flow Conditions.

Unit 3 Boiler Load (MW)	**270**	**195**
Unit 3B Flow (afcm)	520,000	375,000
Unit 3B A/C ratio (ft/min)	~8.0	~6.0
Gas Temperature (ºF)	277	268
Oxygen Concentration (%)	7.84	8.35
Bag Surface Area (ft^2)	62,000	62,000
Ash Particulate Loading (gr/acf)	0.0761	0.0062

Three injection rates were evaluated during the 72-hour test. The first test was conducted at the highest injection rate possible under normal operating conditions, 20 lbs/hr. At this rate and the lower flow, the injection concentration was 0.9 lbs/MMacf instead of 0.6 lbs/MMacf. The injection concentrations were then increased up to a maximum of nominally 3.3 lbs/MMacf.

The results from this test, including inlet and outlet mercury concentrations, mercury removal, and cleaning frequency are presented in Table 1-3. These data more closely matched the results from the 2001 tests. At an injection concentration of 0.9 lbs/MMacf, mercury removal was between 80 and 90%. When injection concentration was increased above 2 lbs/MMacf, mercury removal was well above 90%, and there were no episodes when the removal dropped below this level. Cleaning frequency was acceptable at all injection

rates during these short duration tests (baghouse pressure drops normally increase over long operational periods requiring increased cleaning frequency).

Table 1-3. Results Summary from Low Load Tests, November 2003.

Injection Rate (lb/hr)	Injection Concentration (lbs/MMacf)	Inlet Hg Concentration (µg/Nm^3)	Outlet Hg Concentration (µg/Nm^3)	Removal Efficiency (%)	Cleaning Frequency (pulses/bag/hr)
20	0.9	20.6	3.2	84.2	0.6
45[a]	2.0	22.2	1.0	94.6	0.8
70	3.3	21.4	0.61	97.1	1.4

a. The last 18-hour time period of 45 lb/h test.

The results of the tests performed at Gaston showed that activated carbon injection in a COHPAC® baghouse could remove particulate and up to 90% of the mercury in the flue gas streams. Testing the existing COHPAC® unit provided inferences as to the TOXECON™ concept viability at full scale, but was not flexible enough to provide the information needed to assess a full-scale, commercial installation. The Gaston tests were not sufficient to evaluate the commercial potential due to the size of the COHPAC® unit, which was designed to filter only the particulate loading from the HESP unit and not additional sorbent particles, which is the TOXECON™ contribution. However, Gaston testing provided valuable information in designing the full-scale TOXECON™ unit, such as a maximum A/C ratio of 6, desired carbon injection rate, etc.

1.5 Pilot-Scale TOXECON™ Testing

Over the years, EPRI has conducted numerous pilot- and bench-scale tests of TOXECON™ (Sjostrom, et al., 2002). Figure 1-6 summarizes results from these tests showing mercury removal trends on both bituminous and PRB coals. Since no full-scale COHPAC® or TOXECON™ fabric filters existed on units firing PRB coals, the best data available to predict performance at Presque Isle were shown in this Figure. Both trends indicated that high mercury removal, 90%, can be achieved with an injection concentration less than 3 lbs/MMacf.

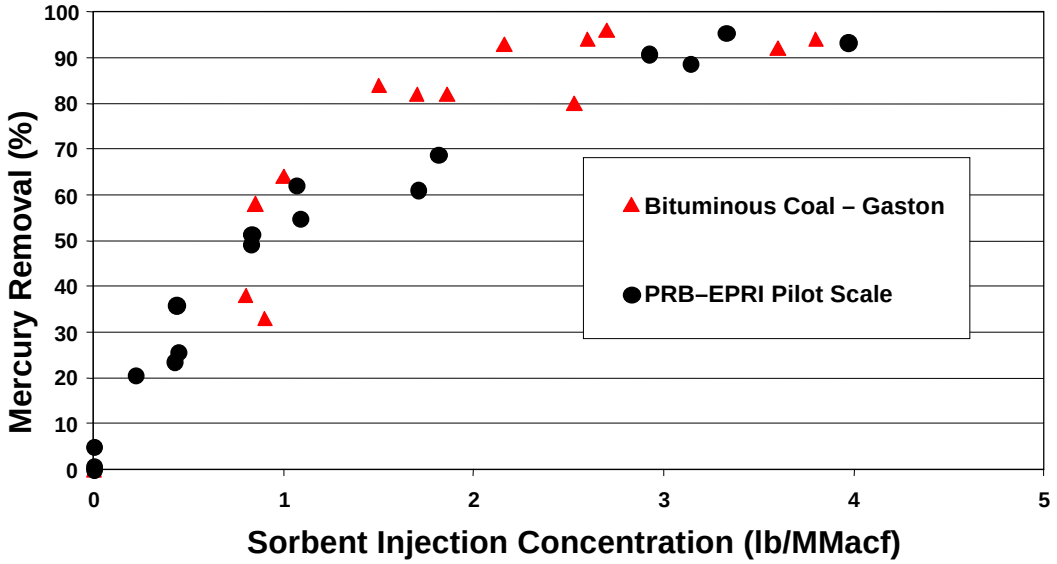


Figure 1-6. Mercury Removal in TOXECON™ Tests on Bituminous and PRB Coals.

References

Berry, M., N. Irvin, L. Monroe, J. Bustard, C. Lindsey, P. Brignac, T. Taylor, R. Schlager, S. Sjostrom, T. Starns, R. Chang, and A. O'Palko (2004). "Field Test Program for Long-Term Operation of a COHPAC® System for Removing Mercury from Coal-Fired Flue Gas," presented at US EPA/DOE/EPRI Combined Power Plant Air Pollutant Control Symposium: The Mega Symposium, Washington, D.C., August 30–September 2.

Bustard, C.J., C. Lindsey, P. Brignac, T. Starns, S. Sjostrom, T. Taylor, and C. Larson (2003). "Field Test Program for Long-Term Operation of a COHPAC® System for Removing Mercury from Coal-Fired Flue Gas," Quarterly Technical Report, Report #41591R05, October 31.

Bustard, C.J., M. Durham, C. Lindsey, T. Starns, K. Baldrey, C. Martin, S. Sjostrom, R. Slye, S. Renninger and L. Monroe (2001). "Full-Scale Evaluation of Mercury Control with Sorbent Injection and COHPAC® at Alabama Power E.C. Gaston," presented at the A&WMA Specialty Conference on Mercury Emissions: Fate, Effects, and Control and The US EPA/DOE/EPRI Combined Power Plant Air Pollutant Control Symposium: The MEGA Symposium, Chicago, IL, August 20–23.

Sjostrom, S., T. Ebner, T. Ley, R. Slye and R. Chang (2002). "Evaluation and Comparison of Novel, Low-Cost Sorbents for Mercury Control," presented at the Nineteenth Annual International Pittsburgh Coal Conference, September 23–27.

Appendix B. Test Plan for PIPP

Test Plan for TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers

Presque Isle Power Plant

Prepared for:
We Energies
DOE/NETL

Prepared by:
ADA-ES, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120
(303) 734-1727

June 15, 2006

Table of Contents

1 Introduction and Summary 4

2 Unit Description 5

3 Project Terminology and Concepts 8

3.1 TOXECON™ Terminology 8
3.2 Presque Isle Unit Load Conditions 8

4 Test Program Description 10

4.1 Optimization Testing 12
4.1.1 Baseline Testing 12
4.1.2 Parametric Testing 13
4.1.3 Flue Gas Temperature 16
4.1.4 Automatic Control 16
4.1.5 Reliability Test Period 17
4.2 Long-Term Testing 18
4.2.1 Adjust Drag Setpoint for Cleaning 18
4.2.2 Air-to-Cloth Ratio Tests 18
4.2.3 Assess Ash Distribution and Quality 20
4.2.4 Sorbent/Ash Recycle 21
4.2.5 Assess Offline Cleaning in the Fabric Filter 22
4.2.6 Particulate Emissions 23
4.2.7 Alternate Sorbent Testing 23
4.3 Experimental Filter Bags 23
4.4 Multi-Pollutant Trim Controls 25
4.5 Mercury Recovery from Spent Sorbent 26

5 Test Program Management and Reporting 27

6 Test Method and Analyzer Descriptions 28

6.1 Flue Gas Mercury Measurements 28
6.1.1 Thermo Electron CEM 28
6.1.2 Sorbent Trap Method 30
6.2 Particulate Measurements 31
6.3 NO_x and SO_x Measurements 32

7 Solids Sampling and Analysis 33

7.1 Coal Sampling and Analysis 33
7.2 Ash Sampling and Analysis 33

8 References 34

9 Appendix: Plant Data Collection Table 35

List of Tables

Table 1. Unit Description 5
Table 2. Blend Coal Quality (Typical Values), As-Received Basis 6
Table 3. Emission Limits 6
Table 4. Schedule of Activities 11
Table 5. Baseline – Mass Balance Tests 13
Table 6. Parametric – DARCO® Hg Tests 15
Table 7. Parametric – DARCO® Hg-LH 16
Table 8. Optimized – Mass Balance Tests 17
Table 9. Adjusted Cleaning Setpoint Tests 18
Table 10. Compartment Isolation and A/C Ratio 19
Table 11. Reduced Air-to-Cloth Ratio Tests 20
Table 12. Ash/Sorbent Distribution Tests 21
Table 13. Test Bag Materials 24

List of Figures

Figure 1. TOXECON™ System Schematic 7
Figure 2. Test Bag Layout 25
Figure 3. Schematic of the Thermo Electron Mercury Freedom System 28
Figure 4. Mercury CEM Extraction Probe 29
Figure 5. Schematic of an STM Carbon Trap 30
Figure 6. Schematic of an STM Sampling Train 31

1 Introduction and Summary

We Energies' Presque Isle Power Plant is the site of a DOE Clean Coal demonstration project being conducted under a cooperative agreement with Wisconsin Energy Corporation (WEC) and the Department of Energy (DOE). The primary goal of this project is to reduce mercury emissions from three 90-MW units. Additional goals are to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) emissions, allow for reuse and sale of fly ash, develop and demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment, and demonstrate a process to recover mercury captured in the sorbent. To achieve these goals, We Energies (the Participant) will design, install, and operate a TOXECON™ system designed to clean the combined flue gases of Units 7, 8, and 9 at the Presque Isle Plant.

TOXECON™ is an Electric Power Research Institute (EPRI) patented process in which a fabric filter system (baghouse) installed downstream of an existing particulate control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. The flue gas emissions will be controlled from the three units using a single baghouse. Mercury will be controlled by injection of activated carbon or other novel sorbents, while NO_x and SO_2 will be controlled by injection of sodium-based or other novel sorbents. Addition of the TOXECON™ baghouse will provide enhanced particulate control. Sorbents will be injected downstream of the existing particulate control device (hot-side electrostatic precipitators) to allow for sale and reuse of captured fly ash, uncontaminated by activated carbon or sodium sorbents.

Methods for sorbent regeneration, i.e., mercury recovery from the sorbent, will be explored and evaluated. Mercury CEM components will be evaluated and the best available will be integrated into a mercury CEM suitable for use in the power plant environment.

The specific objectives of this project are to demonstrate the operation of the TOXECON™ multi-pollutant control system and:

1. Achieve 90% mercury removal from flue gas through activated carbon injection.
2. Reduce particulate emissions through collection by the TOXECON™ baghouse.
3. Maintain 100% utilization of fly ash collected in the existing electrostatic precipitator.
4. Demonstrate a reliable, accurate mercury CEM suitable for use in the power plant environment.
5. Evaluate the potential for 70% SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection.

This test plan identifies the sequence of tests that will be conducted after start-up to optimize the TOXECON™ installation at Presque Isle and to better understand the technology for future applications.

2 Unit Description

We Energies, a utility subsidiary of Wisconsin Energy Corporation, serves more than one million electric customers in Wisconsin and the Upper Peninsula of Michigan. Located on 65 acres of land on the shores of Lake Superior, Presque Isle Power Plant has the capability to produce 617 MW of electricity. Presque Isle Units 7, 8, and 9 are the three units designated to have a mercury control system installed as a DOE Clean Coal demonstration project.

Presque Isle Units 7–9 are Riley turbo-fired, balanced-draft, sub-critical reheat boilers. Each is rated at 615,000 lb/hr at the superheater outlet and generates 90 MW of electrical power. The units fire a variety of PRB low-sulfur, subbituminous coals.

The existing particulate control equipment on Presque Isle Units 7–9 is hot-side electrostatic precipitators (HESP) commissioned in 1977. Each Joy Western weighted-wire HESP is two (2) chambers wide with six (6) mechanical fields per chamber and twelve (12) electrical frames, six (6) per chamber, powered by six (6) full wave T/Rs. Each HESP was designed to treat 530,000 acfm and to operate at temperatures ranging from 565°F to 745°F. The design collection efficiency was 99.20% with a specific collection area (SCA) of 222 ft^2/kacfm. The exhausts from the three units are ducted into individual flues of a common stack. A summary of key unit parameters can be found in Table 1. A typical coal analysis and unit emission limits are summarized in Tables 2 and 3.

Table 1. Unit Description

Parameter	Unit 7–9
Boiler Manufacturer	Riley
Furnace Type	Balanced-Draft
Turbine Rating, MW	90
Flue Gas Temperature (APH outlet), ºF	350–385
Particulate Matter Control Device	HESP
ESP Manufacturer	Joy Western
Specific Collection Area, ft2/kacfm	222
Typical ESP Operating Temperature, ºF	565–745

Table 2. Blend Coal Quality (Typical Values), As-Received Basis

Characteristic	Typical Value
Higher Heating Value, Btu/lb	9,052
Analysis, % by weight	
Moisture	25.85
Carbon	52.49
Hydrogen	3.65
Nitrogen	0.75
Sulfur	0.28
Ash	4.64
Oxygen	12.33
Chlorine	0.01

Table 3. Emission Limits

Emission Limits	Upper Limit
SO_2, lb/MMBtu	1.20
NO_x, lb/MMBtu	0.70
Particulate Matter, lb/MMBtu	0.10
Stack Opacity (6-minute average), %	20

The new TOXECON™ system will include ductwork tie-ins downstream of the ID fan discharges. The three ducts will tie together so that there is a single inlet upstream of the new fabric filter. The fabric filter, supplied by Wheelabrator Air Pollution Control (WAPC), is a pulse-jet style cleaning system with ten compartments and a gross air-to-cloth ratio of 5.5 ft/min. The common outlet duct from the fabric filter splits into three ducts each of which supplies a single centrifugal booster fan. Each booster fan discharges nominally one-third of the total flue gas flow back to the three original stack flues. The ductwork is configured such that the fabric filter can be bypassed and flue gases can be discharged directly from the ID fans to the individual flues. The activated carbon system consists of a single trifurcated silo which supplies carbon to three independent feed trains, each consisting of a screw feeder and pressure blower. The feed trains supply carbon to three injection lances which are located downstream of the ID fan discharges, but upstream of the point where the ducts combine.

Each lance discharges sorbent into the center of its duct, where turbulent flow will provide gas/sorbent mixing. A schematic of the new system is shown in Figure 1.

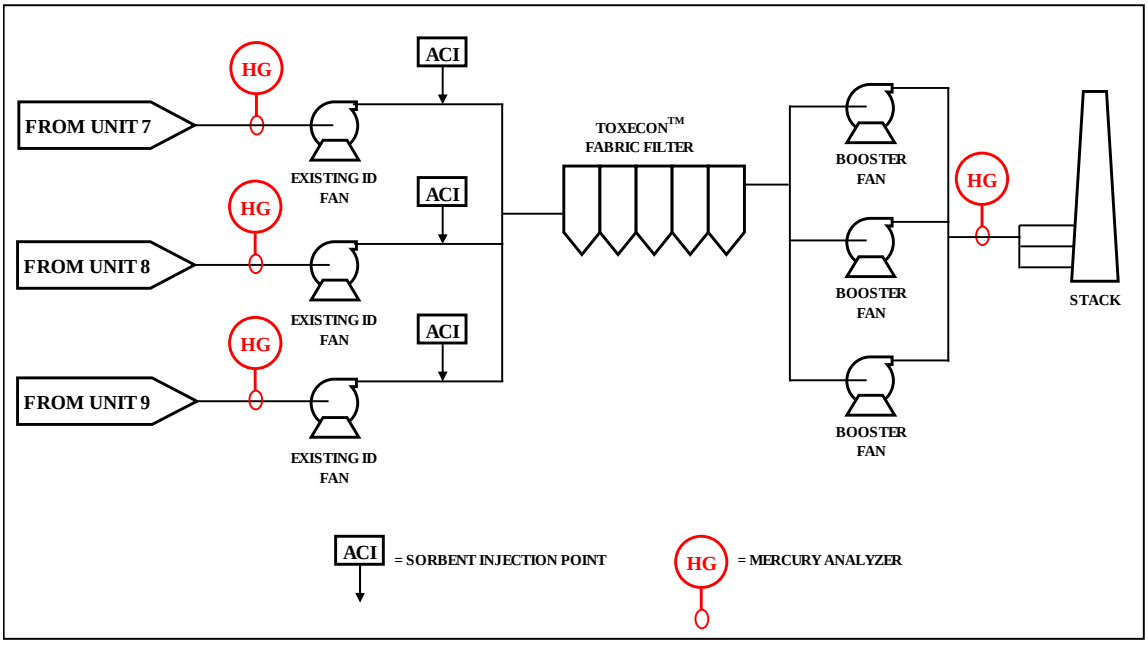


Figure 1. TOXECON™ System Schematic

3 Project Terminology and Concepts

The following section provides the reader with an introduction to common terminology related to fabric filters, the TOXECON™ technology, and unit load operating conditions at Presque Isle Power Plant.

3.1 TOXECON™ Terminology

Pressure Drop/Drag: Pressure drop and drag are both used to monitor the permeability of the filter and filter cake. Pressure drop is a direct measurement of pressure loss across the fabric filters. Drag is a calculated number that normalizes pressure drop to flow by dividing pressure drop by the air-to-cloth ratio. These values are a function of inlet grain loading, filtering characteristics of the particulate matter, and flow and time between cleaning.

Cleaning Frequency: Pressure drop/drag is controlled in a baghouse by the cleaning frequency. It is expected that cleaning frequency will increase with the increased particulate loading from sorbent injection. Cleaning frequency will be monitored before, during, and after sorbent injection.

Opacity/Emissions: Cleaning frequency and particulate matter characteristics can affect collection efficiency across the baghouse. Most emissions occur immediately following a cleaning, so increasing the cleaning frequency can increase outlet emissions. The emissions could also increase if the particulate does not form a high efficiency filter, but tends to work through the fabrics.

Air-to-Cloth (A/C) Ratio: The ratio between flue gas flow (acfm) and total fabric surface area (ft^2), expressed in ft/min. A lower A/C ratio indicates a larger, more conservative design. Typically, pulse-jet fabric filters are designed with A/C ratios between 3 and 4 ft/min. COHPAC® and TOXECON™ applications target a higher, more economical design between 5 and 8 ft/min.

Cleaning Modes: Pulse-jet fabric filters are generally cleaned with either “online” or “offline” cleaning. In either case, cleaning is usually initiated when a predetermined pressure drop or drag setpoint is reached. In the case of offline cleaning, when the setpoint is reached, inlet and/or outlet dampers close, isolating a single compartment. This compartment is then systematically pulsed, row-by-row, until it has been entirely cleaned. The isolating dampers are then opened and flue gas re-enters the compartment. In the case of online cleaning, when the setpoint is reached, single rows are cleaned around the various compartments without any isolation. Because flue gas continues to flow through the bags being cleaned during online cleaning, the degree of cleaning is reduced. The benefits of online cleaning are that there is not a pressure spike (from isolating a compartment) and there is not a sudden very clean area in the fabric filter.

3.2 Presque Isle Unit Load Conditions

For the purpose of this test plan, reference to load conditions shall mean all three units operating at that load, unless otherwise specified. The referenced load conditions shall be:

Full Load: Full load testing will have up to 300 MW operating into the baghouse. This will require all three units operating at the same time.

Mid-Load: Mid-load testing will have approximately 180-200 MW operating into the baghouse. This could be either two units at full load or three units operating at approximately 67 MW. The first option is less costly than the second one and represents normal operation during a scheduled unit outage.

Low-Load: Low-load testing will have approximately 120 MW operating into the baghouse. This would be attained using 2 units at 60 MW each.

4 Test Program Description

This test program is designed to support the overall objectives of the TOXECON™ retrofit at Presque Isle as well as to further the technical understanding of the TOXECON™ technology for both We Energies and the greater industry. In order to achieve these top-level objectives, a number of specific design parameters must be studied and optimized. The program outlined below addresses the known objectives, but like any first-time demonstration project, modifications may be made as data are collected and more informed decisions could be made.

Specifically, the following test program objectives will be initially pursued:

1. Determine baseline mercury levels into the new fabric filter and resulting emissions without sorbent injection.
2. Quantify the sorbent injection rate versus mercury removal relationship and how it may be a function of unit load and flue gas temperature.
3. Develop a chronicle of fabric filter performance over the three-year demonstration period, detailing how pressure drop, cleaning frequency, mercury removal, and bag strength change.
4. Quantify the effects of air-to-cloth ratio on mercury control and required cleaning frequency. Determine a maximum design ratio.
5. Develop a reliable control algorithm for controlling mercury emissions from three generating units using a common TOXECON™ fabric filter.
6. Evaluate the potential for recycling the sorbent/ash mixture for improved sorbent utilization and reduced operating cost.
7. Evaluate the technical and economic performances of various viable sorbents.

The testing will be conducted in two major phases. The first priority will be to conduct testing necessary to place the Presque Isle system in reliable operation. The second phase will involve testing to broaden the general understanding of the process, examine new sorbents, and experiment with potential process upgrades such as ash/sorbent recycle and SO_2 and NO_x trim controls. The following sections outline the major phases of the test program, including the specific tests and objectives.

It is expected that the three units will generally fire their normal fuel blend for the duration of this test program. Plant operations will advise the ADA-ES field manager if there is a shift in fuel profile. The field team will determine whether testing should be modified or delayed to accommodate such shifts.

The various parties to the TOXECON™ project will manage the test program, with ADA-ES taking the lead role. ADA-ES will manage the program with a combination of on-site and remote staff. ADA-ES' test manager will coordinate at all times with We Energies' personnel. Table 4 lists the planned testing activities.

Table 4. Schedule of Activities

Activity	Duration (Weeks)	Start Date	End Date
Start-Up			
Start up Unit 7	1	12/10/2005	12/17/2005
Start up Unit 9	1	12/29/2005	01/05/2006
Start up Unit 8	1	01/20/2006	01/27/2006
Start up PAC injection system	1	01/27/2006	02/05/2006
Optimization			
Baseline testing	1	02/13/2006	02/17/2006
Parametric testing (Plant outages and Testing occur during this time)	22	02/20/2006	07/26/2006
Reliability Testing			
Reliability period	20	07/27/2006	12/14/2006
Mass Balance Tests	1	08/07/2006	08/11/2006
WAPC acceptance testing	1	08/07/2006	08/11/2006
CEM RATA Testing	2	08/07/2006	08/18/2006
Long-Term			
Adjusted drag setpoint testing	2	01/08/2007	01/19/2007
A/C ratio testing	2	01/20/2007	01/31/2007
Offline cleaning test	2	02/01/2007	02/12/2007
Sorbent/ash recycle testing	2	02/19/2007	03/05/2007
Ash/sorbent distribution testing	Periodic		
Particulate testing	Periodic		
Pull sample filter bags	Periodic		
SO_x-NO_x Control			
Multi-pollutant sorbent trials*		03/19/2007	11/13/2007
Mercury Recovery from Sorbent *		04/12/2008	12/19/2008

** Subject to change.*

4.1 Optimization Testing

The first phase of this test program is to determine a stable operating mode for the system and establish that the TOXECON™ technology is commercially viable. For the purpose of this test plan, it is assumed that ADA-ES, WAPC, and We Energies have fully commissioned the equipment, including the fabric filter, mercury CEMs, and the sorbent injection system following the schedule shown above. Note that prior to start-up, the bags will be pre-coated.

4.1.1 Baseline Testing

The purpose of the baseline test is to establish the level of flue gas mercury leaving the air preheater and to determine if there is any native capture across the TOXECON™ fabric filter without sorbent injection. Two mercury CEMs will be monitoring flue gas concentrations entering and leaving the baghouse. Ontario Hydro method testing and STM testing will also be performed to determine mercury speciation and total concentrations.

In addition to the flue gas measurements for mercury, coal and ash samples shall be gathered. Ash samples will be taken from two locations: the HESP hoppers and the fabric filter hoppers. This HESP sample is not expected to yield significant mercury content. Ten fabric filter hopper samples shall be taken, one from each compartment. Loss on Ignition (LOI) tests will also be performed on the ash samples.

The results of these combined measurements should characterize the distribution of mercury throughout the system and yield a mass balance on the unit without sorbent injection. Minimal native capture is expected and mercury emissions should be close to coal levels. This detailed distribution analysis will be repeated once the system is operating at optimal conditions.

In addition to the mercury-oriented measurements, Method 5 or Method 17 particulate measurements will also be made at the fabric filter outlet during this baseline period.

Halogens will also be measured at the outlet of the baghouse. This baseline level for bromine, chlorine, hydrogen bromide (HBr) and hydrogen chloride (HCl) will be used as a comparison with later tests if a brominated sorbent is used for mercury control. It will be important to determine to what extent a brominated sorbent contributes to bromine emissions from the baghouse.

Table 5 outlines the parameters for the baseline tests.

Table 5. Baseline – Mass Balance Tests

Test Title	***Baseline – Mass Balance***		
Test Objective	To determine the native capture and distribution of mercury from the economizer outlet through the TOXECON™ system without sorbent injection.		
Cleaning Mode	Online	**Mercury Control Mode**	(NONE)
Cleaning Setpoint	TBD	**Sorbent**	(NONE)
		Total Duration	1 week

Notes:
(1) All DCS data in accordance with the Appendix.

TEST RUN DESIGNATION	**TEST PARAMETERS**				**SOLID SAMPLING**			**OTHER**
	Duration Hours	**Injection Conc.** lb/MMacf	**Combined Unit Load**	**COOS**[+]	**Coal**	**HESP Ash**	**Fab. Filter Ash**	**Ontario Hydro Method, Sorbent Traps, Method 5 or 17, Method 26A Halogens**
Baseline – Full	72	0	FULL	0	X	X	X	X

[+]COOS = compartments out of service

4.1.2 Parametric Testing

The parametric test phase will yield the data necessary to understand the impact of sorbent injection on mercury capture and fabric filter performance, specifically the impact to cleaning frequency. Two sorbents will be rigorously tested to assess both technical and economic feasibility.

The initial sorbent injection testing and optimization will be conducted using NORIT America's DARCO® Hg activated carbon. DARCO® Hg is the industry benchmark sorbent for mercury capture and has the broadest usage. While it is anticipated that the DARCO® Hg will be able to achieve the mercury removal target of 90%, a second sorbent, DARCO® Hg-LH, will also be tested. The DARCO® Hg-LH, which is a brominated carbon, is a more expensive option, but in many applications provides better results at higher temperatures and lower injection rates.

For the DARCO® Hg sorbent, each parametric test will occur with all three units at full load. Each individual test run will vary the sorbent injection ratio. Sorbent injection concentrations from 0.5 to 3.0 lb/MMacf will be examined.

In addition to the impacts on mercury capture, any impacts on the cleaning cycle will be closely monitored. The fabric filter will be cleaned in an online mode for all parametric tests. The cleaning setpoint shall be near the upper end of the maximum acceptable pressure drop across the baghouse, which is 8 inches WC. As sorbent injection is increased, the time required for the pressure drop to build back up to the setpoint decreases. Consequently, for each combination of sorbent injection rate and A/C ratio, there should be a unique cleaning frequency for a given degree of fabric cleanliness.

Because the impact of a given sorbent injection rate on cleaning frequency takes some time to materialize and stabilize, each test run will be conducted for a minimum 48-hour block. Load shall be permitted to follow demand and sorbent injection concentration (lb/MMacf) will be held at a steady concentration.

For each parametric test run a final, stabilized cleaning rate shall be recorded in terms of pulses/bag/hour.

Coal and hopper ash samples shall be taken for each parametric test run. The primary results of each parametric run shall be based on the mercury CEMs, so coal samples will not be analyzed as a matter of course. The ADA-ES test manager shall determine when coal samples shall be analyzed based on testing conditions and input from the site regarding any fuel shifts. Coal analyses may be coordinated with the plant's regular analyses schedule.

The hopper ash samples will be analyzed for each test run. A key point to be evaluated is the utilization of the sorbent. In other words, what fraction of the sorbents total capacity to adsorb mercury is actually being used? This result should be a function of the cleaning rate and the mercury concentration, which determines how long the sorbent stays on the filter bags and how much mercury is adsorbed. To ensure that the ash samples are representative of the steady-state condition of each parametric condition, once the cleaning cycle has been deemed to have stabilized, all hoppers shall be emptied. Operation shall continue for at least one full cleaning cycle, at which point the samples shall be taken.

Table 6 outlines the conditions for the parametric tests.

Table 6. Parametric – DARCO® Hg Tests

Test Title	***Parametric – DARCO® Hg***		
Test Objective	To determine the relationship between sorbent injection rate and mercury removal at gross A/C ratio and base sorbent.		
Cleaning Mode	Online	**Mercury Control Mode**	Manual
Cleaning Setpoint	TBD	**Sorbent**	DARCO® Hg
		Total Duration	2 weeks

Notes:
(1) All DCS data in accordance with the Appendix.
(2) No special measurements required.

TEST RUN DESIGNATION	**TEST PARAMETERS**				**SOLID SAMPLING**			**OTHER**
	Duration Hours	**Injection Conc.** lb/MMacf	**Combined Unit Load**	**COOS+**	**Coal**	**HESP Ash**	**Fab. Filter Ash**	**(NONE)**
Parametric – 0.5	48	0.5	FULL	0	X	X	X	
Parametric – 1.0	48	1.0	FULL	0	X	X	X	
Parametric – 1.5	48	1.5	FULL	0	X	X	X	
Parametric – 2.0	48	2.0	FULL	0	X	X	X	
Parametric – 2.5	48	2.5	FULL	0	X	X	X	
Parametric – 3.0	48	3.0	FULL	0	X	X	X	

+COOS = compartments out of service

Once the DARCO® Hg tests are complete a second round of parametric tests will be conducted using the DARCO® Hg-LH. Again, the relationship between injection concentration and removal efficiency shall be defined. Table 7 outlines the parameters for these tests.

The team will complete a technical and economic evaluation to determine which of the sorbents is the best solution for this application. The basis for comparison shall be sorbent cost per mass of mercury removed. This evaluation shall be the basis for selecting the sorbent for subsequent testing.

Table 7. Parametric – DARCO® Hg-LH

Test Title	***Parametric – DARCO® Hg-LH***		
Test Objective	To determine the relationship between sorbent injection rate and mercury removal at gross A/C ratio and brominated sorbent.		
Cleaning Mode	Online	**Mercury Control Mode**	Manual
Cleaning Setpoint	TBD	**Sorbent**	DARCO® Hg-LH
		Total Duration	2 weeks

Notes:
(1) All DCS data in accordance with the Appendix.
(2) No special measurements required.

TEST RUN DESIGNATION	**TEST PARAMETERS**				**SOLID SAMPLING**			**OTHER**
	Duration Hours	**Injection Conc.** lb/MMacf	**Combined Unit Load**	**COOS+**	**Coal**	**HESP Ash**	**Fab. Filter Ash**	**(NONE)**
Parametric – 0.5	48	0.5	FULL	0	X	X	X	
Parametric – 1.0	48	1.0	FULL	0	X	X	X	
Parametric – 1.5	48	1.5	FULL	0	X	X	X	
Parametric – 2.0	48	2.0	FULL	0	X	X	X	

+COOS = compartments out of service

4.1.3 Flue Gas Temperature

A technical concern of this project is the expected range of flue gas temperatures. The air preheater on each of the three units deviates significantly from its design such that the gas outlet temperature operating range is about 350ºF to 380ºF. This range is above the optimal condition for untreated sorbent performance and would likely preclude acceptable mercury control with the standard sorbent. Additionally, the high gas exit temperature is a negative impact to unit heat rate and a risk to the filter bags. As such, efforts are being undertaken to reduce the gas outlet temperature. The alternate is to use a spray system to cool the flue gas before treating it with sorbent.

After completion of the parametric testing, the project team will determine whether a spray cooling system will be considered.

4.1.4 Automatic Control

With the completion of the parametric test series, the necessary information should be available to finalize the automatic sorbent injection control algorithm. We Energies personnel will be available to implement any control logic modifications and assist in loop tuning. A loop tuning plan will be jointly developed between ADA-ES personnel and We Energies' control engineers.

4.1.5 Reliability Test Period

After the system appears to be stabilized and operating in fully automatic control, a reliability test period will begin. This will provide an extended window to assess stability and reliability. Upon the successful completion of this period the technology may be preliminarily deemed commercially viable. True viability can only be confirmed over several years of operation after studying bag life.

General system monitoring will continue for the duration of the long-term testing. Table 8 outlines the parameters for these tests.

In addition to monitoring the system for general stability, a full mercury characterization and mass balance will be conducted on the system. Measurements shall be taken in accordance with the procedure outlined in the baseline section of this plan. The units shall operate at full load for at least 8 hours before taking measurements and samples. This test shall occur near the beginning of the reliability period. The field team shall determine the precise timing.

Table 8. Optimized – Mass Balance Tests

Test Title	***Optimized - Mass Balance***		
Test Objective	To determine the capture and distribution of mercury from the economizer outlet through the TOXECON™ system at the optimized injection rate and 90% removal.		
Cleaning Mode	Online	**Mercury Control Mode**	Automatic
Cleaning Setpoint	TBD	**Sorbent**	DARCO® Hg (*assumed*)
		Total Duration	During reliability test period

Notes:
(1) All DCS data in accordance with the Appendix.
(2) Test to occur towards the beginning of the reliability run
(3) "OPT" injection concentration is as determined following the parametric testing.

TEST RUN DESIGNATION	**TEST PARAMETERS**				**SOLID SAMPLING**			**OTHER**
	Duration Hours	**Injection Conc.** lb/MMacf	**Combined Unit Load**	**COOS+**	**Coal**	**HESP Ash**	**Fab. Filter Ash**	**Ontario Hydro Method, Sorbent Traps, Method 5 or 17, Method 26A Halogens**
Baseline – Full	Note 2	OPT	FULL	0	X	X	X	X

+COOS = compartments out of service

4.2 Long-Term Testing

After the reliability test period, the test program can advance to the long term testing phase. During the long-term test, several issues will be evaluated, as described below.

4.2.1 Adjust Drag Setpoint for Cleaning

The drag setpoint that triggers a cleaning cycle effectively determines the characteristics of the steady-state filter cake, while other parameters are held constant. Reducing the setpoint results in less steady-state filter cake because the fabric filter will clean more regularly. This in turn could possibly reduce mercury and particulate polishing control. The trade-off is reducing operating costs in terms of fan power consumption.

To better assess this relationship, the fabric filter will be stepped through a series of lower drag setpoints. These tests should be conducted at full load with the objective of identifying steady-state mercury emissions, steady-state cleaning frequency, and any impact to opacity. Table 9 outlines the parameters for these tests.

Table 9. Adjusted Cleaning Setpoint Tests

Test Title ***Adjusted Cleaning Setpoint***
Test Objective To determine the effect on mercury emissions, cleaning frequency, and opacity when the cleaning setpoint is lowered.

Cleaning Mode Online
Injection Rate Optimized
Mercury Control Mode Manual
Sorbent DARCO® Hg (*assumed*)
Total Duration 2 weeks

Notes:
(1) All DCS data in accordance with the Appendix.
(2) No solid samples required for this test.
(3) "MAX" is the maximum cleaning point established during start-up and parametric testing.

TEST RUN DESIGNATION	TEST PARAMETERS				SOLID SAMPLING			OTHER
	Duration Hours	Cleaning Setpoint (Note 3) IWC	Combined Unit Load	COOS+ ft/min	Coal	HESP Ash	Fab. Filter Ash	(NONE)
Adj. SP – 1	48	MAX – 0.25	FULL	5.5				
Adj. SP – 2	48	MAX – 0.50	FULL	5.5				
Adj. SP – 3	48	MAX – 1.00	FULL	5.5				

+COOS = compartments out of service

4.2.2 Air-to-Cloth Ratio Tests

Previous TOXECON™ testing was conducted at an A/C ratio of approximately 8.0 ft/min. Operating at this aggressive ratio combined with high inlet loading proved unsustainable because the cleaning system could not keep up to maintain an acceptable pressure drop. The

Presque Isle TOXECON™ fabric filter has been designed with a gross A/C ratio of 5.5 ft/min, which is expected to permit easily sustained operation. Because of the economic benefit of installing a higher A/C ratio design, this test series will evaluate the performance of the fabric filter with isolated compartments, effectively increasing the A/C ratio. Table 10 summarizes the effective A/C ratios with compartments isolated.

Table 10. Compartment Isolation and A/C Ratio

Condition	Compartments Isolated	A/C Ratio (ft/min)
Gross	0	5.5
Net	1	6.1
Net-Net	2	6.8

It is possible that for a given injection rate, increasing the A/C ratio will decrease mercury removal. At higher A/C ratios, the cleaning cycle is faster and there is less ash/sorbent filter cake, which is the primary mercury-scrubbing medium.

For each A/C ratio, sorbent injection will begin at the optimized rate. The system will be allowed to reach steady state over a period of one day. The new mercury emission level and cleaning frequency will be recorded. After this is complete, sorbent injection will be modulated above and below the optimal rate in increments of 0.5 lb/MMacf in an effort to reestablish 90% control. The system shall be allowed to reach steady state at each incremental increase in order to provide injection rate versus removal data at each A/C ratio.

Note that the sorbent injection system will need to be operated in a fixed injection rate (lb/hr) mode during these tests, with details to be determined by the field team. Table 11 outlines the parameters for these tests.

Table 11. Reduced Air-to-Cloth Ratio Tests

Test Title	***Reduced Air-to-Cloth Ratio***		
Test Objective	To determine the effect of reduced A/C ratio on mercury control and cleaning frequency.		
Cleaning Mode	Online	**Mercury Control Mode**	Fixed Rate
Cleaning Setpoint	TBD	**Sorbent**	DARCO® Hg (*assumed*)
		Total Duration	2 weeks

Notes:

(1) All DCS data in accordance with the Appendix.
(2) No solid samples required for this test.
(3) "OPT" is the optimized injection concentration determined during the parametric testing. Incremental adjustments in injection concentration are representative, and will be determined by the field team.

TEST RUN DESIGNATION	TEST PARAMETERS				SOLID SAMPLING			OTHER
	Duration (Hours)	Injection Conc. (Note 3) (lb/MMacf)	Combined Unit Load	COOS+	Coal	HESP Ash	Fab. Filter Ash	(NONE)
ACR-6.1 – 1	24	OPT	FULL	1				
ACR-6.1 – 2	24	OPT -0.5	FULL	1				
ACR-6.1 – 3	24	OPT + 0.5	FULL	1				
ACR-6.1 – 4	24	OPT + 1.0	FULL	1				
ACR-6.9 – 1	24	OPT	FULL	2				
ACR-6.9 – 2	24	OPT -0.5	FULL	2				
ACR-6.9 – 3	24	OPT + 1.0	FULL	2				
ACR-6.9 – 4	24	OPT + 2.0	FULL	2				

+COOS = compartments out of service

4.2.3 Assess Ash Distribution and Quality

This test series will attempt to answer two key hopper ash related questions. The first is the distribution of the sorbent and ash throughout the complete fabric filter. It is essential to optimal mercury control that the fly ash and sorbent be equally distributed to all compartments. The second point is to reassess the utilization of the sorbent, as first considered during the parametric test series.

Additionally, sorbent/ash distribution may deteriorate at reduced load. As such a series of mixed load test runs shall be conducted to quantify any impact to hopper ash distribution and determine if there is any correlation with mercury capture.

If carbon distribution deteriorates at reduced flow, caused by either reduced load or unit outages, it may manifest itself in reduced mercury control (or in increased sorbent consumption when run in automatic mode). To allow this effect to fully develop, each reduced load test shall be conducted for a period of 24 hours, if plant operations permit.

After a reduced flow run begins, the hoppers will be pulled after the fabric filter has been completely cleaned, per its normal cleaning cycle. This will remove any ash that is representative of non-test conditions. At the end of the test period, individual ash samples will be taken from each of the ten hoppers. The field leader must confirm that at least one full cleaning cycle has been completed since the hoppers were pulled, before taking the samples. Each ash sample will be tested for LOI and mercury content.

The field leader will monitor the mercury control loop during testing. If ash/sorbent distribution deteriorates, the control loop may increase carbon injection to maintain 90% removal—essentially over-controlling in the modules that are getting disproportionately little ash/sorbent. The steady state injection rate required to maintain target removal should be noted.

The overall distribution of flue gas and particulate loading among the fabric filter compartments is critical to successful operation. The field team will evaluate this by comparing compartment differential pressures. Table 12 outlines the parameters for these tests.

Table 12. Ash/Sorbent Distribution Tests

Test Title	***Ash/Sorbent Distribution***		
Test Objective	To determine the effect of flow on ash and sorbent distribution throughout the fabric and determine whether there is an increase in carbon consumption or decrease in mercury control.		
Cleaning Mode	Online	**Mercury Control Mode**	Automatic
Cleaning Setpoint	TBD	**Sorbent**	DARCO® Hg (*assumed*)
		Total Duration	3 days

Notes:
(1) All DCS data in accordance with the Appendix.
(2) Hopper ash samples to be analyzed individually, not blended.

TEST RUN DESIGNATION	**TEST PARAMETERS**				**SOLID SAMPLING**			**OTHER**
	Duration Minimum hours	**Injection Conc.** lb/MMacf	**Combined Unit Load**	**COOS+**	**Coal**	**HESP Ash**	**Fab. Filter Ash**	**(NONE)**
Dist – Full	24	*AUTO*	Full	0			X	
Dist – Mid	24	*AUTO*	Mid	0			X	
Dist – Low	24	*AUTO*	Low	0			X	

+COOS = compartments out of service

4.2.4 Sorbent/Ash Recycle

A potential design feature for future TOXECON™ installations is the use of a sorbent/ash recycle loop. This would permit sorbent to be reused, maximizing the utilization and

minimizing the operating cost. The potential benefit is related to the once-through utilization measured in the tests described above. A drawback of recycle is that the ash is recycled with the sorbent, which increases the overall particulate loading into the fabric filter. The issues are then:

1. Is once-through utilization low enough that recycle makes sense?
2. Can the fabric filter cleaning cycle keep up with the increased particulate loading?
3. Is there an economic benefit to sorbent/ash recycle?

If a sorbent/ash recycle system were installed in a permanent system, there would be a waste stream of disposed ash and a make-up stream of fresh sorbent. These components are not parts of the Presque Isle design. Consequently, the testing conducted here will be proof of concept only and will not simulate the full process dynamic.

For this test, fabric filter hopper sorbent/ash will be collected for a period of three days and stored in a truck or ash silo. This shall be done during a period of steady operation at the determined optimal injection rate while achieving nominally 90% removal. When the complete reserve of sorbent/ash mixture is accumulated, the silo shall be allowed to empty of the normal sorbent material. Efforts will be made to coordinate the reserve of sorbent/ash to closely coincide with the silo emptying to minimize storage. The sorbent/ash mixture will be loaded into the carbon silo. A sample of the ash loaded into the silo shall be retained for analysis. All three units shall operate at full load for this test. Initially, sorbent/ash shall be fed to the process at the equivalent lb/MMacf rate, based on the known fraction of sorbent in the ash. Sorbent/ash feed rate will need to be controlled in manual mode, instead of automatic. This feed rate is expected to produce less than 90% removal, given that the sorbent is partially spent. The cleaning frequency should increase as well. The sorbent ash/injection rate can be increased to try to re-achieve 90% removal. Samples of the sorbent/ash mixture shall be taken from the hoppers after re-injection and analyzed for LOI and mercury content. These measurements provide twice-through utilization results.

The viability of this test should be reevaluated after initial ash/sorbent utilization measurements become available during optimization testing. If utilization is very high, as determined by the project team, ash/sorbent recycle will yield little if any benefit and this test may be eliminated.

4.2.5 Assess Offline Cleaning in the Fabric Filter

A premise of the project is that offline cleaning, which typically provides more thorough cleaning, would result in spikes in mercury emissions after a compartment is cleaned. The rationale for this is that after a compartment is cleaned and returned to service it has lost the sorbent cake on the bag, so that the only contact with sorbent is in-flight until the cake builds back up again. While this rationale is sound, it is unclear what the magnitude of this effect may be on mercury removal and whether it outweighs the benefits of improved cleaning for long-term performance.

In order to better assess this effect, the fabric filter will be tested in the offline cleaning configuration both with all compartments in service (such that cleaning produces the net condition) and with one compartment out of service (such that cleaning produces the net-net condition).

No special load conditions will be required for this test. Mercury control will be left in automatic mode. The field leader and operations will monitor the mercury emissions profile—spikes and any change to the baseline, carbon usage, and the pressure drop profile. For each test condition, testing should be permitted to continue for one week unless the field team determines that the operating profile is unacceptable.

4.2.6 Particulate Emissions

To assess ongoing particulate control, Method 17 flue gas measurements will be made at the fabric filter outlet nominally every six months. These measurements will be used to monitor any drift in performance as the bags begin to age. Efforts will be made to use any routine source test data that are taken during this time period to avoid unnecessary additional testing.

All Method 17 tests shall be conducted with all units at full load and shall generally mimic the operating conditions at which the fabric filter acceptance testing is performed.

4.2.7 Alternate Sorbent Testing

A goal of the TOXECON™ Retrofit project is to provide a facility for evaluating potential new sorbents. Since sorbent cost is the largest operating cost of the TOXECON™ or any other sorbent injection technology, there is significant benefit to be realized by developing efficient, inexpensive alternative sorbents. There is not a specific schedule or test plan at this time for such additional testing. The intent is to make the facility available to sorbent suppliers who can demonstrate technical feasibility of their product and conform to certain commercial repayment requirements.

The test program for any additional sorbents would likely reflect an abbreviated form of the parametric test program detailed above.

Alternate sorbents may include:

- chemically enhanced activated carbons
- non-carbon based products
- activated carbons with larger particle sizes

Depending on the specifics of the sorbents being tested, it may be necessary to use temporary injection equipment, such as Porta-PACs™ for the test runs. This approach will eliminate the need for emptying the primary sorbent silo to accommodate short duration tests.

4.3 Experimental Filter Bags

The base design for the TOXECON™ fabric filter is to use PPS fabric bags with the following specifications:

- Felted, 2.7 denier PPS fabric
- Weight of nominally 18 ounces/yd^2
- Singed on both sides
- Scrim material made from 3 ounces/yd^2 of PPS
- Mullen burst minimum of 500 psi
- Permeability at 0.5 inches H_2O of 25–40 cfm/ft^2

Table 13 presents the array of other bag materials to be installed for testing:

To the extent possible, one sample bag of each design, including the base PPS design, will be pulled and tested semi-annually to assess deterioration. A detailed schedule for removing sample bags will be coordinated with plant operations based on outage schedules. Generally bags will be removed every six months.

In the case of the Kermel fabric, approximately six 4" x 11" swatches will be installed into the flue gas at a location to be determined. The swatches are then exposed to flue gas and periodically one is removed for strength tests. Although full-scale bags are preferred for the tests, using swatches reduces the risk of premature failures with experimental bags.

Table 13. Test Bag Materials

Material/Design	Quantity
7 denier Torcon with Torcon scrim (Midwesco style #9056)	12
7 denier Torcon with 2.0 oz. PTFE scrim (#9054)	8
7 denier Torcon with 4.0 oz. PTFE scrim (#9055)	8
Dual density Torcon (0.9 and 2 denier blend on filter side, 7 denier on other side) (#9065)	10
P84 bags	13
Scrim-supported PPS felt with a BHA-TEX Expanded microporous PTFE Membrane	12
Toray proprietary material	4
Kermel fabric	Swatches only

Figure 2 shows the bag numbering system and test bag layout for PIPP.

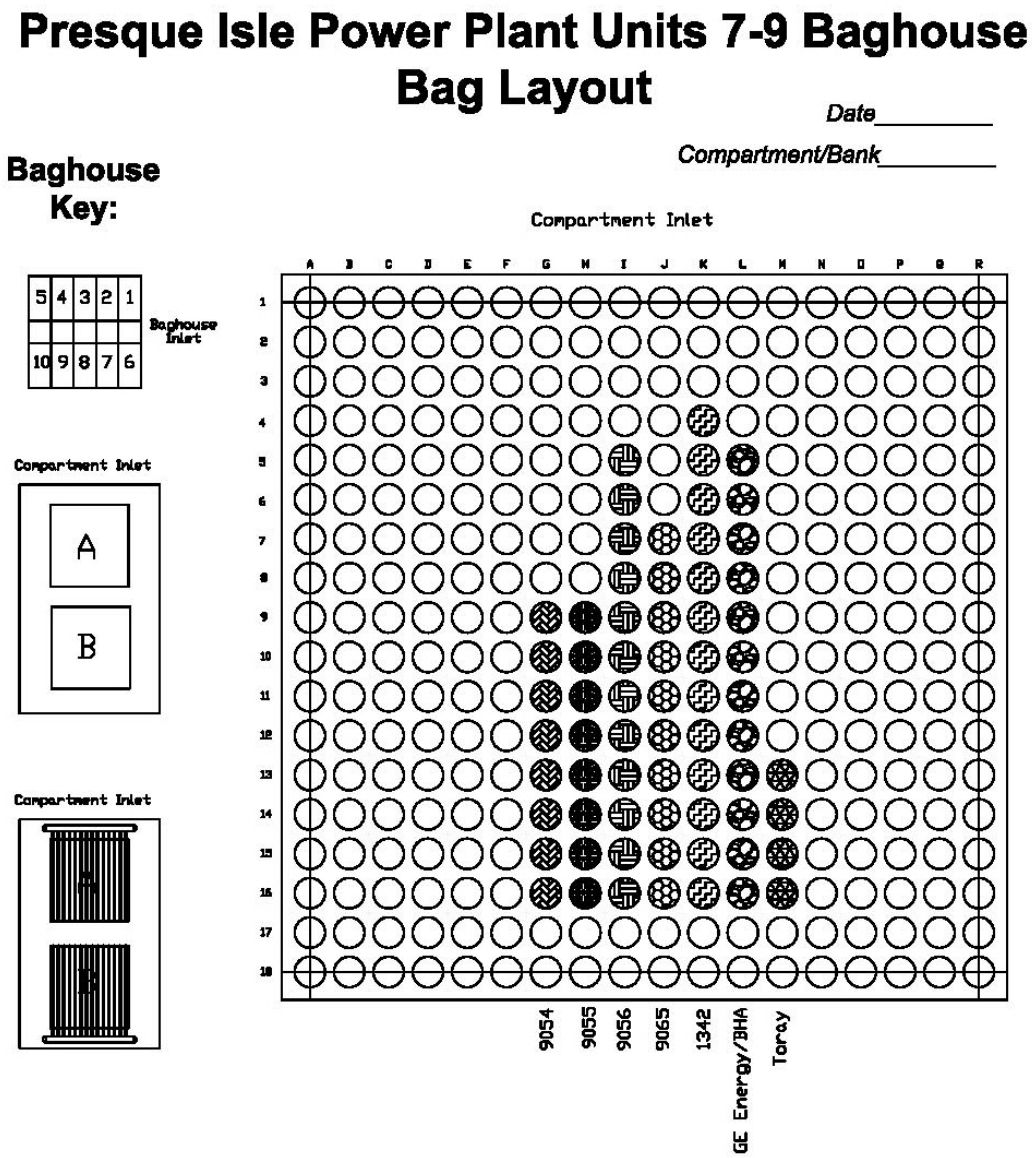


Figure 2. Test Bag Layout

4.4 Multi-Pollutant Trim Controls

After TOXECON™ operation and performance is established for mercury control, a series of parametric and long-term tests will be conducted to assess the capability of TOXECON™ to control other pollutants such as SO_2 and NO_x. Injection equipment and measurement instrumentation will be designed, procured, and installed specifically for these tests.

Testing to date in the TOXECON™/COHPAC® configuration includes:

- Full-scale tests injecting sodium bicarbonate and sodium sesquicarbonate upstream of the Big Brown COHPAC® baghouse for SO_2 control (EPRI, 1994).

- Pilot tests of sodium and lime sorbents injected upstream of COHPAC® for SO_2 control at Southern California Edison's Mohave Station (EPRI, 1996).
- Slipstream tests of sodium, lime, activated carbon, and a proprietary catalyst for NO_x, SO_2, SO_3, HCl, HF, and Hg at the PSEG Hudson Generating Station (EPRI, 1998).

Test results indicate that sodium-based products can achieve from 30% to 70% SO_2 reduction. At normal flue gas temperatures, lime/calcium products are not effective for SO_2 control. Sodium-based sorbents also reduced NO_x by 10% to 20%. HCl removal as high as 50% was documented at Hudson with sodium sesquicarbonate. It is possible that other air toxic metals such as arsenic and selenium may also be reduced.

Air toxic control, other than mercury, with TOXECON™ has undergone limited testing. It is in the interest of this project to determine the full capability of TOXECON™ so that this information can be incorporated into We Energies' long-term pollution control strategy.

4.5 Mercury Recovery from Spent Sorbent

One objective of the test program is to explore potential technologies that can recover adsorbed mercury from the captured ash/sorbent mixture. This step is necessary to avoid returning the captured mercury to the environment with the ash (although research to date suggests that adsorbed mercury is very stable).

Although a formal plan for this phase of the project, which will be conducted in 2008, has not been developed, two companies with potential technologies have been identified and expressed interest. ADA-ES will continue to investigate the possibilities for this objective and will further develop the test plan when possible.

5 Test Program Management and Reporting

ADA-ES, in conjunction with the other project team members, will manage this test program with a combination of an on-site manager and remote support. The extent to which an ADA-ES manager will be on site will be determined as start-up and testing proceed. After the initial effort to get the system operational and stable, many of the ongoing tests may be coordinated through a remote ADA-ES manager working with on-site We Energies' personnel.

ADA-ES will maintain full responsibility for monitoring and all tests, including the compilation of data from the plant and receipt and analysis of all laboratory results. The program presented herein represents the best estimate of how testing should be conducted to evaluate the TOXECON™ technology. This program may be revised during the course of testing as results become available and different approaches become desirable. ADA-ES will continually evaluate the ongoing results with a critical eye toward optimizing this program.

As appropriate throughout the duration of the test program, ADA-ES will issue informal progress reports on the testing. These reports will be issued nominally on a monthly basis and shall include summaries of recent testing with preliminary results, discussion of upcoming testing, and any proposed revisions or updates to the test program.

6 Test Method and Analyzer Descriptions

The following section details how the various measurements required by this test program will be conducted.

6.1 Flue Gas Mercury Measurements

6.1.1 Thermo Electron CEM

A continuous emissions monitor for mercury will be used to provide real-time feedback during the test. A flow diagram of the Thermo Electron Mercury Freedom System is shown in Figure 3. Three key components, the sample extraction probe/converter, mercury analyzer, and the calibration module are described below. Two other modules that are shown in the sketch are the probe controller, which incorporates pressure regulators and temperature controllers for the probe and hot-line, and a zero gas generator for the dilution air that scrubs mercury from clean, dry compressed air.

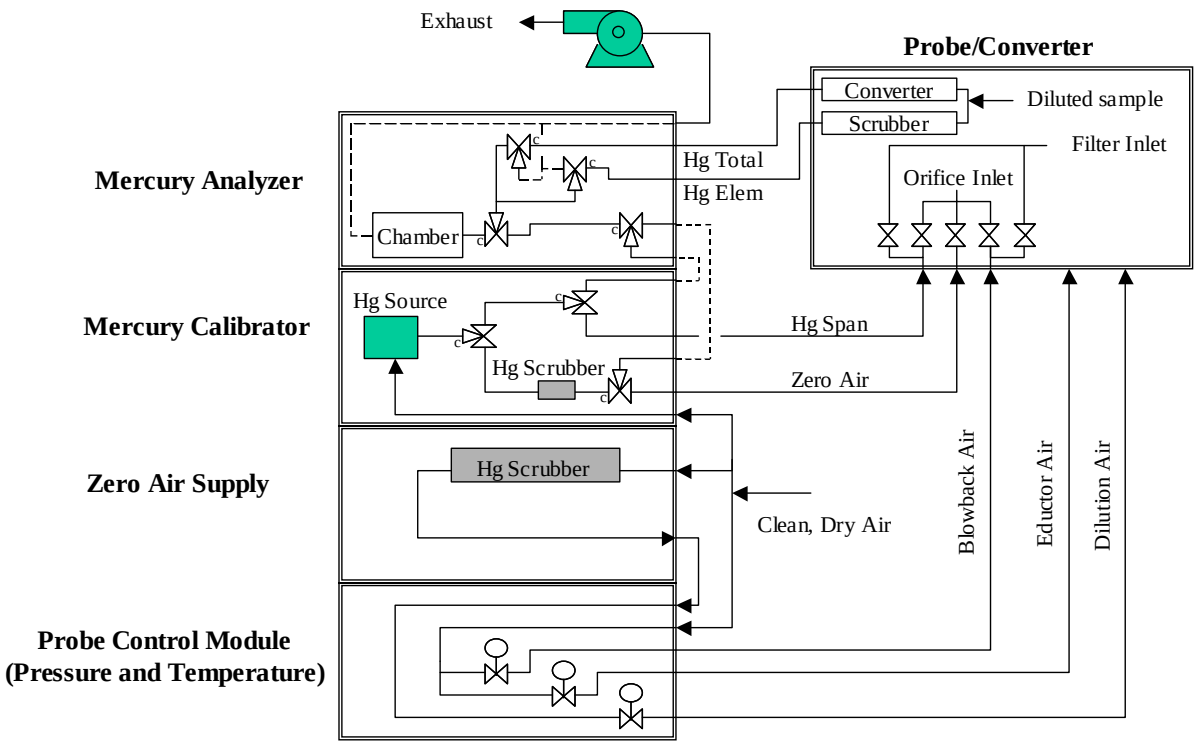


Figure 3. Schematic of the Thermo Electron Mercury Freedom System

A sketch of the inertial filter portion of the extraction probe is shown Figure 4. The inertial filter is used to separate a particulate-free vapor-phase sample while minimizing the interactions with fly ash, which can cause sampling artifacts. Flue gas is drawn into the sampling probe using an eductor pump on the main probe loop. The bulk of the flue gas is then exhausted back into the duct.

A particulate-free sample is drawn from the sample port on the inertial sampling filter using a dilution eductor. Compressed, dry, mercury-free dilution air is delivered to the dilution eductor and a critical orifice is connected between the vacuum port on the eductor and the sample port on the inertial filter to maintain a fixed sample flow rate. The sample is immediately diluted with preheated dilution air to minimize mercury reactions with other flue gas species. The dilution ratio is typically between 25:1 and 100:1, depending on the size of the critical orifice. A lower dilution ratio is appropriate for less reactive flue gas, such as gas produced when firing PRB coal, and a higher dilution ratio is typically preferred on wet or more reactive flue gas, such as downstream of a wet scrubber or when the CEM is used on a high sulfur coal flue gas. The probe is heated and all of the internal surfaces that are exposed to sample gas have a glass coating to prevent unwanted chemical reactions with the mercury.

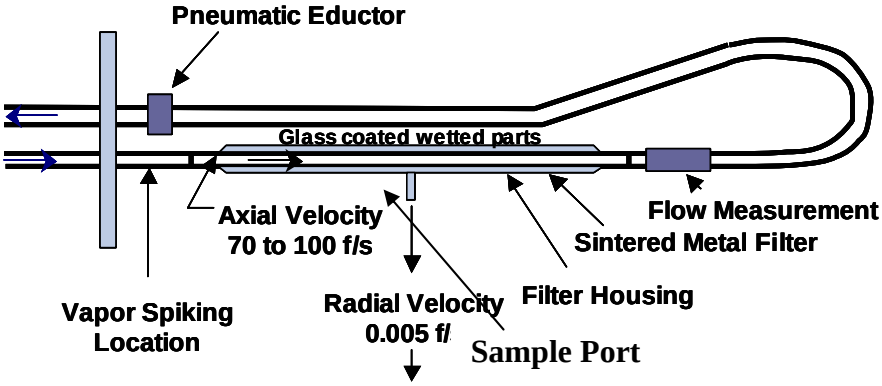


Figure 4. Mercury CEM Extraction Probe

The mercury analyzer is configured to sample from two input streams on a schedule determined by the operator. The two sample streams can be from two separate extraction probes, such as upstream and downstream of a pollution control device, or total and elemental mercury from the same extraction probe.

The converter module, located within the housing for the probe, converts oxidized mercury to elemental mercury for a total vapor-phase mercury measurement. A great deal of progress has been made on the design of the converter since September 2004. The proprietary design combines high temperature (>750ºF) and a chemical reaction to achieve the conversion. Oxidized mercury can be scrubbed from a second sample stream to deliver only elemental mercury to the analyzer through the second sampling line when a speciated measurement is desired.

Mercury is measured directly in the analyzer using Cold Vapor Atomic Fluorescence Spectroscopy (CVAFS). There is no cross interference from SO_2 with CVAFS. Because the sample is diluted, it has low moisture, is relatively non-reactive, and therefore has minimal interference from other gases. Because no moisture is removed from the sample, it is reported on a wet basis. Currently the detection limit is 1 ng/m^3 (~0.1 ppt).

The calibrator module incorporates a mercury source in a temperature-controlled chamber that can be heated or cooled to maintain the source at a precise temperature. The operator can program the calibrator to deliver zero or span gas to the analyzer, to the sample port between the inertial filter and the critical orifice, or upstream of the inertial filter. This allows the user to monitor the operation of the analyzer through direct calibrations, buildup on the critical orifice that could result in changes in the dilution ratio, or particulate deposits on the filter that may scrub mercury. The frequency of the cleaning blowback air is also controlled through the calibrator module. Blowback air can be delivered between the critical orifice and the filter to clean the filter, or upstream of the filter to clear any excess particulate that has deposited in the probe extension.

6.1.2 Sorbent Trap Method

This mercury measurement method extracts a known volume of flue gas from a duct through a dry sorbent trap (containing a specially treated form of activated carbon) as a single-point sample, with a nominal flow rate of about 400 cc/min at the gas meter. This sampling flow rate is held constant (+/- 25%) during testing. The dry sorbent trap, which is in the flue gas stream during testing, represents the entire mercury sample. Each trap is recovered in the field and shipped to a specialized lab such as Frontier Geosciences Inc. for analysis. Each trap is acid leached and the resulting leachate is analyzed for mercury using cold vapor atomic fluorescence spectroscopy. Samples can be collected over time periods ranging from less than an hour to weeks in duration. The test result provides a total vapor-phase mercury measurement of the flue gas stream for the time period of the test.

The sorbent trap method requires that paired samples be collected in the field. The analysis results of the paired sample trains are compared and are typically in agreement within 5% to 20% relative percent difference (RPD), or an average of 5 ng/trap. Another built-in quality assurance measure is achieved through the analysis of two trap sections in series. Each trap has two separate mercury sorbent sections, as shown in Figure 5, and the "B" section is analyzed to evaluate whether any mercury breakthrough occurred. Low B section mercury, in conjunction with a field blank trap, is used to confirm overall sample handling quality.

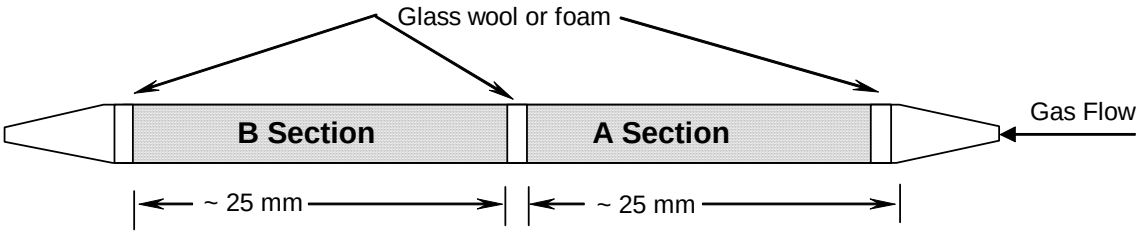


Figure 5. Schematic of an STM Carbon Trap

The sample train is fairly simple, as shown in Figure 6. Major components are a dry sorbent trap mounted directly on the end of a probe (usually heated), a moisture knockout outside the duct, and a console that controls the sampling rate and meters the gas, as well as recording data in a data logger. Temperatures, sampling volume, and barometric pressure are recorded on field sampling data sheets and/or by a data logger for each sample run.

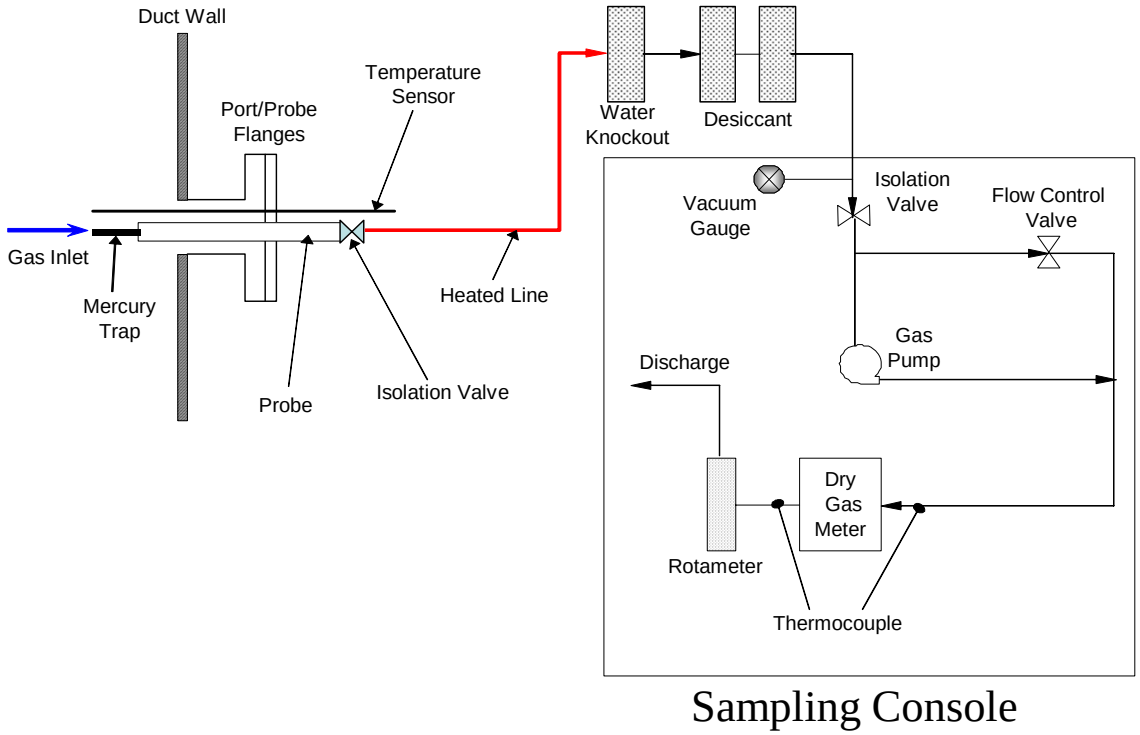


Figure 6. Schematic of an STM Sampling Train

The sorbent trap method directly measures mercury concentration. Using stack gas flow rate, gaseous data from the plant's CEMs, and coal Ultimate Analysis results can be calculated and reported in lb/TBtu.

6.2 Particulate Measurements

Particulate emissions are determined in accordance with the procedures outlined in EPA Method 17. A flue gas sample is extracted isokinetically from the gas stream and the particulate emissions are determined gravimetrically from the material collected in the nozzle, filter holder, and filter. The sampling train consists of the following equipment connected in series:

- Stainless steel nozzle and filter holder
- 30 x 100 glass fiber thimble
- A modified Greenburg-Smith impinger containing 100 ml of distilled water
- A Greenburg-Smith impinger containing 100 ml of distilled water
- A modified Greenburg-Smith impinger, empty
- A modified Greenburg-Smith impinger containing approximately 250g of silica gel

The sample volume is measured by passing it through a calibrated dry gas meter. An S-type pitot tube is attached to the probe to measure stack gas velocity and to maintain isokinetic

sampling. A K-type thermocouple is also attached to the probe to measure the gas temperature.

After the run, the nozzle and filter holder ahead of the filter are brushed and rinsed with acetone. The washings are retained in labeled, glass sample containers for analysis. The impinger contents are measured for increase in volume. The silica gel is returned to the original tared container and weighed to determine moisture gain.

6.3 NO_x and SO_x Measurements

These measurements will be recorded by the plant's installed CEMs.

7 Solids Sampling and Analysis

7.1 Coal Sampling and Analysis

Coal samples shall be obtained per the details provided in Section 4 and at the discretion of the field team. A separate Sampling Plan for each major phase of testing will be developed and sent to team and plant personnel.

Samples shall be placed in clean sample containers and sealed. Each coal sample will be labeled with the date, time, unit identification, and name of the person collecting the sample.

Samples will be analyzed according to the individual needs for each phase of testing, but may include mercury, chloride, ultimate, and proximate analyses.

7.2 Ash Sampling and Analysis

Ash samples will be analyzed for LOI and/or mercury content using Modified ASTM D 672201 for mercury and Modified ASTM C 311-04 for LOI.

8 References

EPRI Project Report number ADA4352002F01, March 1994.

EPRI Project RP 3083-05 Final Report (Mohave Pilot Tests), April 1996.

EPRI Project #TR-110867, "Assessing Air Pollution Control Options at the Hudson Station of Public Service Electric and Gas," August 1998.

9 Appendix: Plant Data Collection Table

Plant Data Collection Points	Units	Units 7–9	Common
Miscellaneous			
Barometric pressure	in Hg		X
Boiler Side			
Unit load, gross	MW	X	
Individual coal feeder flows, 4 per Unit	lbs/hr	X	
Boiler excess O2 (3 plus average)	%	X	
General Back-End			
APH outlet pressure, gas-side	IWC	X	
APH flue gas inlet temperature	°F	X	
APH flue gas outlet temperature	°F	X	
APH air inlet temperature	°F	X	
APH air outlet temperature	°F	X	
Stack temperature	°F	X	
Stack NO_x	ppm	X	
Stack NO_x	lbs/MMBtu	X	
Stack CO	ppm	X	
Opacity, six minute average	%	X	
Stack flue gas flow	kacfm		
Stack SO_2	lbs/MMBtu	X	
TOXECON™			
Unit Mercury	$\mu g/Nm^3$	X	
Unit Mercury – 15 minute ave.	$\mu g/Nm^3$	X	
Unit Mercury – 15 minute ave.	lb/TBtu	X	
Fabric Filter Outlet Mercury	$\mu g/Nm^3$		X
Fabric Filter Outlet Mercury – 15 minute ave.	$\mu g/Nm^3$		X
Fabric Filter Outlet Mercury – 15 minute ave.	lb/TBtu		X
Mercury Removal	%		X
Fabric Filter Inlet Temperature	°F		X
Fabric Filter Outlet Temperature	°F		X
Fabric Filter Inlet Pressure	IWC		X
Fabric Filter Outlet Pressure	IWC		X
Fabric Filter Pressure Drop	IWCD		X

Compartment Pressures (Comp. 1-10)	IWC		X
PAC Unit Injection Rate	%	X	
PAC Overall Injection Rate	lb/MMacf		X
Total Fabric Filter Flue Gas Flow	kacfm		X
Fabric Filter Cleaning Frequency	# pulses		X

Appendix C. Coal and Ash Analysis – Baseline

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	% LOI	Hg (ng/g)
4794	PIPP37	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7A	Base line testing	0.66	<10
4795	PIPP38	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7B	Base line testing	0.61	<10
4796	PIPP39	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7C	Base line testing	0.64	<10
4797	PIPP40	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7D	Base line testing	0.7	<10
4798	PIPP41	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7E	Base line testing	0.73	<10
4799	PIPP42	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7F	Base line testing	0.67	<10
4800	PIPP43	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7G	Base line testing	0.72	<10
4801	PIPP44	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7H	Base line testing	0.63	<10
4802	PIPP45	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7I	Base line testing	0.71	<10
4803	PIPP46	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7J	Base line testing	0.73	<10
4804	PIPP47	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7K	Base line testing	0.74	<10
4805	PIPP48	7005-74	7	2/14/06 0:00	Fly Ash	ESP-7L	Base line testing	0.85	<10
4806	PIPP49	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8A	Base line testing	1.15	<10
4807	PIPP50	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8B	Base line testing	0.99	<10
4808	PIPP51	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8C	Base line testing	0.67	<10
4809	PIPP52	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8D	Base line testing	0.8	<10
4810	PIPP53	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8E	Base line testing	0.86	<10
4811	PIPP54	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8F	Base line testing	0.82	<10
4812	PIPP55	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8G	Base line testing	0.71	<10
4813	PIPP56	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8H	Base line testing	0.68	<10
4814	PIPP57	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8I	Base line testing	0.84	<10
4815	PIPP58	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8J	Base line testing	0.8	<10
4816	PIPP59	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8K	Base line testing	0.79	<10
4817	PIPP60	7005-74	8	2/15/06 0:00	Fly Ash	ESP-8L	Base line testing	0.74	<10
4818	PIPP61	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9A	Base line testing	1.5	<10
4819	PIPP62	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9B	Base line testing	1.15	<10
4820	PIPP63	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9C	Base line testing	0.65	<10
4821	PIPP64	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9D	Base line testing	1.05	<10
4822	PIPP65	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9E	Base line testing	1.19	<10
4823	PIPP66	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9F	Base line testing	1.21	<10
4824	PIPP67	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9G	Base line testing	0.83	<10
4825	PIPP68	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9H	Base line testing	0.66	<10
4826	PIPP69	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9I	Base line testing	0.94	<10
4827	PIPP70	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9J	Base line testing	1.14	<10
4828	PIPP71	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9K	Base line testing	0.77	<10
4829	PIPP72	7005-74	9	2/16/06 0:00	Fly Ash	ESP-9L	Base line testing	0.74	<10
4830	PIPP73	7005-74		2/14/06 0:00	Fly Ash	BH-1	Base line testing	11.04	4690

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	% LOI	Hg (ng/g)
4831	PIPP74	7005-74		2/14/06 0:00	Fly Ash	BH-2	Base line testing	10.87	5590
4832	PIPP75	7005-74		2/14/06 0:00	Fly Ash	BH-3	Base line testing	6.62	3620
4833	PIPP76	7005-74		2/14/06 0:00	Fly Ash	BH-4	Base line testing	10.85	9330
4834	PIPP77	7005-74		2/14/06 0:00	Fly Ash	BH-5	Base line testing	6.94	4290
4835	PIPP78	7005-74		2/14/06 0:00	Fly Ash	BH-6	Base line testing	12.99	2810
4836	PIPP79	7005-74		2/14/06 0:00	Fly Ash	BH-7	Base line testing	11.59	1790
4837	PIPP80	7005-74		2/14/06 0:00	Fly Ash	BH-8	Base line testing	12.72	7830
4838	PIPP81	7005-74		2/14/06 0:00	Fly Ash	BH-9	Base line testing	15.33	14100
4839	PIPP82	7005-74		2/14/06 0:00	Fly Ash	BH-10	Base line testing	17.85	8580
4840	PIPP83	7005-74		2/15/06 0:00	Fly Ash	BH-1	Base line testing	11.49	4770
4841	PIPP84	7005-74		2/15/06 0:00	Fly Ash	BH-2	Base line testing	11.03	6010
4842	PIPP85	7005-74		2/15/06 0:00	Fly Ash	BH-3	Base line testing	7.05	3380
4843	PIPP86	7005-74		2/15/06 0:00	Fly Ash	BH-4	Base line testing	12.03	6040
4844	PIPP87	7005-74		2/15/06 0:00	Fly Ash	BH-5	Base line testing	8.38	6320
4845	PIPP88	7005-74		2/15/06 0:00	Fly Ash	BH-6	Base line testing	12.7	2420
4846	PIPP89	7005-74		2/15/06 0:00	Fly Ash	BH-7	Base line testing	9.64	1820
4847	PIPP90	7005-74		2/15/06 0:00	Fly Ash	BH-8	Base line testing	11.17	3460
4848	PIPP91	7005-74		2/15/06 0:00	Fly Ash	BH-9	Base line testing	15.48	9320
4849	PIPP92	7005-74		2/15/06 0:00	Fly Ash	BH-10	Base line testing	13.31	7550
4850	PIPP93	7005-74		2/16/06 0:00	Fly Ash	BH-1	Base line testing	9.7	2700
4851	PIPP94	7005-74		2/16/06 0:00	Fly Ash	BH-2	Base line testing	12.45	4010
4852	PIPP95	7005-74		2/16/06 0:00	Fly Ash	BH-3	Base line testing	16.07	3020
4853	PIPP96	7005-74		2/16/06 0:00	Fly Ash	BH-4	Base line testing	18.52	4780
4854	PIPP97	7005-74		2/16/06 0:00	Fly Ash	BH-5	Base line testing	11.5	5480
4855	PIPP98	7005-74		2/16/06 0:00	Fly Ash	BH-6	Base line testing	6.89	2170
4856	PIPP99	7005-74		2/16/06 0:00	Fly Ash	BH-7	Base line testing	6.88	1950
4857	PIPP100	7005-74		2/16/06 0:00	Fly Ash	BH-8	Base line testing	12.77	2530
4858	PIPP101	7005-74		2/16/06 0:00	Fly Ash	BH-9	Base line testing	13.39	3670
4859	PIPP102	7005-74		2/16/06 0:00	Fly Ash	BH-10	Base line testing	11.57	1920

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	Hg (ng/g dry)
4758	PIPP1	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	69
4759	PIPP2	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	87.4
4760	PIPP3	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	52.2
4761	PIPP4	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	80.7
4762	PIPP5	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	58.6
4763	PIPP6	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	48.4
4764	PIPP7	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	53
4765	PIPP8	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	55.9
4766	PIPP9	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	61.8
4767	PIPP10	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	60.9
4768	PIPP11	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	53.4
4769	PIPP12	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	52.5
4770	PIPP13	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	53.5
4771	PIPP14	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	73.2
4772	PIPP15	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	48.9
4773	PIPP16	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	46.9
4774	PIPP17	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	47.6
4775	PIPP18	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	53.6
4776	PIPP19	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	89.3
4777	PIPP20	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	59.6
4778	PIPP21	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	55.7
4779	PIPP22	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	54.4
4780	PIPP23	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	57.2
4781	PIPP24	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	60.5
4782	PIPP25	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	56.6
4783	PIPP26	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	35.1
4784	PIPP27	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	58.2
4785	PIPP28	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	44.9
4786	PIPP29	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	60.8
4787	PIPP30	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	63.9
4788	PIPP31	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	51.4
4789	PIPP32	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	62.1
4790	PIPP33	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	51.1

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	Hg (ng/g dry)
4791	PIPP34	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	58.9
4792	PIPP35	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	43.6
4793	PIPP36	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	47.9
4894	4759DUP	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Duplicate of 4759	60.4
4895	4776DUP	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Duplicate of 4776	41.3
4896	4790DUP	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Duplicate of 4790	36

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	Cl (ug/g)
4758	PIPP1	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	46.72
4759	PIPP2	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	68.64
4760	PIPP3	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	70.39
4761	PIPP4	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	82.86
4762	PIPP5	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	115.96
4763	PIPP6	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	104.47
4764	PIPP7	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	68.58
4765	PIPP8	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	113.48
4766	PIPP9	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	69.69
4767	PIPP10	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	91.31
4768	PIPP11	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	63.86
4769	PIPP12	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	64.35
4770	PIPP13	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	49
4771	PIPP14	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	53.99
4772	PIPP15	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	61.62
4773	PIPP16	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	77.72
4774	PIPP17	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	76.67
4775	PIPP18	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	81.46
4776	PIPP19	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	66.24
4777	PIPP20	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	100.73
4778	PIPP21	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	85.1
4779	PIPP22	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	60.01
4780	PIPP23	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	73.14
4781	PIPP24	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	54.39
4782	PIPP25	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	49.38
4783	PIPP26	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	48.58
4784	PIPP27	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	74.89
4785	PIPP28	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	43.13
4786	PIPP29	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	74.67
4787	PIPP30	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	65.39
4788	PIPP31	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	64.24
4789	PIPP32	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	81.06
4790	PIPP33	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	80.06

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	Cl (ug/g)
4791	PIPP34	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	56.21
4792	PIPP35	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	75.49
4793	PIPP36	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	78.19
4894	4759DUP	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Duplicate of 4759	68.12
4895	4776DUP	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Duplicate of 4776	47.24
4896	4790DUP	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Duplicate of 4790	82.79

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	% Ash (as rec)	% Ash (dry)	% C (as rec)	% C (dry)	% H (as rec)	% H (dry)	% H2O (as rec)	% N (as rec)	% N (dry)	% O (as rec)	% O (dry)	% S (as rec)	% S (dry)
4758	PIPP1	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	4.29	5.84	52.67	71.72	3.64	4.96	26.56	0.68	0.92	11.90	16.21	0.26	0.35
4759	PIPP2	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	4.16	5.68	52.57	71.74	3.66	5.00	26.72	0.70	0.95	11.90	16.23	0.29	0.40
4760	PIPP3	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	4.61	6.26	52.36	71.14	3.59	4.88	26.40	0.68	0.93	12.10	16.44	0.26	0.35
4761	PIPP4	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	4.86	6.66	51.77	70.97	3.55	4.86	27.05	0.69	0.94	11.80	16.18	0.28	0.39
4762	PIPP5	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	4.62	6.29	52.68	71.66	3.65	4.97	26.48	0.70	0.95	11.59	15.75	0.28	0.38
4763	PIPP6	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	4.44	6.04	52.39	71.34	3.64	4.95	26.56	0.69	0.94	12.02	16.38	0.26	0.35
4764	PIPP7	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	4.68	6.42	51.58	70.77	3.58	4.91	27.12	0.67	0.92	12.11	16.62	0.26	0.36
4765	PIPP8	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	4.62	6.28	51.96	70.58	3.60	4.89	26.38	0.68	0.92	12.49	16.97	0.27	0.36
4766	PIPP9	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	4.69	6.36	52.28	70.94	3.64	4.94	26.31	0.69	0.94	12.13	16.47	0.26	0.35
4767	PIPP10	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	5.16	6.94	52.30	70.29	3.62	4.86	25.59	0.70	0.94	12.34	16.58	0.29	0.39
4768	PIPP11	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	4.44	6.07	52.01	71.03	3.67	5.01	26.78	0.69	0.94	12.15	16.59	0.26	0.36
4769	PIPP12	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	4.41	6.04	51.73	70.78	3.62	4.95	26.91	0.69	0.94	12.38	16.94	0.26	0.35
4770	PIPP13	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	4.57	6.23	52.12	71.09	3.64	4.96	26.68	0.70	0.95	12.03	16.41	0.26	0.36
4771	PIPP14	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	4.23	5.75	52.52	71.38	3.72	5.05	26.42	0.69	0.94	12.15	16.51	0.27	0.37
4772	PIPP15	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	4.45	6.06	52.38	71.29	3.65	4.97	26.52	0.71	0.96	12.02	16.35	0.27	0.37
4773	PIPP16	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	4.40	6.00	52.23	71.25	3.58	4.88	26.70	0.70	0.95	12.13	16.57	0.26	0.35
4774	PIPP17	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	4.49	6.09	52.60	71.40	3.60	4.89	26.33	0.72	0.98	11.99	16.27	0.27	0.37
4775	PIPP18	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	4.81	6.53	52.18	70.86	3.57	4.85	26.36	0.69	0.94	12.12	16.46	0.27	0.36
4776	PIPP19	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	5.10	6.86	52.77	70.97	3.64	4.89	25.64	0.69	0.93	11.89	15.99	0.27	0.36
4777	PIPP20	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	4.76	6.55	51.62	71.09	3.55	4.89	27.39	0.70	0.97	11.70	16.11	0.28	0.39
4778	PIPP21	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	4.93	6.68	52.44	71.12	3.57	4.84	26.26	0.71	0.96	11.80	16.00	0.29	0.40
4779	PIPP22	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	4.35	6.00	51.74	71.44	3.59	4.95	27.57	0.68	0.94	11.82	16.33	0.25	0.34
4780	PIPP23	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	4.52	6.12	52.96	71.70	3.62	4.90	26.13	0.72	0.97	11.77	15.93	0.28	0.38
4781	PIPP24	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	4.40	6.06	51.64	71.06	3.52	4.84	27.33	0.69	0.95	12.16	16.73	0.26	0.36
4782	PIPP25	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	4.58	6.19	52.63	71.17	3.57	4.83	26.05	0.70	0.95	12.23	16.54	0.24	0.32
4783	PIPP26	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	4.11	5.56	53.55	72.43	3.62	4.90	26.07	0.70	0.95	11.68	15.80	0.27	0.36
4784	PIPP27	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	4.72	6.35	53.34	71.82	3.60	4.85	25.73	0.71	0.96	11.63	15.66	0.27	0.36
4785	PIPP28	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	4.16	5.66	52.90	72.02	3.47	4.73	26.55	0.68	0.93	11.98	16.31	0.26	0.35
4786	PIPP29	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	4.87	6.58	53.02	71.59	3.54	4.78	25.94	0.70	0.95	11.66	15.73	0.27	0.37
4787	PIPP30	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	4.74	6.43	52.94	71.76	3.36	4.55	26.22	0.69	0.93	11.76	15.94	0.29	0.39
4788	PIPP31	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	4.54	6.20	52.64	71.88	3.64	4.97	26.77	0.70	0.95	11.45	15.64	0.26	0.36
4789	PIPP32	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	4.97	6.83	51.93	71.30	3.50	4.80	27.17	0.69	0.95	11.47	15.75	0.27	0.37
4790	PIPP33	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	4.58	6.27	52.23	71.51	3.54	4.84	26.96	0.71	0.97	11.70	16.03	0.28	0.38
4791	PIPP34	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	4.94	6.74	52.33	71.42	3.51	4.79	26.73	0.69	0.94	11.52	15.73	0.28	0.38
4792	PIPP35	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	4.35	5.97	52.67	72.21	3.52	4.82	27.06	0.70	0.96	11.42	15.65	0.28	0.39
4793	PIPP36	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	4.63	6.32	52.39	71.48	3.52	4.80	26.71	0.72	0.98	11.75	16.04	0.28	0.38
4894	4759DUP	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Duplicate of 4759	4.26	5.77	52.87	71.55	3.59	4.86	26.11	0.69	0.93	12.22	16.54	0.26	0.35
4895	4776DUP	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Duplicate of 4776	4.43	6.00	52.52	71.16	3.59	4.86	26.19	0.69	0.93	12.32	16.70	0.26	0.35
4896	4790DUP	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Duplicate of 4790	4.19	5.65	53.53	72.20	3.57	4.81	25.86	0.72	0.97	11.89	16.04	0.24	0.33

ADA ID	Field ID	Project	Unit	Date	Type	Location	Comments	% Ash (as rec)	% Ash (dry)	% FC (as rec)	% FC (dry)	% H2O (as rec)	% S (as rec)	% S (dry)	% Vol (as rec)	% Vol (dry)	BTU/lb (as rec)	BTU/lb (dry)	MAF (BTU/lb)
4758	PIPP1	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	4.29	5.84	38.50	52.43	26.56	0.26	0.35	30.65	41.73	9014	12274	13035
4759	PIPP2	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	4.16	5.68	38.61	52.69	26.72	0.29	0.40	30.51	41.63	9047	12346	13089
4760	PIPP3	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	4.61	6.26	38.70	52.58	26.40	0.26	0.35	30.29	41.16	9012	12245	13063
4761	PIPP4	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	4.86	6.66	38.01	52.10	27.05	0.28	0.39	30.08	41.24	8863	12149	13016
4762	PIPP5	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	4.62	6.29	38.60	52.50	26.48	0.28	0.38	30.30	41.21	9071	12338	13166
4763	PIPP6	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	4.44	6.04	38.44	52.35	26.56	0.26	0.35	30.56	41.61	9031	12297	13087
4764	PIPP7	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	4.68	6.42	38.04	52.20	27.12	0.26	0.36	30.16	41.38	8879	12183	13019
4765	PIPP8	7005-74	8	2/14/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	4.62	6.28	38.31	52.03	26.38	0.27	0.36	30.69	41.69	8996	12220	13039
4766	PIPP9	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	4.69	6.36	38.62	52.42	26.31	0.26	0.35	30.38	41.22	8980	12186	13014
4767	PIPP10	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	5.16	6.94	38.58	51.84	25.59	0.29	0.39	30.67	41.22	8995	12088	12989
4768	PIPP11	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	4.44	6.07	38.32	52.33	26.78	0.26	0.36	30.46	41.60	8942	12212	13001
4769	PIPP12	7005-74	9	2/14/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	4.41	6.04	38.32	52.42	26.91	0.26	0.35	30.36	41.54	8947	12241	13028
4770	PIPP13	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	4.57	6.23	38.24	52.16	26.68	0.26	0.36	30.51	41.61	8968	12231	13044
4771	PIPP14	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	4.23	5.75	38.74	52.65	26.42	0.27	0.37	30.61	41.60	9080	12340	13093
4772	PIPP15	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	4.45	6.06	38.45	52.33	26.52	0.27	0.37	30.58	41.61	9021	12277	13069
4773	PIPP16	7005-74	7	2/15/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	4.40	6.00	38.50	52.52	26.70	0.26	0.35	30.40	41.48	8993	12269	13052
4774	PIPP17	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	4.49	6.09	38.57	52.36	26.33	0.27	0.37	30.61	41.55	9061	12299	13097
4775	PIPP18	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	4.81	6.53	38.50	52.28	26.36	0.27	0.36	30.33	41.19	9009	12234	13089
4776	PIPP19	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	5.10	6.86	38.42	51.67	25.64	0.27	0.36	30.84	41.47	9108	12249	13151
4777	PIPP20	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	4.76	6.55	38.04	52.40	27.39	0.28	0.39	29.81	41.05	8865	12209	13065
4778	PIPP21	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	4.93	6.68	38.58	52.32	26.26	0.29	0.40	30.23	41.00	9037	12255	13132
4779	PIPP22	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	4.35	6.00	38.04	52.53	27.57	0.25	0.34	30.04	41.47	8855	12226	13006
4780	PIPP23	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	4.52	6.12	38.83	52.57	26.13	0.28	0.38	30.52	41.31	9102	12321	13124
4781	PIPP24	7005-74	9	2/15/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	4.40	6.06	38.26	52.64	27.33	0.26	0.36	30.01	41.30	8917	12271	13063
4782	PIPP25	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A1	Base line testing - uncrushed coal	4.58	6.19	38.62	52.23	26.02	0.24	0.32	30.75	41.58	9055	12245	13053
4783	PIPP26	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - A2	Base line testing - uncrushed coal	4.11	5.56	39.10	52.89	26.07	0.27	0.36	30.72	41.55	9124	12342	13069
4784	PIPP27	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B1	Base line testing - uncrushed coal	4.72	6.35	38.66	52.06	25.73	0.27	0.36	30.89	41.59	9115	12273	13105
4785	PIPP28	7005-74	7	2/16/06 0:00	Coal	UNIT 7 - B2	Base line testing - uncrushed coal	4.16	5.66	38.54	52.47	26.55	0.26	0.35	30.75	41.87	8992	12243	12978
4786	PIPP29	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A1	Base line testing - uncrushed coal	4.87	6.58	38.41	51.86	25.94	0.27	0.37	30.78	41.56	9081	12262	13126
4787	PIPP30	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - A2	Base line testing - uncrushed coal	4.74	6.43	38.42	52.07	26.22	0.29	0.39	30.62	41.50	8997	12195	13033
4788	PIPP31	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B1	Base line testing - uncrushed coal	4.54	6.20	38.31	52.32	26.77	0.26	0.36	30.38	41.48	8990	12277	13088
4789	PIPP32	7005-74	8	2/16/06 0:00	Coal	UNIT 8 - B2	Base line testing - uncrushed coal	4.97	6.83	37.66	51.70	27.17	0.27	0.37	30.20	41.47	8834	12130	13019
4790	PIPP33	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Base line testing - uncrushed coal	4.58	6.27	38.23	52.34	26.96	0.28	0.38	30.23	41.39	8961	12268	13089
4791	PIPP34	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A2	Base line testing - uncrushed coal	4.94	6.74	38.05	51.94	26.73	0.28	0.38	30.28	41.32	8817	12034	12904
4792	PIPP35	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B1	Base line testing - uncrushed coal	4.35	5.97	38.42	52.67	27.06	0.28	0.39	30.17	41.36	8972	12300	13081
4793	PIPP36	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - B2	Base line testing - uncrushed coal	4.63	6.32	38.38	52.36	26.71	0.28	0.38	30.28	41.32	8955	12219	13043
4894	4759DUP	7005-74	7	2/14/06 0:00	Coal	UNIT 7 - A2	Duplicate of 4759	4.26	5.77	38.86	52.59	26.11	0.26	0.35	30.77	41.64	9076	12283	13035
4895	4776DUP	7005-74	8	2/15/06 0:00	Coal	UNIT 8 - B1	Duplicate of 4776	4.43	6.00	38.60	52.30	26.19	0.26	0.35	30.78	41.70	9030	12234	13015
4896	4790DUP	7005-74	9	2/16/06 0:00	Coal	UNIT 9 - A1	Duplicate of 4790	4.19	5.65	39.09	52.73	25.86	0.24	0.33	30.86	41.62	9206	12417	13161

Appendix D. Coal Analysis – Long-Term

Coal Ultimate Analysis

Field ID	Date	Type	Location	Comments	% Ash (as rec)	% Ash (dry)	% C (as rec)	% C (dry)	% H (as rec)	% H (dry)	% H2O (as rec)	% N (as rec)	% N (dry)	% O (as rec)	% O (dry)	% S (as rec)	% S (dry)
PIPP339	11/06/06	Coal	UNIT 7 - A1	Parametric testing-2.5	5.03	6.53	54.58	70.87	3.82	4.96	22.98	0.31	0.40	12.99	16.86	0.29	0.38
PIPP340	11/06/06	Coal	UNIT 8 - A1	Parametric testing-2.5	4.07	5.40	54.31	72.01	3.93	5.21	24.58	0.34	0.45	12.51	16.59	0.26	0.34
PIPP341	11/06/06	Coal	UNIT 9 - A1	Parametric testing-2.5	4.06	5.39	54.08	71.86	3.90	5.19	24.74	0.30	0.40	12.65	16.80	0.27	0.36
PIPP377	03/13/07	Coal	UNIT 7 - A1	Parametric testing - 2.5	3.82	5.13	53.33	71.68	3.95	5.31	25.59	0.32	0.42	12.74	17.13	0.25	0.33
PIPP378	03/13/07	Coal	UNIT 8 - A1	Parametric testing - 2.5	4.34	5.80	53.17	71.06	3.60	4.81	25.18	0.34	0.46	13.09	17.50	0.28	0.37
	11/04/08	Coal	Unit 8		4.83	6.65	50.75	69.83	3.37	4.64	27.33	0.61	0.83.	12.81	17.64	0.30	0.41
	11/05/08	Coal	Unit 8		4.30	5.91	51.20	70.39	3.42	4.70	27.25	0.61	0.83	13.00	17.87	0.22	0.30
	11/06/08	Coal	Unit 8		4.57	6.27	51.09	70.01	3.46	4.75	27.03	0.61	0.84	13.00	17.80	0.24	0.33

Coal Proximate Analysis

Field ID	Date	Type	Location	Comments	% Ash (as rec)	% Ash (dry)	% FC (as rec)	% FC (dry)	% H2O (as rec)	% S (as rec)	% S (dry)	% Vol (as rec)	% Vol (dry)	BTU/lb (as rec)	BTU/lb (dry)	MAF (BTU/lb)
PIPP339	11/06/06	Coal	UNIT 7 - A1	Parametric testing-2.5	5.03	6.53	39.15	50.83	22.98	0.29	0.38	32.84	42.64	9327	12109	12955
PIPP340	11/06/06	Coal	UNIT 8 - A1	Parametric testing-2.5	4.07	5.40	39.33	52.14	24.58	0.26	0.34	32.02	42.46	9255	12271	12972
PIPP341	11/06/06	Coal	UNIT 9 - A1	Parametric testing-2.5	4.06	5.39	39.08	51.93	24.74	0.27	0.36	32.12	42.68	9263	12308	13010
PIPP377	03/13/07	Coal	UNIT 7 - A1	Parametric testing - 2.5	3.82	5.13	38.67	51.96	25.59	0.25	0.33	31.92	42.91	9181	12339	13006
PIPP378	03/13/07	Coal	UNIT 8 - A1	Parametric testing - 2.5	4.34	5.80	38.55	51.52	25.18	0.28	0.37	31.93	42.68	9189	12281	13037
	11/04/08	Coal	Unit 8		4.83	6.65	36.82	50.66	27.33	0.30	0.41	31.02	42.69	8860	12191	13059
	11/05/08	Coal	Unit 8		4.30	5.91	37.40	51.40	27.25	0.22	0.30	31.05	42.69	8905	12242	13010
	11/06/08	Coal	Unit 8		4.57	6.27	37.22	51.00	27.03	0.24	0.33	31.18	42.73	8927	12234	13051

Coal Mercury Analysis

Field ID	Date	Type	Location	Comments	% H2O	Hg (ng/g as rec)	Hg (ng/g dry)
	10/27/06	Coal	WE Energies Sample	FL43552	8.6	42.5	46.5
	10/30/06	Coal	WE Energies Sample	FL43553	7	63.7	68.5
	10/30/06	Coal	WE Energies Sample	FL43554	8.1	40.1	43.6
	10/30/06	Coal	WE Energies Sample	FL43555	10.7	35.3	39.5
	11/01/06	Coal	WE Energies Sample	FL43556	13.5	40.9	47.3
	11/02/06	Coal	WE Energies Sample	FL43557	14.7	36.3	42.6
PIPP339	11/06/06	Coal	UNIT 7 - A1	Parametric testing-2.5	9.3		45.5
PIPP340	11/06/06	Coal	UNIT 8 - A1	Parametric testing-2.5	9.4		45.2
PIPP341	11/06/06	Coal	UNIT 9 - A1	Parametric testing-2.5	9.8		51.4
PIPP377	03/13/07	Coal	UNIT 7 - A1	Parametric testing - 2.5	9.5		33.7
PIPP378	03/13/07	Coal	UNIT 8 - A1	Parametric testing - 2.5	8.8		67.3
	11/04/08	Coal	Unit 7		11.7		46.6
	11/04/08	Coal	Unit 8		11.6		113
	11/05/08	Coal	Unit 9		8.5		49.7
	11/05/08	Coal	Unit 7		11.1		41.3
	11/05/08	Coal	Unit 8		9.9		39.6
	11/06/08	Coal	Unit 7		9.3		50.4
	11/06/08	Coal	Unit 8		8.8		49.1
	11/06/08	Coal	Unit 9		8.8		36
	11/05/08	Coal	Unit 9		11.8		62.8

Coal Halogen Analysis

Field ID	Date	Type	Location	Comments	Br (ug/g)	Cl Dry (ug/g)
PIPP339	11/06/06	Coal	UNIT 7 - A1	Parametric testing-2.5		36
PIPP340	11/06/06	Coal	UNIT 8 - A1	Parametric testing-2.5		35
PIPP341	11/06/06	Coal	UNIT 9 - A1	Parametric testing-2.5		19
PIPP377	03/13/07	Coal	UNIT 7 - A1	Parametric testing - 2.5		22
PIPP378	03/13/07	Coal	UNIT 8 - A1	Parametric testing - 2.5		30
	11/04/08	Coal	Unit 7		1.2	35
	11/04/08	Coal	Unit 8		1.2	12
	11/05/08	Coal	Unit 9		2.1	42
	11/05/08	Coal	Unit 7		2.2	21
	11/05/08	Coal	Unit 8		1.3	17
	11/06/08	Coal	Unit 7		1.1	21
	11/06/08	Coal	Unit 8		2.3	23
	11/06/08	Coal	Unit 9		3	33
	11/05/08	Coal	Unit 9		3.5	25

Coal Mineral Analysis

Field ID	Date	Type	Location	Comments	% Al2O3	% BaO	% CaO	% Fe2O3	% K2O	% MgO	% Mn3O4	% Na2O	% P2O5	% SiO2	% SO3	% SrO	% TiO2
PIPP339	11/06/06	Coal	UNIT 7 - A1	Parametric testing-2.5	19.17	0.59	16.90	4.48	0.49	4.10	0.01	3.71	0.76	36.28	11.80	0.44	1.27
PIPP340	11/06/06	Coal	UNIT 8 - A1	Parametric testing-2.5	16.45	0.81	20.58	5.75	0.37	4.85	0.02	4.02	1.20	29.98	14.39	0.51	1.07
PIPP341	11/06/06	Coal	UNIT 9 - A1	Parametric testing-2.5	16.38	0.73	19.78	6.50	0.44	4.76	0.02	4.63	0.72	29.41	14.92	0.52	1.19
PIPP377	03/13/07	Coal	UNIT 7 - A1	Parametric testing - 2.5	15.84	0.75	22.03	5.49	0.39	5.20	0.01	4.35	0.78	28.77	14.72	0.49	1.18
PIPP378	03/13/07	Coal	UNIT 8 - A1	Parametric testing - 2.5	14.63	0.79	19.21	5.97	0.49	4.51	0.01	4.17	0.90	32.96	14.70	0.49	1.17
PIPP1063	09/15/09	Coal	UNIT 8	Long Term	18.04	0.95	20.87	5.53	0.43	5.09	0.02	4.53	1.32	28.51	12.94	0.50	1.27

Coal Elemental Analysis

Project	Date	Type	Location	Comments	As (ug/g)	Be (ug/g)	Cd (ug/g)	Cr (ug/g)	Mn (ug/g)	Pb (ug/g)	Se (ug/g)
7005-74	11/04/08	Coal	Unit 8		1.00	0.20	<0.2	3.00	12.00	2.00	<1
7005-74	11/05/08	Coal	Unit 8		<1	0.20	<0.2	4.00	11.00	<2	<1
7005-74	11/06/08	Coal	Unit 8		<1	0.20	<0.2	4.00	11.00	<2	<1

Appendix E. Ash Analysis – Long-Term

Ash LOI and Mercury Analysis

Field ID	Date	Type	Location	Comments	% H2O	% LOI	Hg (ng/g)
PIPP109	02/22/06	Fly Ash	BH-1	Parametric testing	0.66	8.35	4160
PIPP110	02/22/06	Fly Ash	BH-2	Parametric testing	0.66	11.25	7970
PIPP111	02/22/06	Fly Ash	BH-3	Parametric testing	0.59	12.27	6510
PIPP112	02/22/06	Fly Ash	BH-4	Parametric testing	0.95	13.09	10000
PIPP113	02/22/06	Fly Ash	BH-5.	Parametric testing	0.97	11.91	8170
PIPP114	02/22/06	Fly Ash	BH-6	Parametric testing	0.87	13.52	14300
PIPP115	02/22/06	Fly Ash	BH-7	Parametric testing	0.83	14.41	9730
PIPP116	02/22/06	Fly Ash	BH-8	Parametric testing	0.82	9.58	1035
PIPP117	02/22/06	Fly Ash	BH-9	Parametric testing	0.66	6.89	1890
PIPP118	02/22/06	Fly Ash	BH-10	Parametric testing	0.46	17.29	33200
PIPP125	02/24/06	Fly Ash	BH-1	Parametric testing	0.4	22.48	15700
PIPP126	02/24/06	Fly Ash	BH-2	Parametric testing	0.51	19.11	22700
PIPP127	02/24/06	Fly Ash	BH-3	Parametric testing	0.66	18.3	16000
PIPP128	02/24/06	Fly Ash	BH-4	Parametric testing	1.59	20.93	25700
PIPP129	02/24/06	Fly Ash	BH-5.	Parametric testing	1.19	22.3	28100
PIPP130	02/24/06	Fly Ash	BH-6	Parametric testing	0.8	27.31	45000
PIPP131	02/24/06	Fly Ash	BH-7	Parametric testing	0.95	28.4	29500
PIPP132	02/24/06	Fly Ash	BH-8	Parametric testing	1.18	26.04	31900
PIPP133	02/24/06	Fly Ash	BH-9	Parametric testing	0.99	27.17	32700
PIPP134	02/24/06	Fly Ash	BH-10	Parametric testing	1.15	28.72	35700
PIPP141	02/27/06	Fly Ash	BH-1	Parametric testing	1.36	31.08	37900
PIPP142	02/27/06	Fly Ash	BH-2	Parametric testing	2.98	34.67	46300

PIPP143	02/27/06	Fly Ash	BH-3	Parametric testing	1.46	21.45	18300
PIPP144	02/27/06	Fly Ash	BH-4	Parametric testing	2.28	30.91	38100
PIPP145	02/27/06	Fly Ash	BH-5.	Parametric testing	1.33	18.58	22600
PIPP146	02/27/06	Fly Ash	BH-6	Parametric testing	0.61	23.34	51900
PIPP147	02/27/06	Fly Ash	BH-7	Parametric testing	0.68	38.82	42700
PIPP148	02/27/06	Fly Ash	BH-8	Parametric testing	1.34	38.28	45400
PIPP149	02/27/06	Fly Ash	BH-9	Parametric testing	1.5	38.47	40800
PIPP150	02/27/06	Fly Ash	BH-10	Parametric testing	0.64	38.94	44200
PIPP157	03/01/06	Fly Ash	BH-1	Parametric testing	0.57	37.18	35400
PIPP158	03/01/06	Fly Ash	BH-2	Parametric testing	0.49	40.03	48600
PIPP159	03/01/06	Fly Ash	BH-3	Parametric testing	0.1	33.4	38500
PIPP160	03/01/06	Fly Ash	BH-4	Parametric testing	1.09	18.3	25700
PIPP161	03/01/06	Fly Ash	BH-5.	Parametric testing	0.4	15.29	1805
PIPP162	03/01/06	Fly Ash	BH-6	Parametric testing	0.36	11.73	21800
PIPP163	03/01/06	Fly Ash	BH-7	Parametric testing	0.95	25.63	37100
PIPP164	03/01/06	Fly Ash	BH-8	Parametric testing	0.81	45.46	41600
PIPP165	03/01/06	Fly Ash	BH-9	Parametric testing	0.68	48.4	41700
PIPP166	03/01/06	Fly Ash	BH-10	Parametric testing	1.55	45.96	36100
PIPP167	03/03/06	Fly Ash	BH-1	Parametric testing	1.72	30.96	20300
PIPP168	03/03/06	Fly Ash	BH-2	Parametric testing	1.59	25.19	34600
PIPP169	03/03/06	Fly Ash	BH-3	Parametric testing	0.3	37.8	40700
PIPP170	03/03/06	Fly Ash	BH-4	Parametric testing	0.31	42.29	44300
PIPP171	03/03/06	Fly Ash	BH-5.	Parametric testing	3.37	33.93	37400
PIPP172	03/03/06	Fly Ash	BH-6	Parametric testing	4.1	34.88	34300

PIPP173	03/03/06	Fly Ash	BH-7	Parametric testing	1.39	24.92	16900
PIPP174	03/03/06	Fly Ash	BH-8	Parametric testing	3.01	32.79	34300
PIPP175	03/03/06	Fly Ash	BH-9	Parametric testing	2.57	34.06	36100
PIPP176	03/03/06	Fly Ash	BH-10	Parametric testing	3.03	33.9	41200
PIPP183	08/15/06	Fly Ash	Bag (1liter1,5,6,&10)	Base line testing	0.35	2.62	153
PIPP204	08/21/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing (.05)	0.59	6.21	6625
PIPP211	08/25/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing (1.0)	0.76	14.85	12533
PIPP212	08/25/06	Fly Ash	Bag (5 gal. all)	Parametric testing (1.0)	0.49	27.12	31033
PIPP227	08/28/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing (1.5)	0.26	22.1	22267
PIPP234	09/01/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing (2.0)	0.74	31.81	31925
PIPP245	09/04/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing (2.5)	1.24	34.28	34600
PIPP258	09/07/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing (3.0)	0	53.45	44025
PIPP259	09/07/06	Fly Ash	Bag (5 gal. all)	Parametric testing (3.0)	0.14	40.33	28760
PIPP275	09/22/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing - 0.5 BH	1.06	31.71	58460
PIPP276	10/07/06	Fly Ash	Bag (1liter1,5,6,&10)	Base line testing - 0.5	0	5.59	799
PIPP277	10/11/06	Fly Ash	Bag (1liter1,5,6,&10)	Base line testing - 0.5	0.38	3.11	573
PIPP278	10/16/06	Fly Ash	Bag (1liter1,5,6,&10)	Base line testing - 0.5	2.44	13.68	24250
PIPP285	10/19/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing - 1.0	0.22	24.97	34900
PIPP301	10/24/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing - 0.5	1.86	27.06	38000
PIPP314	10/27/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing - 1.0	1.66	31.8	43900
PIPP323	10/30/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing - 1.5	1.35	32.92	38250
PIPP330	11/02/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing - 2.0	1.98	50.45	48200
PIPP345	11/06/06	Fly Ash	Bag (1liter1,5,6,&10)	Parametric testing-2.5	0.44	54.44	41050
PIPP346	12/13/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.0	2.93	41.36	51850

PIPP347	12/15/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.0	2.15	45.66	63900
PIPP348	12/18/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.0	1.57	46.11	41800
PIPP349	12/20/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.0	1.54	45.25	63000
PIPP350	12/22/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.0	2.32	45.11	34100
PIPP351	12/25/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.0	1.96	45.64	53300
PIPP352	12/27/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.69	48.37	44700
PIPP353	12/29/06	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.0	0.85	42.81	39700
PIPP354	01/01/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.97	42.2	40200
PIPP355	01/03/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.54	53.43	51400
PIPP356	01/05/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.43	43.96	43800
	01/08/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.93	45.53	47800
PIPP357	01/10/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.93	56.05	56700
PIPP358	01/12/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.26	55.84	54200
PIPP359	01/15/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.25	52.62	40600
PIPP360	01/17/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.13	51.97	55600
PIPP361	01/19/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.09	45.88	38000
PIPP362	01/22/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.91	39.82	45300
PIPP363	01/24/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.26	51.99	47800
PIPP364	01/26/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.51	51.23	32800
PIPP365	01/29/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.67	52.8	48300
PIPP366	01/31/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.49	53.93	51900
PIPP367	02/02/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.37	50.5	39700
PIPP368	02/05/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.44	49.6	47500
PIPP369	02/07/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.51	51.94	41600

PIPP370	02/09/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.45	51.61	53050
PIPP371	02/12/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	1.62	49.17	54350
PIPP374	02/19/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	1.22	50.49	50900
PIPP379	03/02/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	0.81	41.35	28100
PIPP380	03/05/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	0.82	39.22	37700
PIPP383	03/12/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	0.88	56.08	57800
PIPP386	03/19/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.9	54.33	37200
PIPP389	03/26/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.62	48.22	55200
PIPP392	04/02/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.31	56.26	65200
PIPP395	04/09/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	2.08	55.03	46700
	04/30/07	Trona	Solvay	Trona sample			<10
PIPP398	04/16/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	1.63	32.73	21600
PIPP401	04/23/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	0.95	41.78	44500
PIPP405	05/02/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	0.87	51.15	45900
PIPP407	05/07/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing - 2.5	0.81	50.61	40500
PIPP409	05/11/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	0.49	51.6	55750
PIPP502	05/18/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.65	53.58	56700
PIPP505	05/25/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-2.5	1.33	39.47	44300
PIPP508	06/01/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	2.26	51.85	57500
PIPP511	06/08/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	4.53	47.33	46300
PIPP514	06/15/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	1.16	53.02	80900
PIPP517	06/22/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	0.18	43.17	75400
PIPP520	06/29/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	0.76	54.39	73750
PIPP523	07/06/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	0.05	54.14	64300

PIPP526	07/13/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	0.7	44.65	61900
PIPP529	07/20/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	1.05	48.37	64750
PIPP532	07/27/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	0.24	55.55	69400
	08/01/07	Fly Ash	Bag (1,5,6,&10)	Parametric testing-trim	0.03	54.53	76900
PIPP540	08/02/07	Fly Ash	BH-1	Parametric - 2,161 lbs/hr	1.03	24.69	34700
PIPP541	08/02/07	Fly Ash	BH-2	Parametric - 2,161 lbs/hr	0.85	22.45	25900
PIPP542	08/02/07	Fly Ash	BH-3	Parametric - 2,161 lbs/hr	0.66	29.25	29900
PIPP543	08/02/07	Fly Ash	BH-4	Parametric - 2,161 lbs/hr	0.83	22.78	24900
PIPP544	08/02/07	Fly Ash	BH-5	Parametric - 2,161 lbs/hr	0.33	22.18	28700
PIPP545	08/02/07	Fly Ash	BH-6	Parametric - 2,161 lbs/hr	0.42	16.39	11700
PIPP546	08/02/07	Fly Ash	BH-7	Parametric - 2,161 lbs/hr	0.04	21.06	20800
PIPP547	08/02/07	Fly Ash	BH-8	Parametric - 2,161 lbs/hr	0.08	16.73	14800
PIPP548	08/02/07	Fly Ash	BH-9	Parametric - 2,161 lbs/hr	0.04	20.31	20200
PIPP549	08/02/07	Fly Ash	BH-10	Parametric - 2,161 lbs/hr	0.96	24.91	19600
PIPP552	08/03/07	Fly Ash	Bag (1,5,6,&10)	Parametric - 4,322 lbs/hr	0.62	19.49	21500
PIPP553	08/04/07	Fly Ash	BH-1	Parametric - 4,322 lbs/hr	0.31	9.49	9530
PIPP554	08/04/07	Fly Ash	BH-2	Parametric - 4,322 lbs/hr	0.25	9.22	9050
PIPP555	08/04/07	Fly Ash	BH-3	Parametric - 4,322 lbs/hr	0.24	11.9	11150
PIPP556	08/04/07	Fly Ash	BH-4	Parametric - 4,322 lbs/hr	0.3	12.27	11100
PIPP557	08/04/07	Fly Ash	BH-5	Parametric - 4,322 lbs/hr	0.44	14.09	11600
PIPP558	08/04/07	Fly Ash	BH-6	Parametric - 4,322 lbs/hr	0.16	6.08	2375
PIPP559	08/04/07	Fly Ash	BH-7	Parametric - 4,322 lbs/hr	0.25	6.64	2140
PIPP560	08/04/07	Fly Ash	BH-8	Parametric - 4,322 lbs/hr	0.06	9.98	5960
PIPP561	08/04/07	Fly Ash	BH-9	Parametric - 4,322 lbs/hr	0.4	13.82	11600

PIPP562	08/04/07	Fly Ash	BH-10	Parametric - 4,322 lbs/hr	0	11.65	9880
	08/05/07	Fly Ash	Bag (1,5,6,&10)	Parametric-5,403 lbs/hr	0.5	10.82	8100
PIPP563	08/06/07	Fly Ash	BH-1	Parametric - 5,900 lbs/hr	0.68	13.02	13200
PIPP564	08/06/07	Fly Ash	BH-2	Parametric - 5,900 lbs/hr	0.25	15.1	15800
PIPP565	08/06/07	Fly Ash	BH-3	Parametric - 5,900 lbs/hr	0.81	10.93	9460
PIPP566	08/06/07	Fly Ash	BH-4	Parametric - 5,900 lbs/hr	0.86	12.18	10100
PIPP567	08/06/07	Fly Ash	BH-5	Parametric - 5,900 lbs/hr	1.7	11.54	9475
PIPP568	08/06/07	Fly Ash	BH-6	Parametric - 5,900 lbs/hr	0.99	10.66	7600
PIPP569	08/06/07	Fly Ash	BH-7	Parametric - 5,900 lbs/hr	0.27	11.92	10000
PIPP570	08/06/07	Fly Ash	BH-8	Parametric - 5,900 lbs/hr	1.27	10.81	8310
PIPP571	08/06/07	Fly Ash	BH-9	Parametric - 5,900 lbs/hr	0.93	10.82	8190
PIPP572	08/06/07	Fly Ash	BH-10	Parametric - 5,900 lbs/hr	2.06	10.68	8520
PIPP576	08/07/07	Fly Ash	BH-1	Parametric - 5,900 lbs/hr	2.75	13.51	14200
PIPP577	08/07/07	Fly Ash	BH-2	Parametric - 5,900 lbs/hr	0.44	14.33	16500
PIPP578	08/07/07	Fly Ash	BH-3	Parametric - 5,900 lbs/hr	0.19	13.9	15300
PIPP579	08/07/07	Fly Ash	BH-4	Parametric - 5,900 lbs/hr	1.05	14.03	15800
PIPP580	08/07/07	Fly Ash	BH-5	Parametric - 5,900 lbs/hr	0.87	14.41	14600
PIPP581	08/07/07	Fly Ash	BH-6	Parametric - 5,900 lbs/hr	0.36	13.99	14700
PIPP582	08/07/07	Fly Ash	BH-7	Parametric - 5,900 lbs/hr	0.75	14.61	13800
PIPP583	08/07/07	Fly Ash	BH-8	Parametric - 5,900 lbs/hr	0.01	13.4	10700
PIPP584	08/07/07	Fly Ash	BH-9	Parametric - 5,900 lbs/hr	0	12.75	12900
PIPP585	08/07/07	Fly Ash	BH-10	Parametric - 5,900 lbs/hr	0.49	12.95	12100
PIPP589	08/08/07	Fly Ash	BH-1	Parametric - 5,900 lbs/hr	0.85	7.19	6420
PIPP590	08/08/07	Fly Ash	BH-2	Parametric - 5,900 lbs/hr	0.64	14.21	16200

PIPP591	08/08/07	Fly Ash	BH-3	Parametric - 5,900 lbs/hr	0.46	13.54	14800
PIPP592	08/08/07	Fly Ash	BH-4	Parametric - 5,900 lbs/hr	0.47	14.56	15900
PIPP593	08/08/07	Fly Ash	BH-5	Parametric - 5,900 lbs/hr	0.33	4.13	816
PIPP594	08/08/07	Fly Ash	BH-6	Parametric - 5,900 lbs/hr	0.05	11.91	14100
PIPP595	08/08/07	Fly Ash	BH-7	Parametric - 5,900 lbs/hr	0.26	12.25	654
PIPP596	08/08/07	Fly Ash	BH-8	Parametric - 5,900 lbs/hr	0.01	10.91	11400
PIPP597	08/08/07	Fly Ash	BH-9	Parametric - 5,900 lbs/hr	0.23	12.96	14200
PIPP598	08/08/07	Fly Ash	BH-10	Parametric - 5,900 lbs/hr	0.17	4.87	1750
PIPP599	08/09/07	Fly Ash	BH-1	Parametric - 5,900 lbs/hr	2.36	4.23	910
PIPP600	08/09/07	Fly Ash	BH-2	Parametric - 5,900 lbs/hr	0.4	6.64	4940
PIPP601	08/09/07	Fly Ash	BH-3	Parametric - 5,900 lbs/hr	0.53	8.16	5710
PIPP602	08/09/07	Fly Ash	BH-4	Parametric - 5,900 lbs/hr	0.57	8.74	4870
PIPP603	08/09/07	Fly Ash	BH-5	Parametric - 5,900 lbs/hr	0.35	7.83	4360
PIPP604	08/09/07	Fly Ash	BH-6	Parametric - 5,900 lbs/hr	0.58	5.49	1900
PIPP605	08/09/07	Fly Ash	BH-7	Parametric - 5,900 lbs/hr	0.16	4.82	572
PIPP606	08/09/07	Fly Ash	BH-8	Parametric - 5,900 lbs/hr	0.6	5.76	2250
PIPP607	08/09/07	Fly Ash	BH-9	Parametric - 5,900 lbs/hr	0.09	7.98	5020
PIPP608	08/09/07	Fly Ash	BH-10	Parametric - 5,900 lbs/hr	0.36	7.51	5240
PIPP612	08/10/07	Fly Ash	BH-1	Parametric - 5,900 lbs/hr	0.19	9.29	6710
PIPP613	08/10/07	Fly Ash	BH-2	Parametric - 5,900 lbs/hr	0.58	7.8	4610
PIPP614	08/10/07	Fly Ash	BH-3	Parametric - 5,900 lbs/hr	0.04	8.09	5530
PIPP615	08/10/07	Fly Ash	BH-4	Parametric - 5,900 lbs/hr	0.3	8.43	5050
PIPP616	08/10/07	Fly Ash	BH-5	Parametric - 5,900 lbs/hr	0.05	9.3	4630
PIPP617	08/10/07	Fly Ash	BH-6	Parametric - 5,900 lbs/hr	0.46	9.67	4570

PIPP618	08/10/07	Fly Ash	BH-7	Parametric - 5,900 lbs/hr	0.52	10.79	7210
PIPP619	08/10/07	Fly Ash	BH-8	Parametric - 5,900 lbs/hr	0.09	10.62	7350
PIPP620	08/10/07	Fly Ash	BH-9	Parametric - 5,900 lbs/hr	0	11.26	9410
PIPP621	08/10/07	Fly Ash	BH-10	Parametric - 5,900 lbs/hr	0.16	9.71	4570
PIPP622	08/10/07	Fly Ash	No anti hardener 1liter	Parametric - 5,900 lbs/hr	21.58	13.04	8230
PIPP623	08/10/07	Fly Ash	No anti hardener 1liter	Parametric - 5,900 lbs/hr	24.48	11.47	7200
PIPP624	08/10/07	Fly Ash	No anti hardener 55 gal	Parametric - 5,900 lbs/hr	0.07	10.78	8160
PIPP641	08/29/07	Fly Ash	BH-1	Preciptator test-Base	0.47	51.19	85650
PIPP642	08/29/07	Fly Ash	BH-2	Preciptator test-Base	0.63	51.78	71000
PIPP643	08/29/07	Fly Ash	BH-3	Preciptator test-Base	0.32	50.63	79500
PIPP644	08/29/07	Fly Ash	BH-4	Preciptator test-Base	0.58	52.56	83800
PIPP645	08/29/07	Fly Ash	BH-5	Preciptator test-Base	0.23	52.2	75600
PIPP646	08/29/07	Fly Ash	BH-6	Preciptator test-Base	0.26	53.56	76700
PIPP647	08/29/07	Fly Ash	BH-7	Preciptator test-Base	0.1	52.56	78450
PIPP648	08/29/07	Fly Ash	BH-8	Preciptator test-Base	0.03	52.2	72800
PIPP649	08/29/07	Fly Ash	BH-9	Preciptator test-Base	0.04	52.01	71200
PIPP650	08/29/07	Fly Ash	BH-10	Preciptator test-Base	0.14	52.66	82300
PIPP651	08/31/07	Fly Ash	BH-1	Preciptator test-A2/B2 off	1.14	50.14	80400
PIPP652	08/31/07	Fly Ash	BH-2	Preciptator test-A2/B2 off	0.87	49.78	84300
PIPP653	08/31/07	Fly Ash	BH-3	Preciptator test-A2/B2 off	0.52	50.21	75800
PIPP654	08/31/07	Fly Ash	BH-4	Preciptator test-A2/B2 off	0.53	50.55	84600
PIPP655	08/31/07	Fly Ash	BH-5	Preciptator test-A2/B2 off	1.81	47.94	82100
PIPP656	08/31/07	Fly Ash	BH-6	Preciptator test-A2/B2 off	0.9	52.5	78650
PIPP657	08/31/07	Fly Ash	BH-7	Preciptator test-A2/B2 off	0.77	52.43	75700

PIPP658	08/31/07	Fly Ash	BH-8	Preciptator test-A2/B2 off	0.76	51.9	81200
PIPP659	08/31/07	Fly Ash	BH-9	Preciptator test-A2/B2 off	0.84	51.57	80100
PIPP660	08/31/07	Fly Ash	BH-10	Preciptator test-A2/B2 off	0.71	51.45	75000
PIPP661	09/03/07	Fly Ash	BH-1	Preciptator test-A2/B2 off	3.08	45.91	69500
PIPP662	09/03/07	Fly Ash	BH-2	Preciptator test-A2/B2 off	2.87	44.93	66100
PIPP663	09/03/07	Fly Ash	BH-3	Preciptator test-A2/B2 off	0.23	48.62	74000
PIPP664	09/03/07	Fly Ash	BH-4	Preciptator test-A2/B2 off	0.52	46.33	63100
PIPP665	09/03/07	Fly Ash	BH-5	Preciptator test-A2/B2 off	0.44	49.05	61600
PIPP666	09/03/07	Fly Ash	BH-6	Preciptator test-A2/B2 off	0.18	48.67	71800
PIPP667	09/03/07	Fly Ash	BH-7	Preciptator test-A2/B2 off	0.29	49.8	62500
PIPP668	09/03/07	Fly Ash	BH-8	Preciptator test-A2/B2 off	0.03	50.01	74800
PIPP669	09/03/07	Fly Ash	BH-9	Preciptator test-A2/B2 off	0	49.34	65200
PIPP670	09/03/07	Fly Ash	BH-10	Preciptator test-A2/B2 off	0.05	48.04	60100
PIPP671	09/05/07	Fly Ash	BH-1	Preciptator test-A2/B2 off	4.37	44.9	68200
PIPP672	09/05/07	Fly Ash	BH-2	Preciptator test-A2/B2 off	5.02	46.06	64400
PIPP673	09/05/07	Fly Ash	BH-3	Preciptator test-A2/B2 off	1.04	48.16	70100
PIPP674	09/05/07	Fly Ash	BH-4	Preciptator test-A2/B2 off	0.77	37.02	38800
PIPP675	09/05/07	Fly Ash	BH-5	Preciptator test-A2/B2 off	0.93	46.33	58400
PIPP676	09/05/07	Fly Ash	BH-6	Preciptator test-A2/B2 off	0.82	49.09	41350
PIPP677	09/05/07	Fly Ash	BH-7	Preciptator test-A2/B2 off	0.7	46.31	61000
PIPP678	09/05/07	Fly Ash	BH-8	Preciptator test-A2/B2 off	0.97	46	64800
PIPP679	09/05/07	Fly Ash	BH-9	Preciptator test-A2/B2 off	0.41	45.94	50500
PIPP680	09/05/07	Fly Ash	BH-10	Preciptator test-A2/B2 off	0.81	46.73	62300
PIPP681	09/07/07	Fly Ash	BH-1	Preciptator test-A2/B2 off	2.96	42.48	56000

PIPP682	09/07/07	Fly Ash	BH-2	Preciptator test-A2/B2 off	0.13	42.7	56200
PIPP683	09/07/07	Fly Ash	BH-3	Preciptator test-A2/B2 off	0.92	43.81	61800
PIPP684	09/07/07	Fly Ash	BH-4	Preciptator test-A2/B2 off	0.81	44.23	49800
PIPP685	09/07/07	Fly Ash	BH-5	Preciptator test-A2/B2 off	1.18	46.35	49500
PIPP686	09/07/07	Fly Ash	BH-6	Preciptator test-A2/B2 off	0.8	44.34	52600
PIPP687	09/07/07	Fly Ash	BH-7	Preciptator test-A2/B2 off	0.93	46.72	49600
PIPP688	09/07/07	Fly Ash	BH-8	Preciptator test-A2/B2 off	1.19	45.41	57800
PIPP689	09/07/07	Fly Ash	BH-9	Preciptator test-A2/B2 off	1.58	45.85	58000
PIPP690	09/07/07	Fly Ash	BH-10	Preciptator test-A2/B2 off	0.08	43.28	55300
	09/10/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10287, 10291, 10292, 10296	1.11	45.83	54800
	09/12/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10297, 10305, 10307, 10315	0.56	12.72	12450
	09/17/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10317, 10321, 10322, 10326	1.48	11.12	12500
	09/19/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10327, 10331, 10332, 10336	0.21	47.66	56600
	09/21/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10337, 10341, 10342, 10346	0	48.6	59400
PIPP781	10/01/07	Fly Ash	Bag (1,5,6,&10)	Preciptator test - 7F1,8F1,9F1	0.09	45.63	57000
	09/24/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10367, 10371, 10372, 10376	0.96	47.9	66800
	09/26/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10377, 10381, 10382, 10386	0	50.32	68100
	09/28/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10387, 10391, 10392, 10396	5.56	33.14	43100
PIPP782	10/03/07	Fly Ash	Bag (1,5,6,&10)	Precip Test - HG - 7F1,8F1,9F1	0.94	43.93	58400
PIPP783	10/05/07	Fly Ash	Bag (1,5,6,&10)	Precip Test - HG - 7F1,8F1,9F1	1.34	50.46	53200
PIPP784	10/08/07	Fly Ash	Bag (1,5,6,&10)	Precip Test - HG - 7F1,8F1,9F1	1.96	23.83	68500
PIPP785	10/10/07	Fly Ash	Bag (1,5,6,&10)	Precip Test - HG - 7F1,8F1,9F1	0.58	48.37	65900
	10/12/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10835, 10836, 10837, 10838	0.83	47.81	66300
	10/15/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10839, 10840, 10841, 10842	0.01	46.33	64700

	10/17/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10847-10850	0	45.3	70200
	10/19/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10851-10854	0	41.61	56300
	10/22/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10855-10858	0	40.88	50000
PIPP822	10/31/07	Fly Ash	BH-10	Unit 5&6 Fly Ash - FA Silo	0.04	23.15	142
	10/24/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10862-10865	0.35	45.55	52600
	10/26/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10866-10869	0.25	47.21	67100
	10/29/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10870-10873	0.57	46.14	58500
	10/31/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10874-10877	0.5	43.19	53300
	08/27/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10222, 10226, 10227, 10231	0.16	52.06	76300
	08/29/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10237, 10241, 10242, 10246	0	52.33	75100
	08/31/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10247, 10251, 10252, 10256	0.51	51.97	65400
	09/03/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10257, 10261, 10262, 10266	0.69	48.61	59800
	09/05/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10267, 10271, 10272, 10276	1.39	47.97	53400
	09/07/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 10277, 10281, 10282, 10286	0.78	45.96	51600
	11/09/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11171-11174	0.68	45.84	54600
	11/12/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11175-11178	1.86	44.39	57500
	11/14/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11179-11182	1.47	45.4	56400
	11/16/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11218-11221	0.05	43.83	74100
	11/19/07	Fly Ash	WE Energies Sample	Composite of samples 11222-11225	1.04	46.99	67200
	11/21/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11226-11229	0.92	44.77	63500
	11/23/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11230-11233	1.21	49.57	73000
	11/26/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11234-11237	0.45	49.37	74300
	11/28/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11238-11241	0.67	47.37	65200
	11/30/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11242-11245	0.01	41.51	58900

	12/01/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11246-11249	0	41.83	63700
	12/03/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11250-11253	0.39	38.13	57600
	12/05/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11296-11299	0.49	33.51	46700
	12/07/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11300-11303	0.27	27.26	34900
	12/10/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11304-11307	0.46	30.47	43600
	12/12/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11308-11311	1.11	30.47	45800
	12/14/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11312-11315	0.78	31.3	47900
	12/17/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11316-11319	0.44	30.86	43900
	12/19/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11342-11345	1	30.85	53050
	12/21/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11346-11349	0.13	33.91	67300
	12/24/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11350-11353	1.52	31.89	65300
	12/26/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11354-11357	2.02	30.6	57200
	12/28/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11358-11361	0.2	31.71	62900
	12/31/07	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11367-11370	0.48	27.32	52500
	01/02/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11371-11374	0.46	25.94	51000
	01/04/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11375-11378	0.71	20.36	39000
	01/07/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11379-11382	0.31	21.89	44300
	01/09/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11407-11410	1.11	20.87	42200
	01/11/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11411-11414	0.91	18.77	44100
	01/14/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11415-11418	1.23	21.98	48700
	01/16/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11431-11434	1.07	28.18	72200
	01/18/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11435-11438	2.38	32	86700
	01/21/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11439-11442	0.66	27.48	60300
	01/23/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11465-11468	0.6	25.56	63350

	01/25/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11469-11472	0.13	25.74	67700
	01/28/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11473-11476	0.51	25.82	72300
	01/30/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11477-11480	0.14	14.52	28600
	02/01/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11481-11484	0.37	20.61	55600
	02/04/08	Fly Ash	WE Energies Sample	Composite of samples 11518-11521	0.19	4.98	2630
	02/05/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11522-11525	0.15	4.97	4300
	02/06/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11529-11532	0.21	7.73	2180
	02/07/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11533-11536	0.31	6.07	2520
	02/08/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11648-11651	0.47	15.42	2830
	02/11/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11655-11658	0.46	10.74	1025
	02/12/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11659-11662	0.55	10.06	1080
	02/13/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11666-11669	0.16	10.55	869
	02/14/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11670-11673	0.25	26.59	2650
	02/15/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11677-11679 & 11750	0.2	27.06	6860
	02/16/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11680-11683	0.09	26.95	6420
	02/22/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11684-11687	1.49	33.55	26700
	02/18/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11688-11691	0.5	15.82	2580
	02/19/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11695-11698	0.87	16.62	12900
	02/21/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11702-11705	1.1	27.55	40500
	02/26/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11706-11709	0.66	15.23	3400
	02/27/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11767-11770	0.55	22.78	30700
	02/28/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11771-11774	0.18	36.44	55800
	02/29/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11778-11781	1.14	37.83	46900
	03/03/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11784-11787	0.31	39.94	68700

	03/04/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11788-11791	0.23	34.76	57700
	03/06/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11809-11812	0.85	23.98	31050
	03/05/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11816-11819	0.32	29.17	42900
	03/12/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11820-11823	0.66	24.51	33900
	03/13/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11824-11827	0.46	13.81	23800
	03/14/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 11831-11834	0.38	19.77	46800
	03/15/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 1218-12121	0.74	23.47	39800
	03/16/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 12122-12125	0.67	20.74	46100
	03/18/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 12126-12129	0.48	16.23	18400
	03/19/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 12133-12136	0.96	16.39	15600
	03/20/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 12137-12140	0.68	29.61	52300
	03/21/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 12156-12159	0.84	26.31	27050
	03/22/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 12160-12163	0.43	20.87	5540
	11/04/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 13278-13281	1.44	41.39	75000
	11/05/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 13285-13288	1.9	40.33	70200
	11/06/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 13291-13294	0.3	41.37	64900
	11/07/08	Fly Ash	Bag (1,5,6,&10)	Composite of samples 13298-13301	0.12	41.54	71800
	11/19/08	Fly Ash	ESP Composite	Composite from 11/4/08 & 11/5/08	0.03	1.21	<10
	02/20/09	Fly Ash	Bag (1,5,6,&10)	Blend 1 - composite of samples 13513-13516	0.27	35.93	67200
	02/17/09	Fly Ash	Bag (1,5,6,&10)	Blend 2 - composite of samples 13517-13520	0.57	11.99	19200
	02/22/09	Fly Ash	Bag (1,5,6,&10)	Blend 3 - composite of samples 13521-13524	1.31	36.87	70500
	02/26/09	Fly Ash	Bag (1,5,6,&10)	Blend 4 - composite of samples 13525-13528	0.97	41.78	75800
	02/28/09	Fly Ash	Bag (1,5,6,&10)	Blend 5 - composite of samples 13529-13532	0.72	38.19	69600
	02/24/09	Fly Ash	Bag (1,5,6,&10)	Blend 6 - composite of samples 13533-13536	0.42	40.89	71300

PIPP1224	09/03/09	Fly Ash	BH-2		0.52	43.92	76500
PIPP1225	09/03/09	Fly Ash	BH-3		0	45.95	78600
PIPP1226	09/03/09	Fly Ash	BH-4		0	46.68	74600
PIPP1227	09/03/09	Fly Ash	BH-5		0	47.17	75100
PIPP1228	09/03/09	Fly Ash	BH-6		0	46.85	82700
PIPP1229	09/03/09	Fly Ash	BH-7		0	46.39	82100
PIPP1230	09/03/09	Fly Ash	BH-8		0	46.24	74000
PIPP1231	09/03/09	Fly Ash	BH-9		0	46.69	73800
PIPP1232	09/03/09	Fly Ash	BH-10		0	46.04	76450
PIPP1233	09/03/09	Fly Ash	composite	Precip 3rd row	0.05	0.49	<10
	09/03/09	Fly Ash	BH-1		0	45.27	86000

Appendix F. PAC Size Distribution

Result Analysis Report

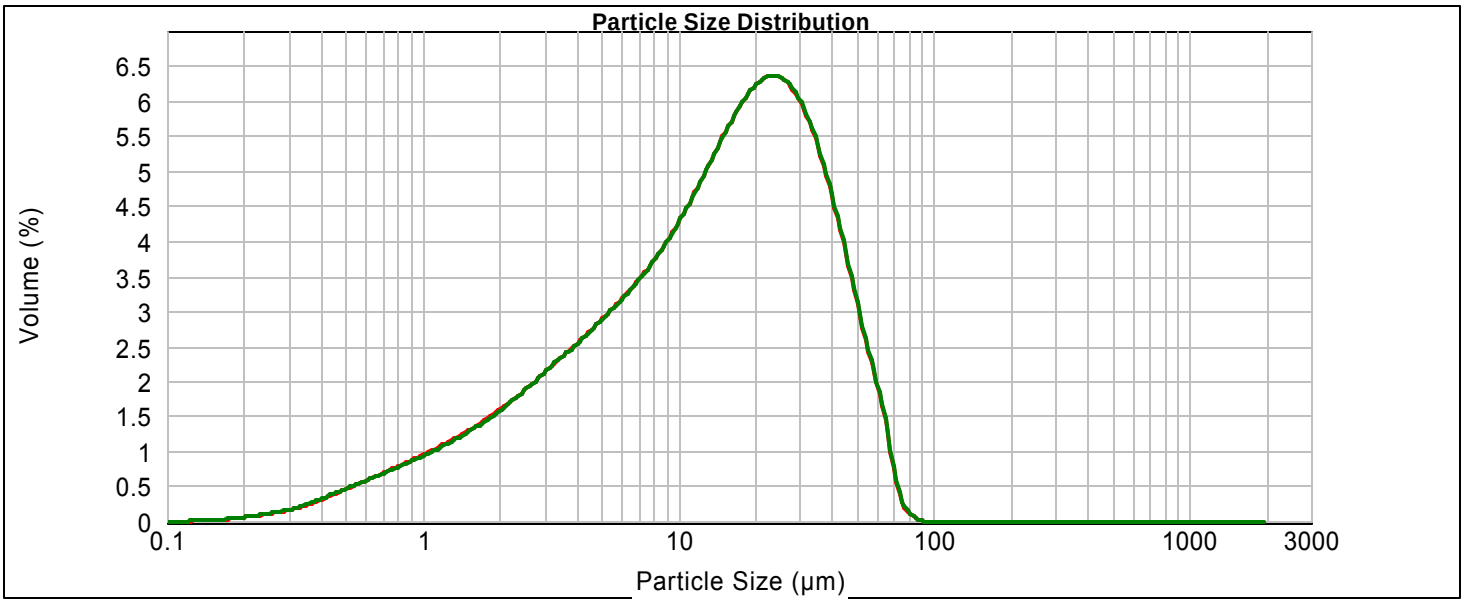
Sample Name: Hg	**Method Name:** DryStart	**Measured:** Friday, December 15, 2006 9:49:47 AM
Operator: michaelp	**Submitter:** ADA-ES	**Reported:** Friday, December 15, 2006 9:49:49 AM

Material: Carbon	**Accessory Name:** Scirocco 2000 (A)	**Analysis model:** General purpose	**Sensitivity:** Normal
Particle RI: 2.420	**Absorption:** 1	**Size range:** 0.020 to 2000.000 um	**Obscuration:** 3.86 %
Dispersant Name:	**Dispersant RI:** 1.000	**Weighted Residual:** 0.714 %	**Result Emulation:** Off

Concentration: 0.0005 %Vol	**Span :** 2.702	**Uniformity:** 0.843	**Result units:** Volume
Median: 14.318 um	**Mean D[4,3]:** 18.227 um	**Mode:** 23.673 um	

Operator notes:

d(0.1): 2.019 um **d(0.5): 14.318 um** **d(0.9): 40.711 um**



Size (µm)	Volume In %
0.020	0.00
0.022	0.00
0.025	0.00
0.028	0.00
0.032	0.00
0.036	0.00
0.040	0.00
0.045	0.00
0.050	0.00
0.056	0.00
0.063	0.00
0.071	0.00
0.080	0.00
0.089	0.00
0.100	0.00
0.112	0.00
0.126	0.00
0.142	0.00

Size (µm)	Volume In %
0.142	0.01
0.159	0.02
0.178	0.03
0.200	0.05
0.224	0.07
0.252	0.09
0.283	0.12
0.317	0.16
0.356	0.21
0.399	0.26
0.448	0.32
0.502	0.37
0.564	0.43
0.632	0.48
0.710	0.54
0.796	0.60
0.893	0.66
1.002	

Size (µm)	Volume In %
1.002	0.73
1.125	0.79
1.262	0.87
1.416	0.94
1.589	1.03
1.783	1.12
2.000	1.23
2.244	1.34
2.518	1.45
2.825	1.58
3.170	1.71
3.557	1.84
3.991	1.96
4.477	2.10
5.024	2.23
5.637	2.37
6.325	2.52
7.096	

Size (µm)	Volume In %
7.096	2.69
7.962	2.87
8.934	3.08
10.024	3.32
11.247	3.57
12.619	3.84
14.159	4.12
15.887	4.37
17.825	4.58
20.000	4.72
22.440	4.77
25.179	4.71
28.251	4.52
31.698	4.21
35.566	3.78
39.905	3.25
44.774	2.68
50.238	

Size (µm)	Volume In %
50.238	2.06
56.368	1.51
63.246	0.87
70.963	0.19
79.621	0.03
89.337	0.00
100.237	0.00
112.468	0.00
126.191	0.00
141.589	0.00
158.866	0.00
178.250	0.00
200.000	0.00
224.404	0.00
251.785	0.00
282.508	0.00
316.979	0.00
355.656	

Size (µm)	Volume In %
355.656	0.00
399.052	0.00
447.744	0.00
502.377	0.00
563.677	0.00
632.456	0.00
709.627	0.00
796.214	0.00
893.367	0.00
1002.374	0.00
1124.683	0.00
1261.915	0.00
1415.892	0.00
1588.656	0.00
1782.502	0.00
2000.000	

Result Analysis Report

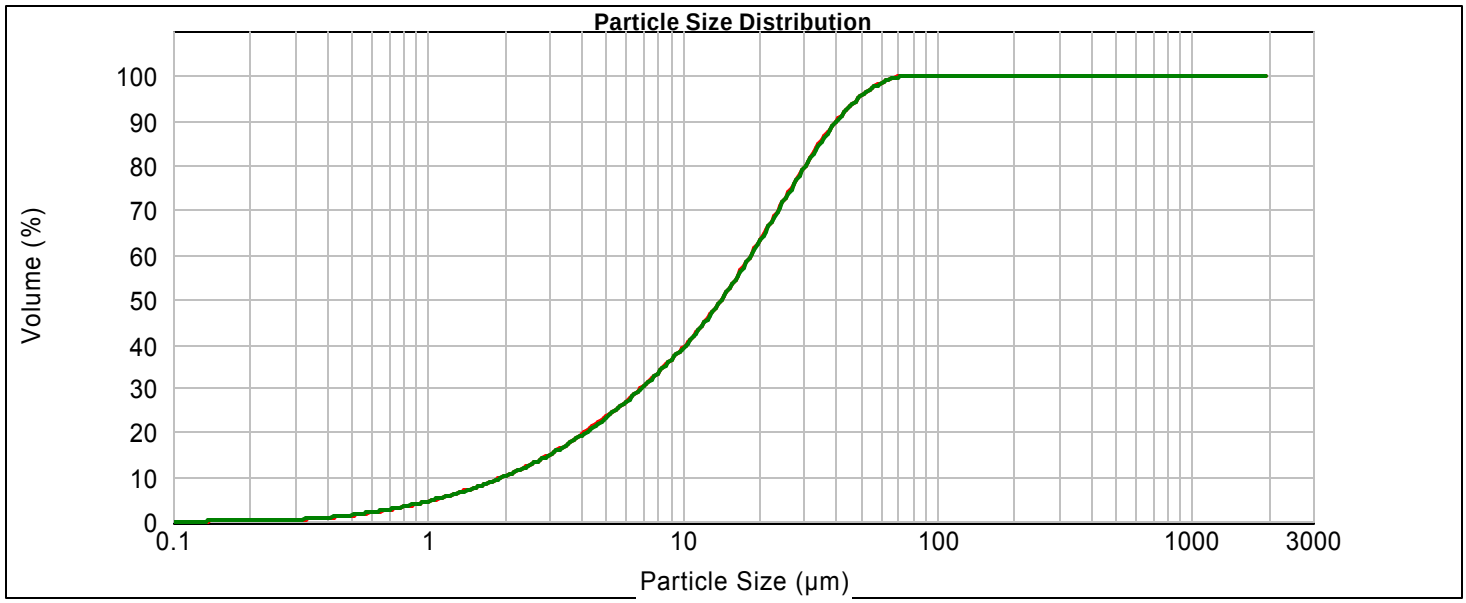
Sample Name: Hg	**Method Name:** DryStart	**Measured:** Friday, December 15, 2006 9:49:47 AM
Operator: michaelp	**Submitter:** ADA-ES	**Reported:** Friday, December 15, 2006 9:49:49 AM

Material: Carbon	**Accessory Name:** Scirocco 2000 (A)	**Analysis model:** General purpose	**Sensitivity:** Normal
Particle RI: 2.420	**Absorption:** 1	**Size range:** 0.020 to 2000.000 um	**Obscuration:** 3.86 %
Dispersant Name:	**Dispersant RI:** 1.000	**Weighted Residual:** 0.714 %	**Result Emulation:** Off

Concentration: 0.0005 %Vol	**Span :** 2.702	**Uniformity:** 0.843	**Result units:** Volume
Median: 14.318 um	**Mean D[4,3]:** 18.227 um	**Mode:** 23.673 um	

Operator notes:

d(0.1): 2.019 um **d(0.5): 14.318 um** **d(0.9): 40.711 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.020	0.00	0.142	0.00	1.002	4.42	7.096	30.23	50.238	95.33	355.656	100.00
0.022	0.00	0.159	0.01	1.125	5.15	7.962	32.92	56.368	97.39	399.052	100.00
0.025	0.00	0.178	0.03	1.262	5.94	8.934	35.79	63.246	98.90	447.744	100.00
0.028	0.00	0.200	0.06	1.416	6.81	10.024	38.88	70.963	99.77	502.377	100.00
0.032	0.00	0.224	0.11	1.589	7.75	11.247	42.19	79.621	99.97	563.677	100.00
0.036	0.00	0.252	0.18	1.783	8.78	12.619	45.77	89.337	100.00	632.456	100.00
0.040	0.00	0.283	0.28	2.000	9.90	14.159	49.61	100.237	100.00	709.627	100.00
0.045	0.00	0.317	0.40	2.244	11.13	15.887	53.73	112.468	100.00	796.214	100.00
0.050	0.00	0.356	0.55	2.518	12.47	17.825	58.10	126.191	100.00	893.367	100.00
0.056	0.00	0.399	0.76	2.825	13.92	20.000	62.68	141.589	100.00	1002.374	100.00
0.063	0.00	0.448	1.02	3.170	15.50	22.440	67.40	158.866	100.00	1124.683	100.00
0.071	0.00	0.502	1.33	3.557	17.21	25.179	72.18	178.250	100.00	1261.915	100.00
0.080	0.00	0.564	1.71	3.991	19.04	28.251	76.89	200.000	100.00	1415.892	100.00
0.089	0.00	0.632	2.13	4.477	21.01	31.698	81.41	224.404	100.00	1588.656	100.00
0.100	0.00	0.710	2.62	5.024	23.10	35.566	85.62	251.785	100.00	1782.502	100.00
0.112	0.00	0.796	3.16	5.637	25.34	39.905	89.40	282.508	100.00	2000.000	100.00
0.126	0.00	0.893	3.76	6.325	27.71	44.774	92.65	316.979	100.00		

Result Analysis Report

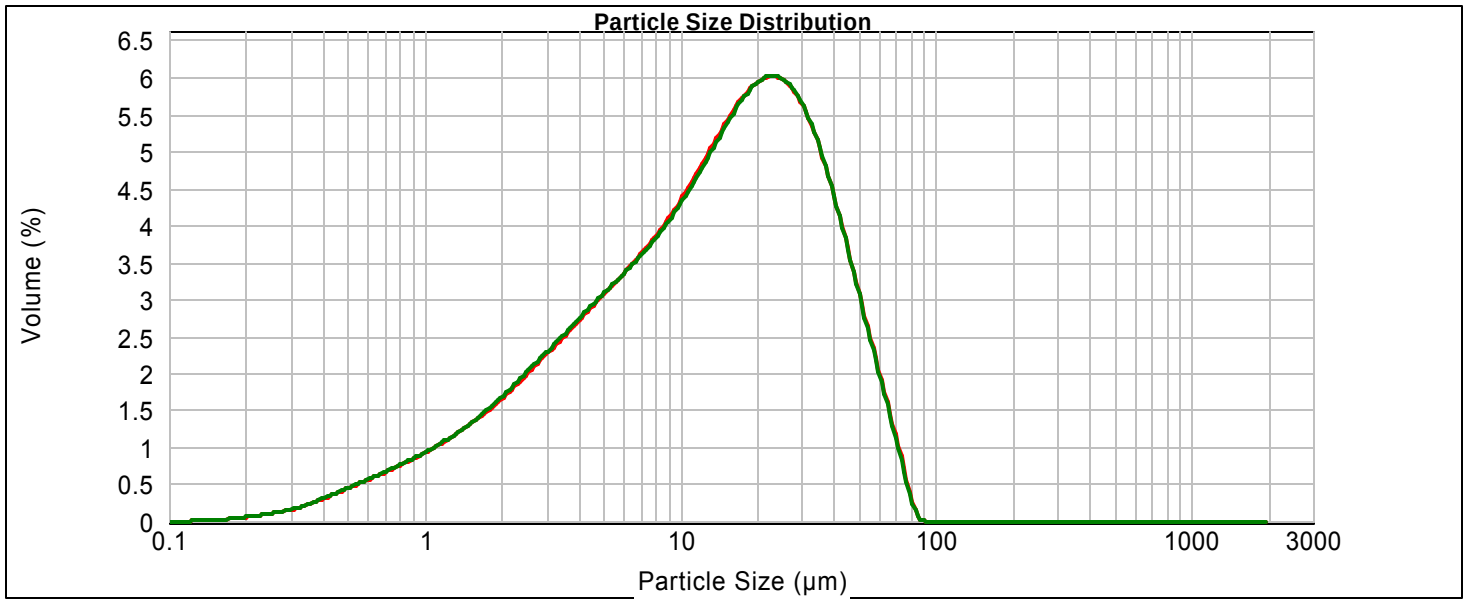
Sample Name: Hg-LH	**Method Name:** DryStart	**Measured:** Friday, December 15, 2006 9:59:23 AM
Operator: michaelp	**Submitter:** ADA-ES	**Reported:** Friday, December 15, 2006 9:59:25 AM

Material: Carbon	**Accessory Name:** Scirocco 2000 (A)	**Analysis model:** General purpose	**Sensitivity:** Normal
Particle RI: 2.420	**Absorption:** 1	**Size range:** 0.020 to 2000.000 um	**Obscuration:** 3.78 %
Dispersant Name:	**Dispersant RI:** 1.000	**Weighted Residual:** 0.339 %	**Result Emulation:** Off

Concentration: 0.0005 %Vol	**Span :** 2.872	**Uniformity:** 0.899	**Result units:** Volume
Median: 13.607 um	**Mean D[4,3]:** 18.033 um	**Mode:** 23.123 um	

Operator notes:

d(0.1): 1.996 um **d(0.5): 13.607 um** **d(0.9): 41.082 um**



Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %
0.020	0.00	0.142	0.01	1.002	0.73	7.096	2.79	50.238	2.05	355.656	0.00
0.022	0.00	0.159	0.02	1.125	0.80	7.962	2.95	56.368	1.54	399.052	0.00
0.025	0.00	0.178	0.03	1.262	0.89	8.934	3.13	63.246	1.02	447.744	0.00
0.028	0.00	0.200	0.05	1.416	0.98	10.024	3.33	70.963	0.51	502.377	0.00
0.032	0.00	0.224	0.07	1.589	1.08	11.247	3.54	79.621	0.05	563.677	0.00
0.036	0.00	0.252	0.09	1.783	1.19	12.619	3.77	89.337	0.00	632.456	0.00
0.040	0.00	0.283	0.12	2.000	1.31	14.159	4.00	100.237	0.00	709.627	0.00
0.045	0.00	0.317	0.15	2.244	1.44	15.887	4.22	112.468	0.00	796.214	0.00
0.050	0.00	0.356	0.20	2.518	1.58	17.825	4.39	126.191	0.00	893.367	0.00
0.056	0.00	0.399	0.25	2.825	1.71	20.000	4.50	141.589	0.00	1002.374	0.00
0.063	0.00	0.448	0.31	3.170	1.85	22.440	4.52	158.866	0.00	1124.683	0.00
0.071	0.00	0.502	0.36	3.557	1.99	25.179	4.45	178.250	0.00	1261.915	0.00
0.080	0.00	0.564	0.42	3.991	2.12	28.251	4.26	200.000	0.00	1415.892	0.00
0.089	0.00	0.632	0.47	4.477	2.25	31.698	3.96	224.404	0.00	1588.656	0.00
0.100	0.00	0.710	0.53	5.024	2.38	35.566	3.56	251.785	0.00	1782.502	0.00
0.112	0.00	0.796	0.59	5.637	2.51	39.905	3.08	282.508	0.00	2000.000	
0.126	0.00	0.893	0.66	6.325	2.65	44.774	2.57	316.979	0.00		
0.142		1.002		7.096		50.238		355.656			

Result Analysis Report

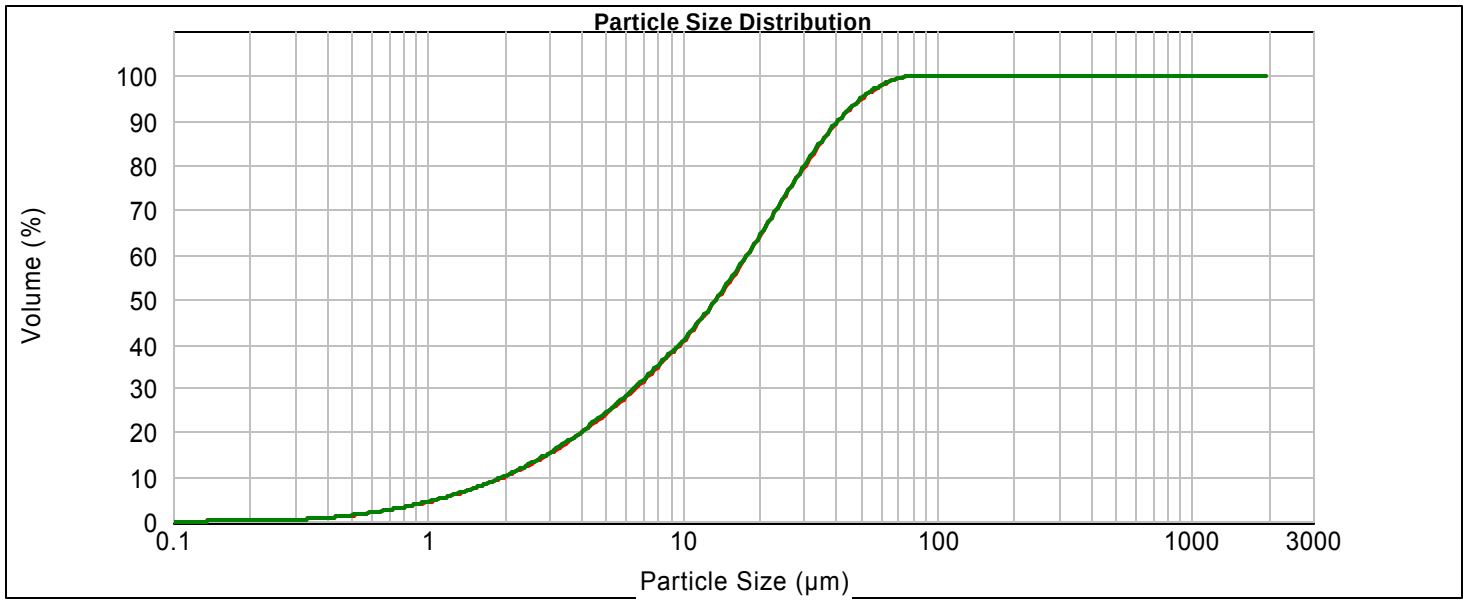
Sample Name: Hg-LH	**Method Name:** DryStart	**Measured:** Friday, December 15, 2006 9:59:23 AM
Operator: michaelp	**Submitter:** ADA-ES	**Reported:** Friday, December 15, 2006 9:59:25 AM

Material: Carbon	**Accessory Name:** Scirocco 2000 (A)	**Analysis model:** General purpose	**Sensitivity:** Normal
Particle RI: 2.420	**Absorption:** 1	**Size range:** 0.020 to 2000.000 um	**Obscuration:** 3.78 %
Dispersant Name:	**Dispersant RI:** 1.000	**Weighted Residual:** 0.339 %	**Result Emulation:** Off

Concentration: 0.0005 %Vol	**Span :** 2.872	**Uniformity:** 0.899	**Result units:** Volume
Median: 13.607 um	**Mean D[4,3]:** 18.033 um	**Mode:** 23.123 um	

Operator notes:

d(0.1): 1.996 um **d(0.5): 13.607 um** **d(0.9): 41.082 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.020	0.00	0.142	0.00	1.002	4.35	7.096	31.82	50.238	94.83	355.656	100.00
0.022	0.00	0.159	0.01	1.125	5.08	7.962	34.61	56.368	96.88	399.052	100.00
0.025	0.00	0.178	0.03	1.262	5.88	8.934	37.56	63.246	98.42	447.744	100.00
0.028	0.00	0.200	0.06	1.416	6.77	10.024	40.69	70.963	99.44	502.377	100.00
0.032	0.00	0.224	0.11	1.589	7.75	11.247	44.01	79.621	99.95	563.677	100.00
0.036	0.00	0.252	0.18	1.783	8.83	12.619	47.56	89.337	100.00	632.456	100.00
0.040	0.00	0.283	0.27	2.000	10.02	14.159	51.33	100.237	100.00	709.627	100.00
0.045	0.00	0.317	0.39	2.244	11.34	15.887	55.33	112.468	100.00	796.214	100.00
0.050	0.00	0.356	0.54	2.518	12.78	17.825	59.55	126.191	100.00	893.367	100.00
0.056	0.00	0.399	0.74	2.825	14.35	20.000	63.94	141.589	100.00	1002.374	100.00
0.063	0.00	0.448	1.00	3.170	16.07	22.440	68.44	158.866	100.00	1124.683	100.00
0.071	0.00	0.502	1.30	3.557	17.92	25.179	72.96	178.250	100.00	1261.915	100.00
0.080	0.00	0.564	1.67	3.991	19.91	28.251	77.40	200.000	100.00	1415.892	100.00
0.089	0.00	0.632	2.09	4.477	22.03	31.698	81.66	224.404	100.00	1588.656	100.00
0.100	0.00	0.710	2.56	5.024	24.29	35.566	85.61	251.785	100.00	1782.502	100.00
0.112	0.00	0.796	3.09	5.637	26.67	39.905	89.17	282.508	100.00	2000.000	100.00
0.126	0.00	0.893	3.69	6.325	29.18	44.774	92.26	316.979	100.00		

Appendix G. GE Baseline Stack Testing 2006

GE Energy

888 Industrial Drive
Elmhurst, IL 60126
USA

T 630 530 6600
F 630 530 6630

June 2, 2006

Mr. William Mundorf
DOE

Re. Copywrite

Dear Mr. Mundorf:

You are hereby authorized to use the information contained in GE's report number M22E1184.

Please let me know if you have any questions.

Thank you for your attention in this matter.

Sincerely,

Frank H. Jarke
Manager, Quality Assurance.

ISO 9001 Accredited
Quality System

PARTICULATE AND GASEOUS EMISSIONS STUDY

Prepared For
ADA-ES, Inc.

Performed At
We Energies
Presque Isle Power Plant
Baghouse Inlet and Outlet
Marquette, Michigan

Test Dates
February 14 through 16, 2006

Report No.
GE Energy Management Services, Inc. Report M22E1184A

Report Submittal Date
April 18, 2006

GE Energy

Douglas M. Ryan
Project Manager

ISO 9001 Accredited
Quality System

PARTICULATE AND GASEOUS EMISSIONS STUDY

Prepared For
ADA-ES, Inc.

Performed At
We Energies
Presque Isle Power Plant
Baghouse Inlet and Outlet
Marquette, Michigan

Test Dates
February 14 through 16, 2006

Report No.
GE Energy Management Services, Inc. Report M22E1184A

Report Submittal Date
April 18, 2006

GE Energy Management Services, Inc.
888 Industrial Drive
Elmhurst, IL 60126
USA

T 630-530-6600
F 630-530-6630

GE Energy

TABLE OF CONTENTS

CERTIFICATION SHEET i

1.0 INTRODUCTION 1
- 1.1 Project Contact Information 1

2.0 SUMMARY OF RESULTS 2

3.0 DISCUSSION OF RESULTS 3

4.0 TEST PROCEDURES 3
- 4.1 Volumetric Flowrate Determination 3
- 4.2 Oxygen (O_2)/Carbon Dioxide (CO_2) Determination 3
- 4.3 Particulate Determination 4
- 4.4 Speciated Mercury Determination 4
- 4.5 Hydrogen Halides (HCl, HBr, HF) and Halogens (Cl_2, Br_2) Determination 4
- 4.6 Vapor Phase Mercury Determination - Sorbent Trap Method 5

5.0 QUALITY ASSURANCE PROCEDURES 6

6.0 TEST RESULTS SUMMARY 7

APPENDIX
- Test Section Diagrams 15
- Sample Train Diagrams 17
- Sample Analysis Data 21
- Calculation Nomenclature and Formulas 107
- Test Data and Results (Computerized) 119
- Calibration Data 156
- Field Data Sheets 181

GE Energy

CERTIFICATION SHEET

Having reviewed the test program described in this report, I hereby certify the data, information, and results in this report to be accurate and true according to the methods and procedures used.

Data collected under the supervision of others is included in this report and is presumed to have been gathered in accordance with recognized standards.

GE ENERGY MANAGEMENT SERVICES, INC.

_____

Frank H. Jarke
Quality Assurance Manager

© 2006, General Electric Company. All rights reserved. The contents of this document are the property of General Electric Company. No part of this work may be reproduced or transmitted in any form or by any means, except as permitted in written license agreement with General Electric Company. General Electric Company has made every reasonable attempt to ensure the completeness and accuracy of this document. The GE logo is a registered trademark of General Electric Company.

GE Energy

PARTICULATE AND GASEOUS EMISSIONS STUDY
Performed For
ADA-ES, Inc.
At The
We Energies
Presque Isle Power Plant
Baghouse Inlet and Outlet
February 14 through 16, 2006

1.0 INTRODUCTION

GE Energy Management Services, Inc., ("GE Energy") performed a particulate and gaseous emission test program on the Baghouse Inlet and Outlet at the Presque Isle Power Plant of We Energies in Marquette, Michigan on February 14 through 16, 2006. The tests were authorized by We Energies and performed for ADA-ES, Inc.

The purpose of this test program was to determine hydrogen chloride (HCl), bromine (Br_2), hydrogen bromide (HBr), chlorine (Cl_2), particulate, mercury and speciated mercury emission rates during normal operating conditions.

1.1 Project Contact Information

Location	Address	Contact
Test Coordinator	ADA-ES, Inc. 8100 South Park Way Unit B Littleton, Colorado, 80120	Ms. Robin Stewart Senior Project Engineer 303-339-8863 (phone) 303-339-0330 (fax) robins@adaes.com (email)
Testing Company Representative	GE Energy Management Services, Inc. 888 Industrial Drive Elmhurst, Illinois 60126	Mr. Douglas M. Ryan Project Manager 630-530-6640 (phone) 630-530-6630 (fax) douglas.ryan@ge.com

The tests were conducted by Messrs. A. Sakellariou, C. Miller, T. Cassin, M. Hamling and D. Ryan of GE Energy.

2.0 SUMMARY OF RESULTS

The following tables summarizes test results at each of the test locations:

Parameter	Reference Method	Units	Common Inlet	Common Outlet
Particle Bound Mercury	Ontario Hydro	lbs/hr	0.00005	0.00002
		lb/Tbtu	0.01589	0.00629
Oxidized Mercury	Ontario Hydro	lbs/hr	0.00139	0.01173
		lb/Tbtu	0.43604	3.85586
Elemental Mercury	Ontario Hydro	lbs/hr	0.01547	0.00160
		lb/Tbtu	4.72178	0.51653
Total Mercury	Ontario Hydro	lbs/hr	0.01692	0.01336
		lb/Tbtu	5.29333	4.38950
HCl	Method 26A	lbs/hr	---	14.9909
		lb/mmBtu	---	0.0049
HBr	Method 26A	lbs/hr	---	0.4604
		lb/mmBtu	---	0.0001
Br_2	Method 26A	lbs/hr	---	0.0000
		lb/mmBtu	---	0.0000
Cl_2	Method 26A	lbs/hr	---	0.0000
		lb/mmBtu	---	0.0000
Filterable Particulate	Method 5	lbs/hr	110.166	1.701
		lb/mmBtu	0.0347	0.0006

Parameter	Reference Method	Units	Unit 7 Inlet	Unit 8 Inlet	Unit 9 Inlet	Baghouse Outlet
Mercury (Hg)	**Method 324**	ppm	0.00010	0.00008	0.00323	0.00054
		ug/l	0.00080	0.00212	0.02700	0.00455

Complete test results for all test locations and parameters are appended in Section 6.0.

3.0 DISCUSSION OF RESULTS

Source operation appeared normal during the entire test program. Problems were encountered with the M324 sampling trains. At each of the four test locations, it was discovered that significant variation existed from trap to trap. The thin-walled Teflon sleeves used to connect the two glass trap sections and glass liner all fit with varying amounts of resistance. Some traps were very difficult to separate and others separated unintentionally during assembly, and in one case sampling. Once this variation was discovered, every effort was made to check the connections and switch sleeves as needed. However, based on the sample analysis results, it appears that significant in-leakage occurred on many of the tests.

4.0 TEST PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed as described in the Title 40, Code of Federal Regulations, Part 60 (40CFR60), Appendix A, Methods 1, 2, 3, 5, 26A and 40CFR63 Method 324 and the Ontario Hydro Method. Where applicable, the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, United States Environmental Protection Agency (USEPA) 600/R-94/038c, September 1994 was used to supplement procedures.

4.1 Volumetric Flowrate Determination

In order to determine the emission rate on a lbs/hr basis, the gas velocities and volumetric flowrates were determined using Method 2, 40CFR60.

Velocity pressures were determined by traversing the test locations with S-type pitot tubes. Temperatures were measured using K-type thermocouples with calibrated digital temperature indicators. The molecular weight and moisture content of the gases were determined to permit the calculation of the volumetric flowrate. Sampling points utilized were determined using Method 1, 40CFR60.

4.2 Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

Oxygen (O_2) and carbon dioxide (CO_2) gas contents were determined in accordance with Method 3, 40CFR60. This method collected samples in a grab manner and analyzed the samples using a Hays Orsat gas analyzer. Several gas extractions were performed during each test run to ensure a stable reading. Mandatory leak checks were performed prior to and following each use. Chemicals are changed frequently and inspected for reactivity prior to each use.

4.3 Particulate Determination

A total of 24 test points were sampled using six (6) ports at the Baghouse Common Inlet and Outlet test locations.

The particulate sample trains were manufactured by Nutech Corporation of Durham, North Carolina and meet all specifications required by Method 5, 40CFR60. Teflon-lined probes were used. Drawings depicting the sampling ports, test point locations, and sample trains are appended to this report. Velocity pressures were determined simultaneously during sampling with a calibrated S-type pitot tube and inclined manometer. All temperatures were measured using K-type thermocouples with calibrated digital temperature indicators.

The filter media were Whatman 934-AH glass microfibre filters exhibiting a $\geq$ 99.97% efficiency on 0.3 micron DOP smoke particles in accordance with ASTM Standard Method D-2986-71. All sample contact surfaces of the trains were washed with HPLC reagent-grade acetone. These washes were placed in sealed and marked containers for analysis.

4.4 Speciated Mercury Determination

A total of 24 test points were sampled using six (6) ports at the Baghouse Common Inlet and Outlet test locations.

The speciated mercury sample trains were manufactured by Nutech Corporation of Durham, North Carolina and meet all specifications required by The Ontario Hydro Method. Teflon-lined probe were used. Drawings depicting the sampling ports, test point locations, and sample trains are appended to this report. Velocity pressures were determined simultaneously during sampling with a calibrated S-type pitot tube and inclined manometer. All temperatures were measured using K-type thermocouples with calibrated digital temperature indicators.

The filter media were quartz filters exhibiting a $\geq$99.97% efficiency on 0.3 micron DOP smoke particles in accordance with ASTM Standard Method D-2986-71. All sample contact surfaces of the train were washed with 0.1 N Nitric Acid. These washes were placed in sealed and marked containers for analysis. All sample recovery of impinger solutions was performed on site.

4.5 Hydrogen Halides (HCl, HBr, HF) and Halogens (Cl_2, Br_2) Determination

Hydrogen chloride (HCl), hydrogen fluoride (HF), hydrogen bromide (HBr), bromine (Br_2) and chlorine (Cl_2) concentrations were determined using Method 26A, 40CFR60. An integrated twenty-four-point sample was extracted from the common outlet gas stream and passed through 0.1 N sulfuric acid (H_2SO_4) and 0.1 N sodium hydroxide (NaOH). The samples were then analyzed by ion chromatography. The sample train consisted of a heated glass probe liner, a heated filter, and six impingers. The first impinger was short stemmed and empty to knock out heavy moisture, the second and third impingers contained the dilute sulfuric acid, the fourth and fifth impingers contained a 0.1 N sodium hydroxide (NaOH) scrubber solution to remove any remaining chlorine, and the sixth impinger contained silica gel to absorb any remaining moisture. The train was leak checked prior to and after each run. The sample was then extracted isokinetically. The samples were recovered by quantitatively transferring the contents of the first three impingers (the knock out and the two acidic absorbing solution impingers) and deionized water rinses to a glass sample jar. Impingers 4 and 5 (alkaline absorbing solution) and deionized water rinses were transferred to a separate glass sample jar. The samples were labeled, and the level marked for transfer to the laboratory. The samples were then analyzed by ion chromatography.

The test trains were weighed before and after each test for moisture determination.

The test crew performed sample recovery at the test site and initial analysis was performed on site. Samples were transported to an approved lab for final analysis. Copies of all sample analysis sheets are appended to this report.

4.6 Vapor Phase Mercury Determination - Sorbent Trap Method

Mercury emissions were determined in accordance with USEPA Draft Method 324. A single point was used for paired train sorbent sampling at baghouse inlets 7, 8 & 9 and the common baghouse outlet.

Sorbent traps included main and backup sections in series for collection of Hg. The sorbent trap was supported on a probe and inserted directly into the flue gas stream. No heating of the probe was required as duct temperatures were within the specified 200° to 375° F. range. Sampling was performed at a constant rate of (approximately 0.4 liters/min) for a period of two hours.

After sampling, sorbent traps were removing from the probe, both ends were plugged, and traps were then placed into clean sample storage containers.

Each trap was then acid leached and the resulting leachate analyzed by cold vapor atomic fluorescence spectrometry (CVAFS) detection.

Copies of all sample analysis sheets are appended to this report.

Calculations were performed on a computer and by hand. An explanation of the nomenclature and calculations along with the complete test results are appended. Also appended are the calibration data and copies of the raw field data sheets.

Raw data are kept on file at the GE Energy office in Elmhurst, Illinois. All samples from this test program (not already used in analysis) will be retained for 60 days after the submittal of the report, after which they will be discarded unless GE Energy is advised otherwise.

5.0 QUALITY ASSURANCE PROCEDURES

GE Energy recognizes the previously described reference methods to be very technique oriented and attempts to minimize all factors which can increase error by implementing its Quality Assurance Program into every segment of its testing activities.

Shelf life of chemical reagents prepared at the GE Energy laboratory or at the jobsite did not exceed those specified in the above mentioned methods; and, those reagents having a shelf life of one week were prepared daily at the jobsite. When on-site analyses were required, all reagent standardizations were performed daily by the same person performing the analysis.

Dry and wet test meters were calibrated according to methods described in the Quality Assurance Handbook, Sections 3.3.2, 3.4.2 and 3.5.2. Percent error for the wet test meter according to the methods was less than the allowable error of 1.0 percent. The dry test meters measured the test sample volumes to within 2 percent at the flowrate and conditions encountered during sampling.

6.0 TEST RESULTS SUMMARY

GE Energy

PARTICULATE TEST RESULTS SUMMARY

Company: We Energies
Plant: Presque Isle Power Plant
Unit: Baghouse Inlet

Test Run Number	**1**	**2**	**3**	**Average**
Source Condition	Normal	Normal	Normal	
Date	02/16/2006	02/16/2006	02/16/2006	
Start Time	8:30	11:20	14:00	
End Time	9:54	13:12	15:17	
Filterable PM:				
grains/dscf	0.0142	0.0174	0.0235	0.0183
lb/hr	84.868	104.438	141.192	110.166
lb/mmBtu	0.0270	0.0329	0.0442	0.0347
Stack Parameters:				
Gas Volumetric Flow Rate, acfm	1,238,832	1,232,324	1,224,983	1,232,047
Gas Volumetric Flow Rate, dscfm	699,058	701,495	702,104	700,886
Average Gas Temperature, °F	337.3	331.3	333.3	334.0
Average Gas Velocity, ft/sec	61.268	60.947	60.584	60.933
Flue Gas Moisture, percent by volume	11.6	11.5	10.7	11.3
Average Flue Pressure, in. Hg	28.84	28.84	28.84	
Barometric Pressure, in. Hg	29.32	29.32	29.32	
Average $\%CO_2$ by volume, dry basis	13.6	13.8	13.8	13.7
Average $\%O_2$ by volume, dry basis	5.6	5.5	5.4	5.5
Dry Molecular Wt. of Gas, lb/lb-mole	30.400	30.428	30.424	
Gas Sample Volume, dscf	39.763	41.753	39.855	
Isokinetic Variance	101.8	106.5	101.5	

GE Energy

SPECIATED MERCURY TEST RESULTS SUMMARY

Company: ADA-ES
Plant: We Energies - Presque Isle
Unit: Baghouse Inlet

Test Run Number	**1**	**2**	**3**	**Average**
Source Condition	Normal	Normal	Normal	
Date	02/14/2006	02/14/2006	02/14/2006	
Start Time	9:25	12:35	15:30	
End Time	12:03	14:56	17:48	
Particle Bound Mercury Emissions				
ppm	0.000005	0.000000	0.000002	0.000002
ug/dscm	0.04	0.00	0.02	0.02
lb/hr	0.00011	0.00000	0.00004	0.00005
lb/mmBtu	0.00000003	0.00000000	0.00000001	0.00000002
lb/Tbtu	0.03438	0.00000	0.01328	0.01589
Elemental Mercury Emissions				
ppm	0.000684	0.000687	0.000730	0.000700
ug/dscm	5.71	5.73	6.09	5.84
lb/hr	0.01510	0.01523	0.01609	0.01547
lb/mmBtu	0.0000047	0.0000047	0.0000047	0.0000047
lb/Tbtu	4.72732	4.71901	4.71901	4.72178
Oxidized Mercury Emissions				
ppm	0.000068	0.000064	0.000057	0.000063
ug/dscm	0.57	0.53	0.48	0.53
lb/hr	0.00151	0.00141	0.00126	0.00139
lb/mmBtu	0.0000005	0.0000004	0.0000004	0.0000004
lb/Tbtu	0.47273	0.43695	0.39844	0.43604
Total Mercury Emissions				
ppm	0.000757	0.000750	0.000789	0.000765
ug/dscm	6.32	6.26	6.58	6.39
lb/hr	0.01672	0.01664	0.01740	0.01692
lb/mmBtu	0.0000052	0.0000052	0.0000055	0.0000053
lb/Tbtu	5.23444	5.15596	5.48958	5.29333
Stack Parameters:				
Average Gas Temperature, °F	331.5	331.3	331.4	331.4
Average Gas Velocity, ft/sec	61.623	61.683	61.582	61.629
Flue Gas Moisture, percent by volume	10.6	10.3	10.6	10.5
Average Flue Pressure, in. Hg	28.44	28.44	28.44	
Barometric Pressure, in. Hg	28.95	28.95	28.95	
Average $\%CO_2$ by volume, dry basis	13.6	13.8	13.8	13.7
Average $\%O_2$ by volume, dry basis	5.5	5.4	5.6	5.5
Dry Molecular Wt. of Gas, lb/lb-mole	30.396	30.424	30.432	
Gas Sample Volume, dscf	68.089	66.537	66.529	
Isokinetic Variance	102.6	99.9	100.4	

GE Energy

PARTICULATE TEST RESULTS SUMMARY

Company: We Energies
Plant: Presque Isle Power Plant
Unit: Baghouse Outlet

Test Run Number	**1**	**2**	**3**	**Average**
Source Condition	Base-Load	Base-Load	Base-Load	
Date	02/16/2006	02/16/2006	02/16/2006	
Start Time	8:30	11:20	14:00	
End Time	9:55	12:45	15:25	
Filterable PM:				
grains/dscf	0.0007	0.0001	0.0001	0.0003
lb/hr	4.179	0.368	0.556	1.701
lb/mmBtu	0.0014	0.0001	0.0002	0.0006
Stack Parameters:				
Gas Volumetric Flow Rate, acfm	1,167,586	1,163,998	1,169,827	1,167,137
Gas Volumetric Flow Rate, dscfm	691,212	688,582	698,186	692,660
Average Gas Temperature, °F	337.8	330.7	331.5	333.3
Average Gas Velocity, ft/sec	61.079	60.891	61.196	61.056
Flue Gas Moisture, percent by volume	9.7	10.5	9.6	9.9
Average Flue Pressure, in. Hg	29.62	29.62	29.62	
Barometric Pressure, in. Hg	29.40	29.40	29.40	
Average %CO_2 by volume, dry basis	13.1	13.2	13.1	13.1
Average %O_2 by volume, dry basis	5.7	5.8	5.8	5.8
Dry Molecular Wt. of Gas, lb/lb-mole	30.324	30.344	30.328	
Gas Sample Volume, dscf	50.312	49.443	49.800	
Isokinetic Variance	104.9	103.5	102.8	

GE Energy

HALOGEN TEST RESULTS SUMMARY	
Company:	We Energies
Plant:	Presque Isle Power Plant
Unit:	Baghouse Outlet

Test Run Number	**1**	**2**	**3**	**Average**
Source Condition	Base-Load	Base-Load	Base-Load	
Date	02/16/2006	02/16/2006	02/16/2006	
Start Time	8:30	11:20	14:00	
End Time	9:55	12:45	15:25	
HCl Emissions:				
ppm:	3.79	3.90	3.73	3.81
lb/hr	14.9018	15.2718	14.7991	14.9909
lb/mmBtu	0.0048	0.0050	0.0048	0.0049
HBr Emissions:				
ppm:	0.16	0.00	0.00	0.05
lb/hr	1.3811	0.0000	0.0000	0.4604
lb/mmBtu	0.0004	0.0000	0.0000	0.0001
Cl_2 Emissions:				
ppm:	0.00	0.00	0.00	0.00
lb/hr	0.0000	0.0000	0.0000	0.0000
lb/mmBtu	0.0000	0.0000	0.0000	0.0000
Br_2 Emissions:				
ppm:	0.00	0.00	0.00	0.00
lb/hr	0.0000	0.0000	0.0000	0.0000
lb/mmBtu	0.0000	0.0000	0.0000	0.0000
Stack Parameters:				
Gas Volumetric Flow Rate, acfm	1,167,586	1,163,998	1,169,827	1,167,137
Gas Volumetric Flow Rate, dscfm	691,212	688,582	698,186	692,660
Average Gas Temperature, °F	337.8	330.7	331.5	333.3
Average Gas Velocity, ft/sec	61.079	60.891	61.196	61.056
Flue Gas Moisture, percent by volume	9.7	10.5	9.6	9.9
Average Flue Pressure, in. Hg	29.62	29.62	29.62	
Barometric Pressure, in. Hg	29.40	29.40	29.40	
Average $\%CO_2$ by volume, dry basis	13.1	13.2	13.1	13.1
Average $\%O_2$ by volume, dry basis	5.7	5.8	5.8	5.8
Dry Molecular Wt. of Gas, lb/lb-mole	30.324	30.344	30.328	
Gas Sample Volume, dscf	50.312	49.443	49.800	
Isokinetic Variance	104.9	103.5	102.8	

GE Energy

SPECIATED MERCURY TEST RESULTS SUMMARY

Company: ADA-ES
Plant: We Energies - Presque Isle
Unit: Baghouse Outlet

Test Run Number	**1**	**2**	**3**	**Average**
Source Condition	Base-Load	Base-Load	Base-Load	
Date	02/14/2006	02/14/2006	02/14/2006	
Start Time	9:25	12:35	15:30	
End Time	11:52	14:55	17:48	
Particle Bound Mercury Emissions				
ppm	0.000001	0.000001	0.000001	0.000001
ug/dscm	0.01	0.01	0.00	0.01
lb/hr	0.00002	0.00002	0.00001	0.00002
lb/mmBtu	0.0000000	0.0000000	0.0000000	0.0000000
lb/Tbtu	0.00756	0.00756	0.00374	0.00629
Elemental Mercury Emissions				
ppm	0.000070	0.000075	0.000080	0.000075
ug/dscm	0.59	0.63	0.66	0.63
lb/hr	0.00151	0.00160	0.00170	0.00160
lb/mmBtu	0.0000005	0.0000005	0.0000005	0.0000005
lb/Tbtu	0.49161	0.52899	0.52899	0.51653
Oxidized Mercury Emissions				
ppm	0.000524	0.000589	0.000531	0.000548
ug/dscm	4.37	4.92	4.43	4.57
lb/hr	0.01124	0.01261	0.01135	0.01173
lb/mmBtu	0.0000037	0.0000042	0.0000037	0.0000039
lb/Tbtu	3.66814	4.15637	3.74307	3.85586
Total Mercury Emissions				
ppm	0.000595	0.000665	0.000611	0.000624
ug/dscm	4.96	5.55	5.10	5.21
lb/hr	0.01278	0.01423	0.01307	0.01336
lb/mmBtu	0.0000042	0.0000047	0.0000043	0.0000044
lb/Tbtu	4.16731	4.69292	4.30827	4.38950
Stack Parameters:				
Average Gas Temperature, °F	331.7	331.9	334.8	332.8
Average Gas Velocity, ft/sec	60.893	61.315	61.541	61.250
Flue Gas Moisture, percent by volume	9.0	10.0	10.0	9.7
Average Flue Pressure, in. Hg	29.11	29.11	29.11	
Barometric Pressure, in. Hg	28.89	28.89	28.89	
Average $\%CO_2$ by volume, dry basis	13.4	13.3	13.2	13.3
Average $\%O_2$ by volume, dry basis	5.7	5.8	5.8	5.8
Dry Molecular Wt. of Gas, lb/lb-mole	30.372	30.360	30.344	
Gas Sample Volume, dscf	78.397	78.981	79.729	
Isokinetic Variance	101.5	102.7	103.7	

GE Energy

We Energies
Presque Isle Power Plant
February 15, 2006

Method 324 Test Result Summary

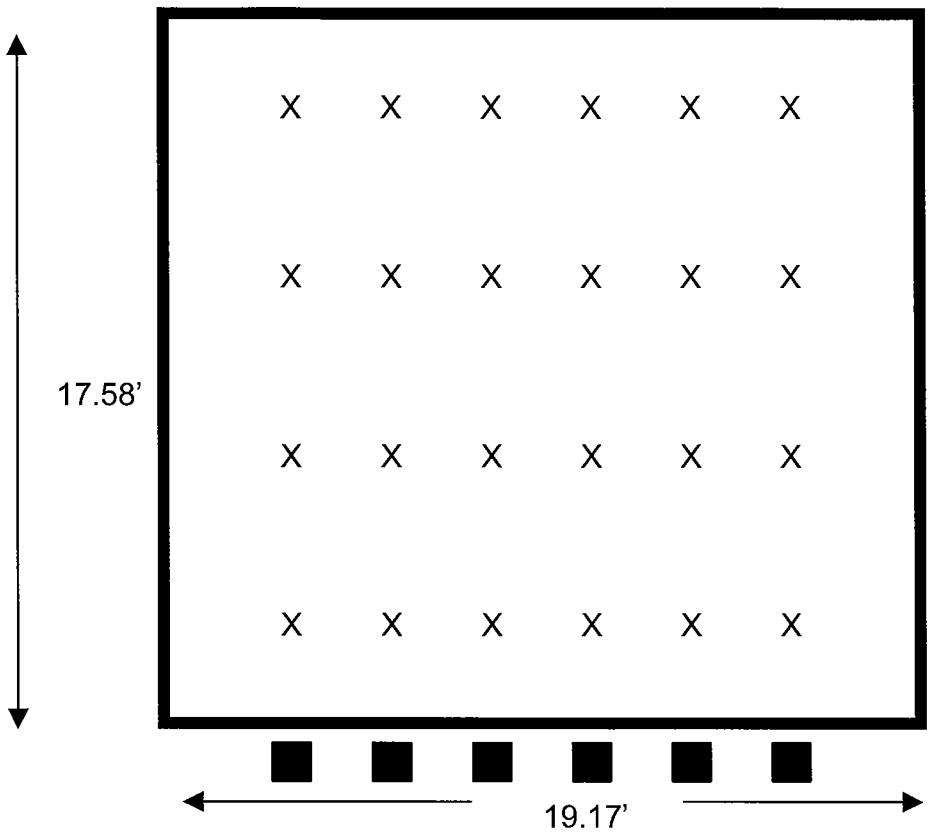
Unit	Unit 7 Inlet				Unit 8 Inlet				Unit 9 Inlet			
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average
Hg ppm	0.00012	0.00009	0.00008	0.00010	0.00009	0.00007	0.00007	0.00008	0.00211	0.00550	0.00210	0.00323
Hg ug/l	0.00096	0.00074	0.00070	0.00080	0.00073	0.00061	0.00501	0.00212	0.01758	0.04589	0.01752	0.02700

Unit	Baghouse Outlet				
	Test 1*	Test 2	Test 3	Test 4	Average
Hg ppm	0.00072	0.00034	0.00063	0.00066	0.00054
Hg ug/l	0.00597	0.00287	0.00524	0.00554	0.00455

* Test 1 is not included in average

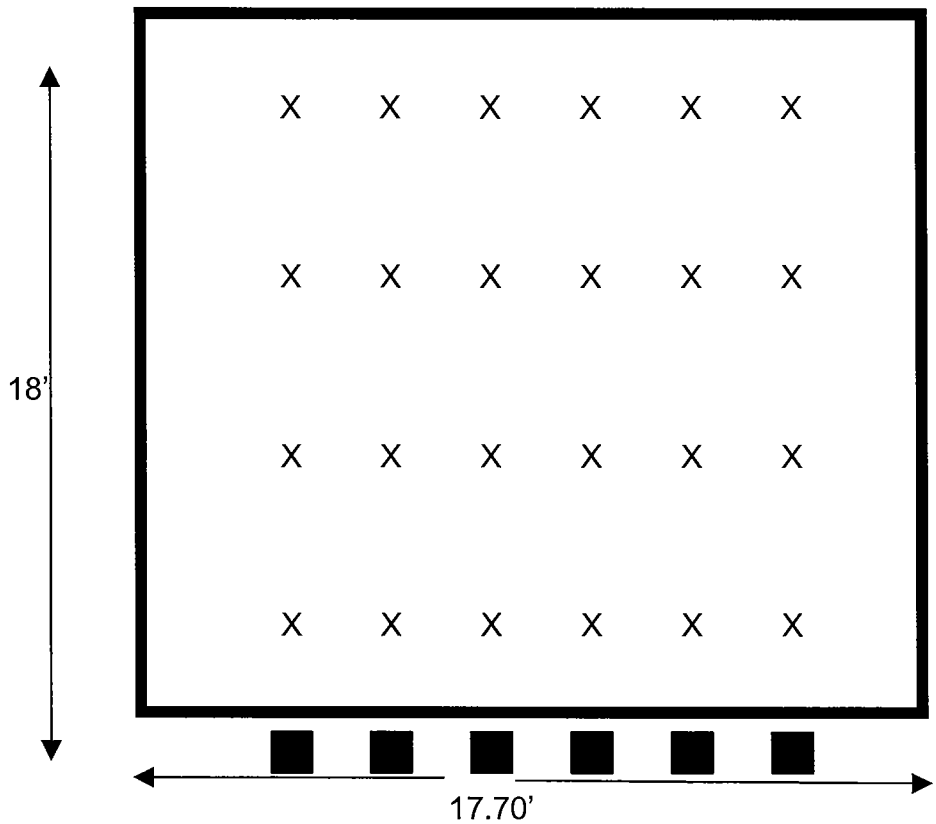
APPENDIX

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



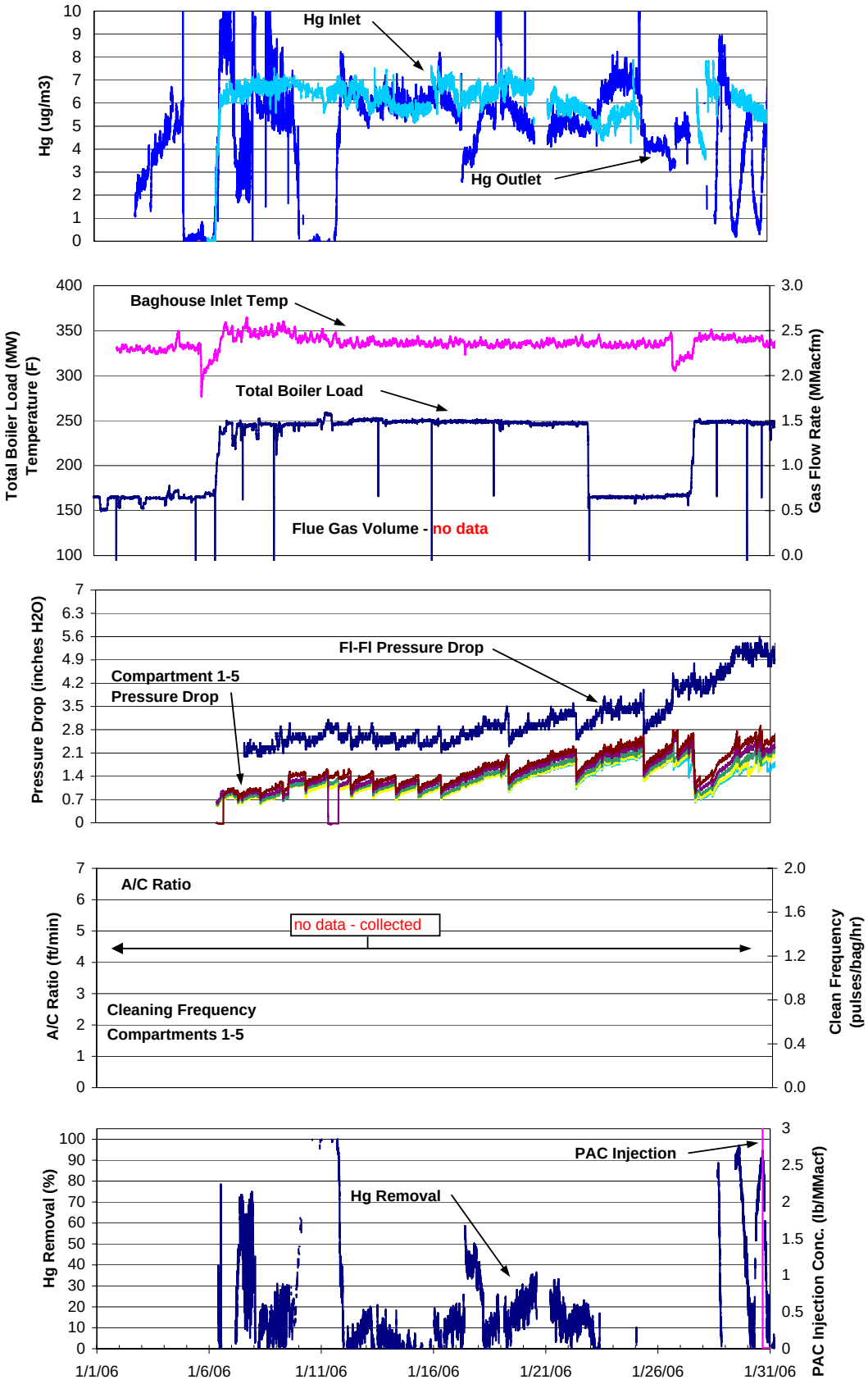
Job:	We Energies Marquette, Michigan		
Date:	February 14 through 16, 2006	Area:	336.996 Square Feet
Test Location:	Baghouse Inlet	No. Test Ports:	4
Length:	17.58 Feet	Tests Points per Port:	6
Width:	19.17 Feet		

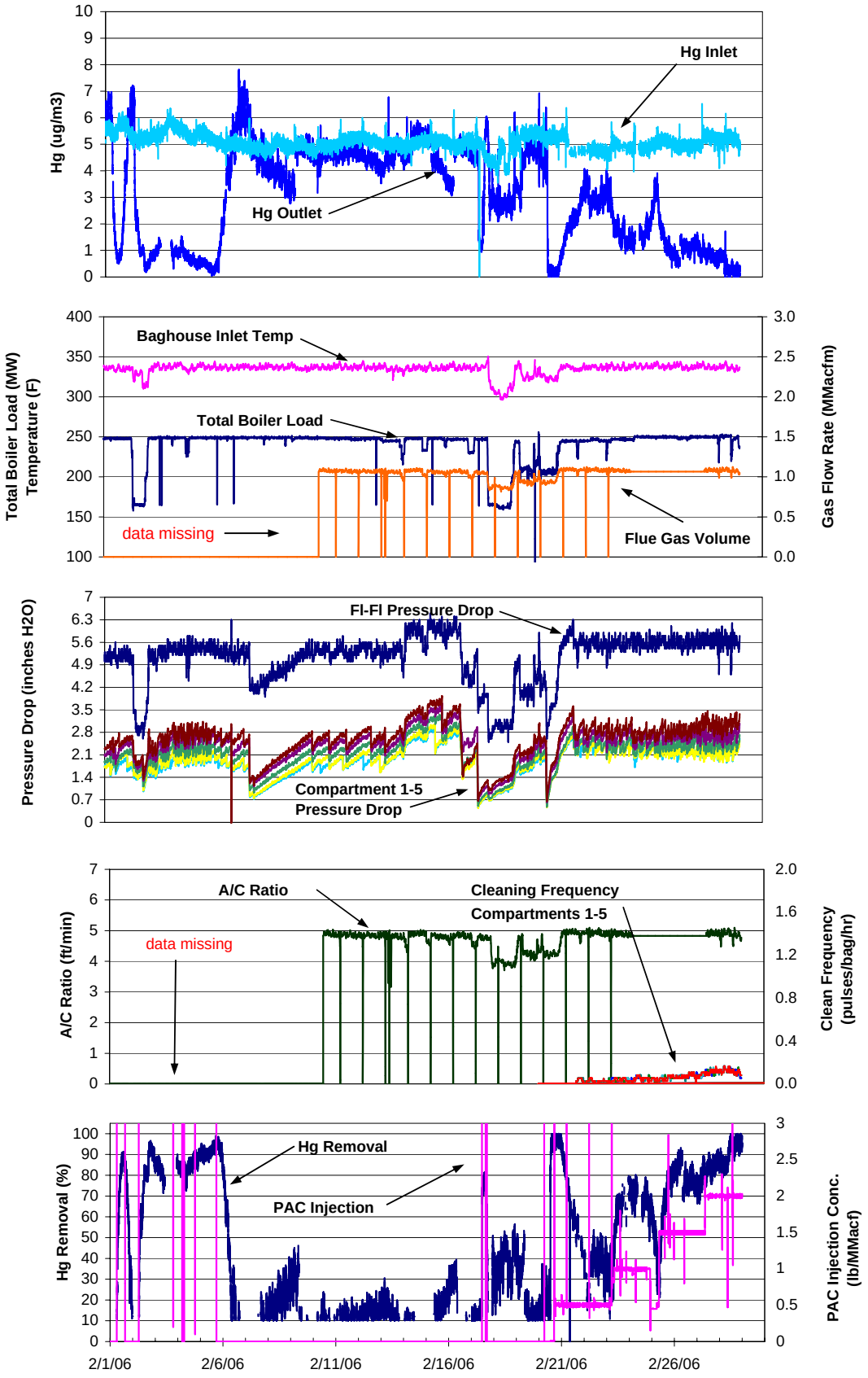
EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS

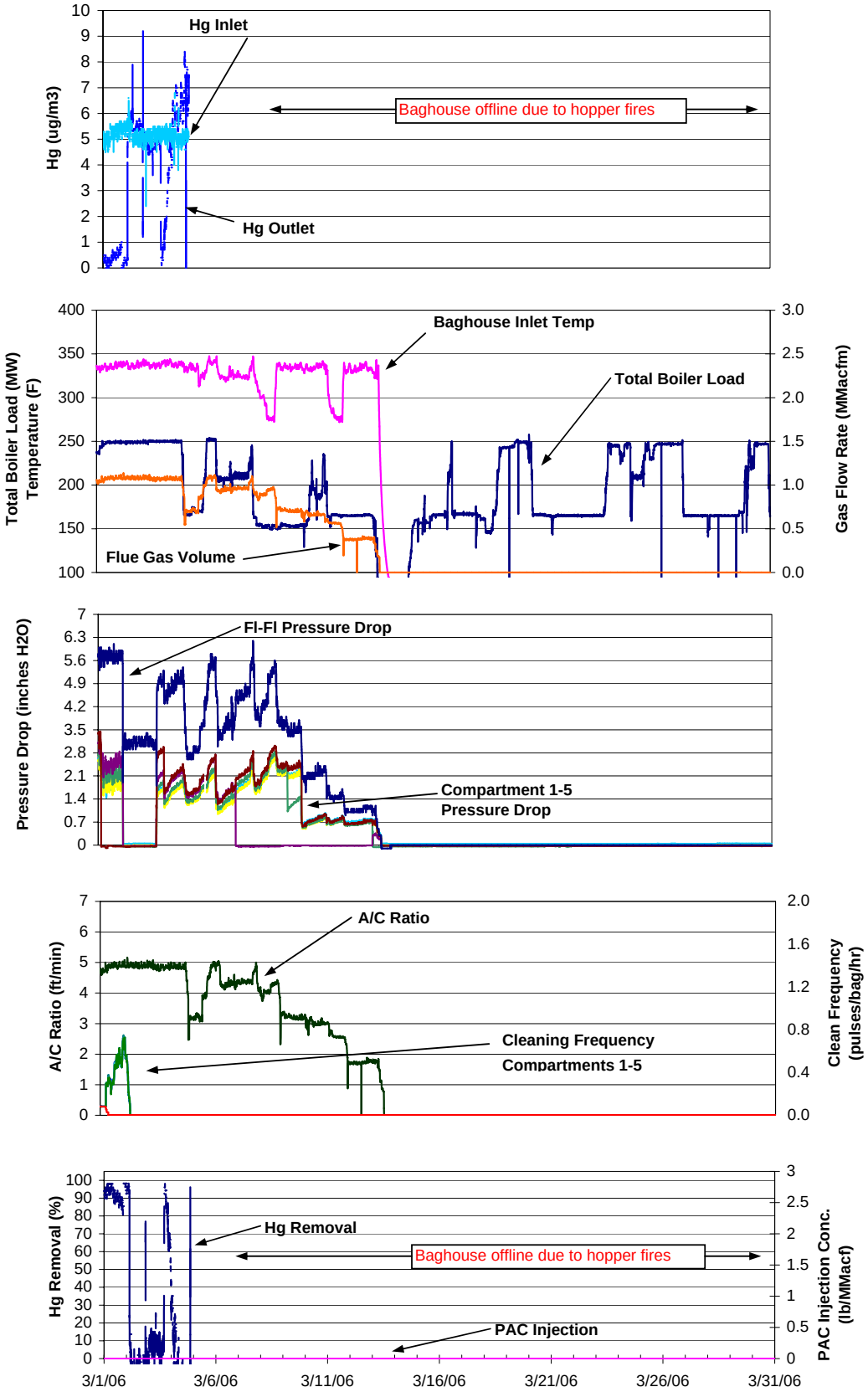


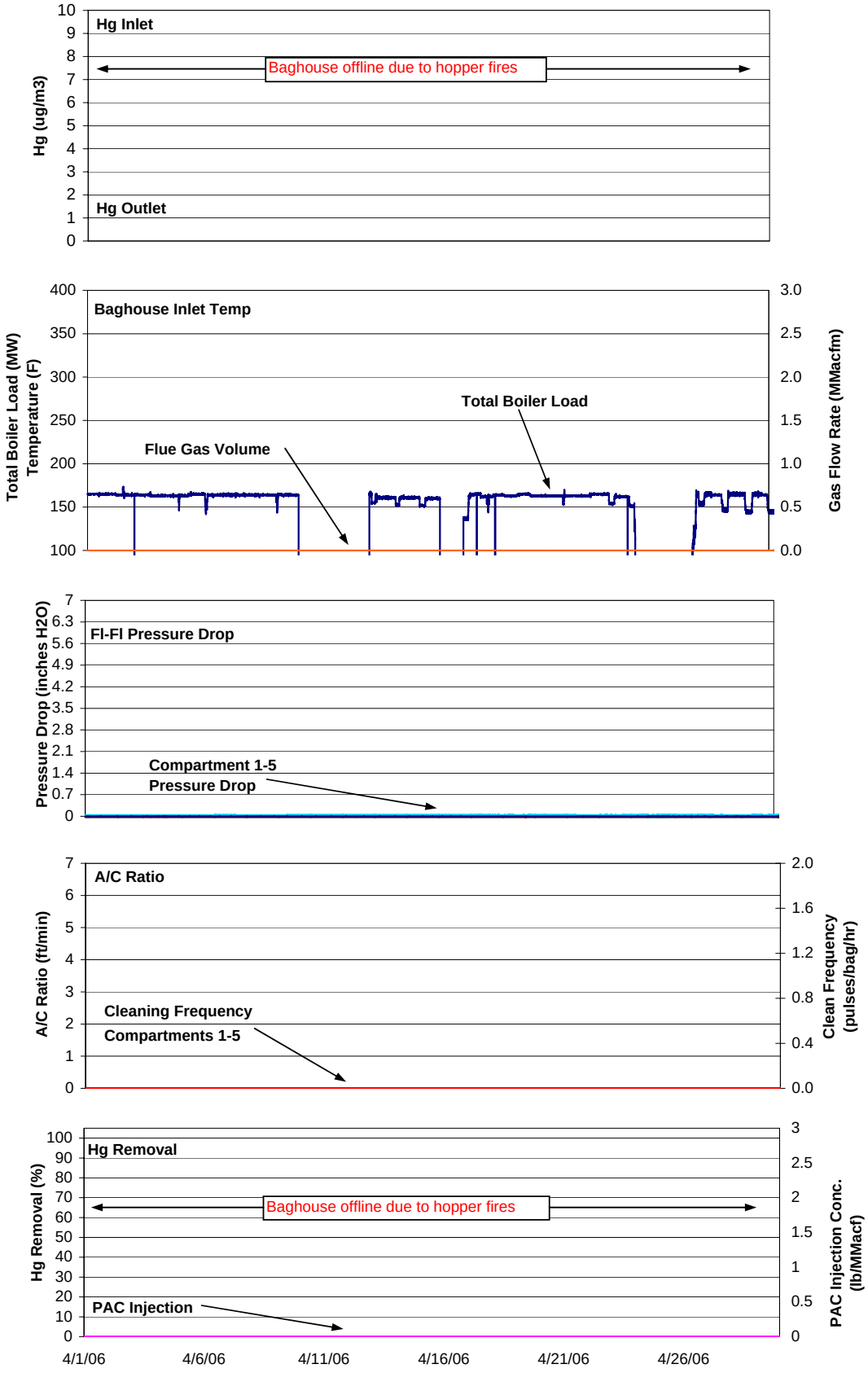
Job:	We Energies Marquette, Michigan		
Date:	February 14 through 16, 2006	Area:	318.600 Square Feet
Test Location:	Baghouse Outlet	No. Test Ports:	6
Length:	18.0 Feet	Tests Points per Port:	4
Width:	17.70 Feet		

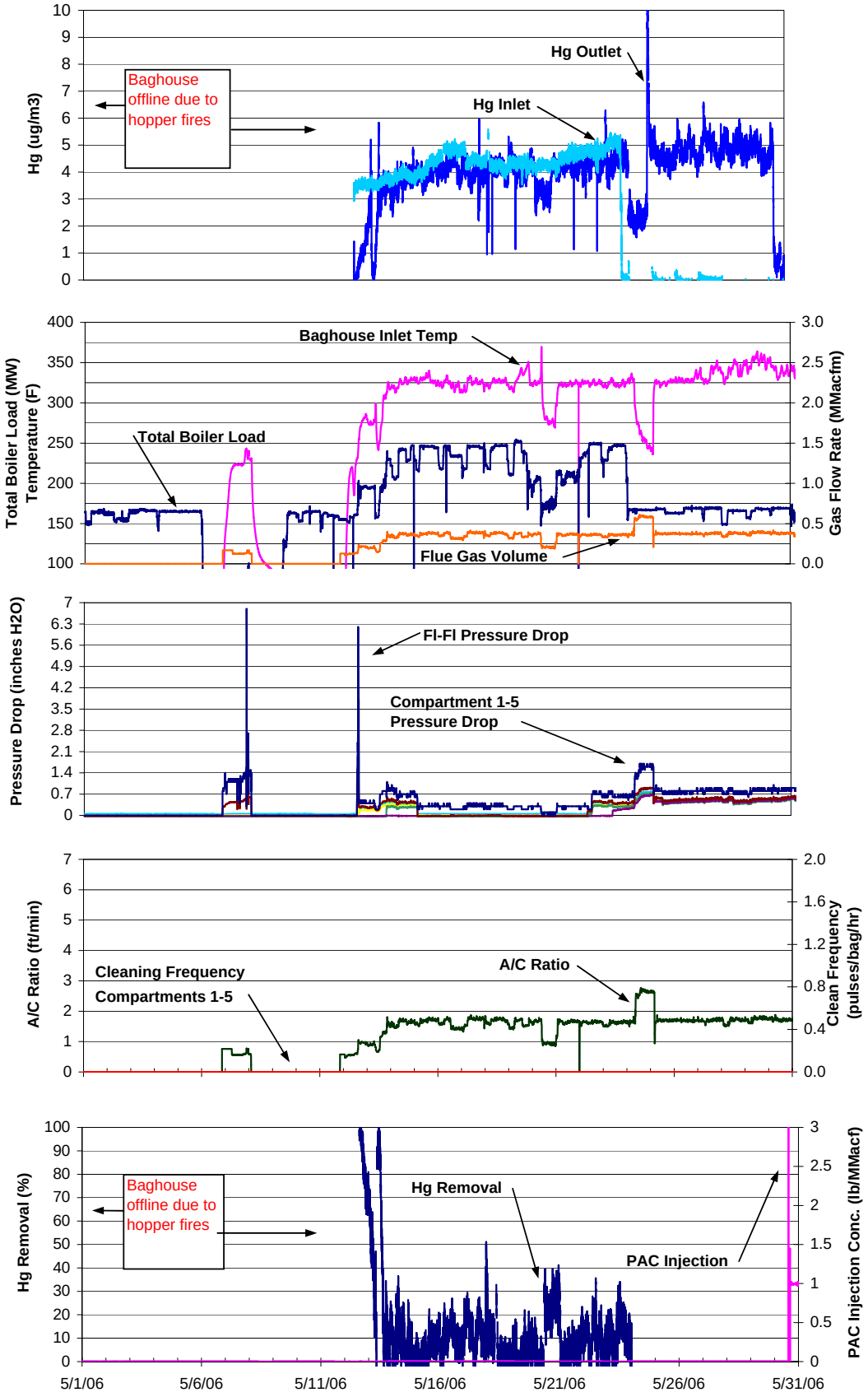
Appendix H. Monthly Baghouse Operation Graphs

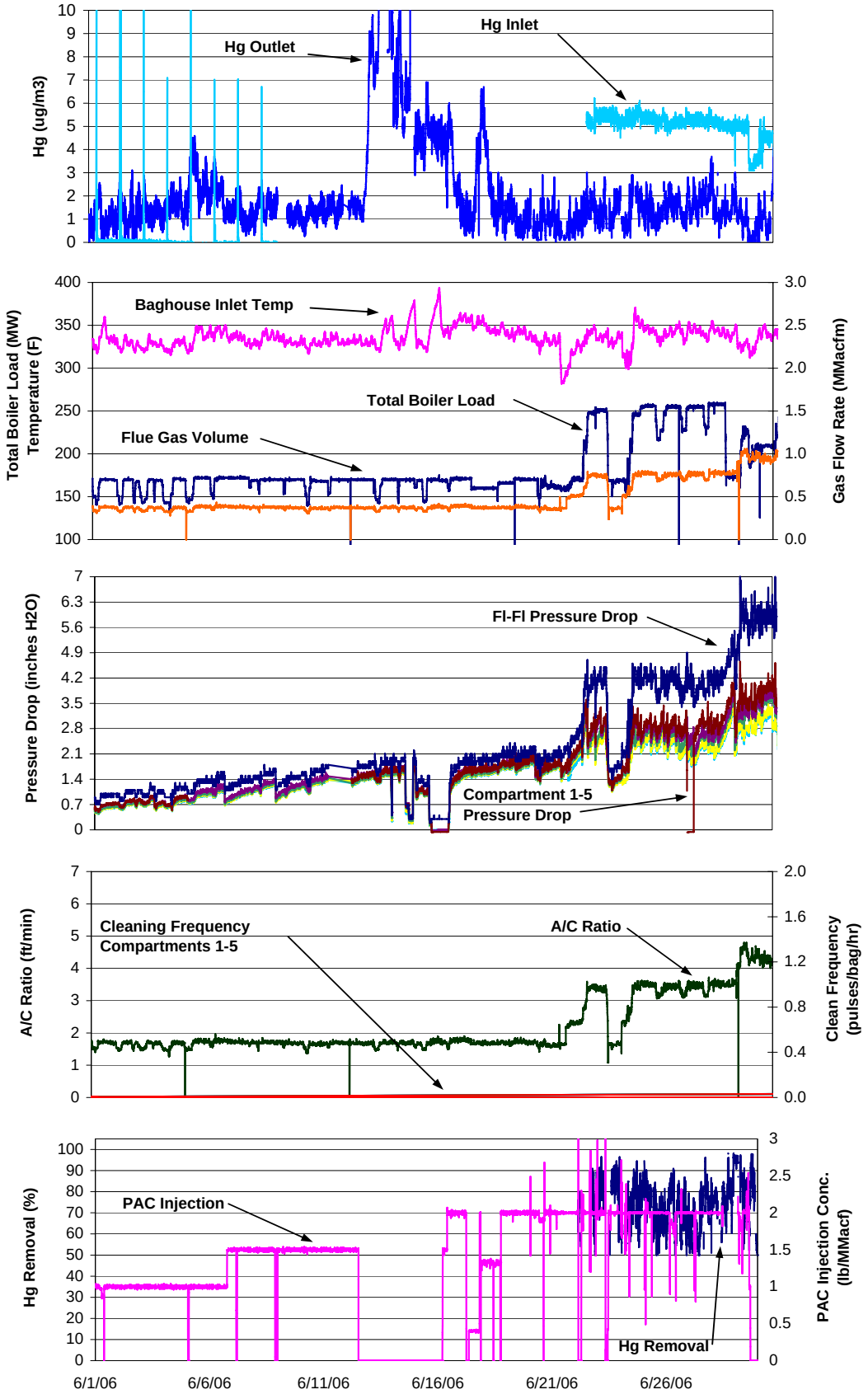

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume - no data
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
no data - collected
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
PAC Injection
Hg Removal
1/1/06
1/6/06
1/11/06
1/16/06
1/21/06
1/26/06
1/31/06

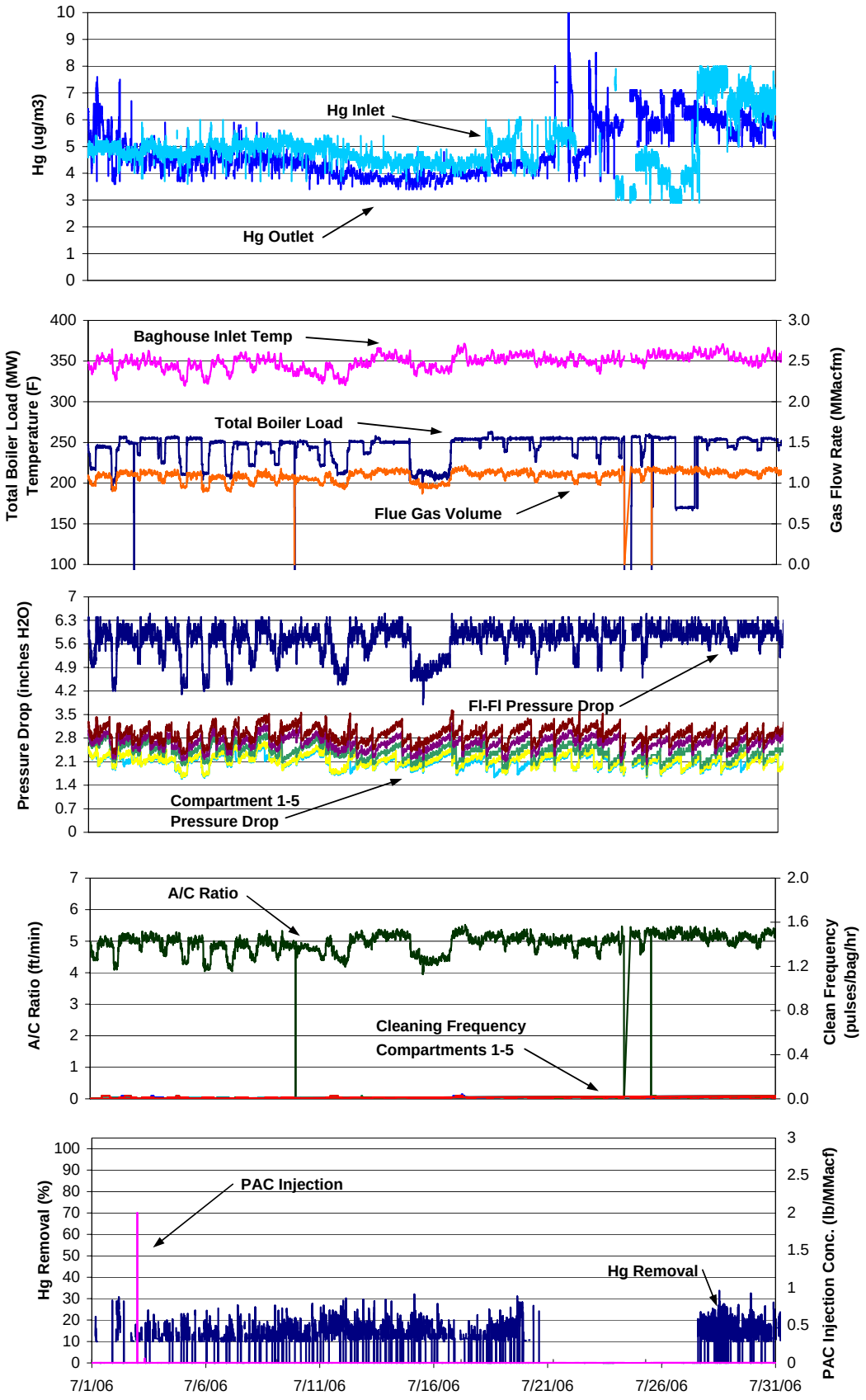

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
data missing
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency
Compartments 1-5
data missing
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc.
(lb/MMacf)
2/1/06
2/6/06
2/11/06
2/16/06
2/21/06
2/26/06

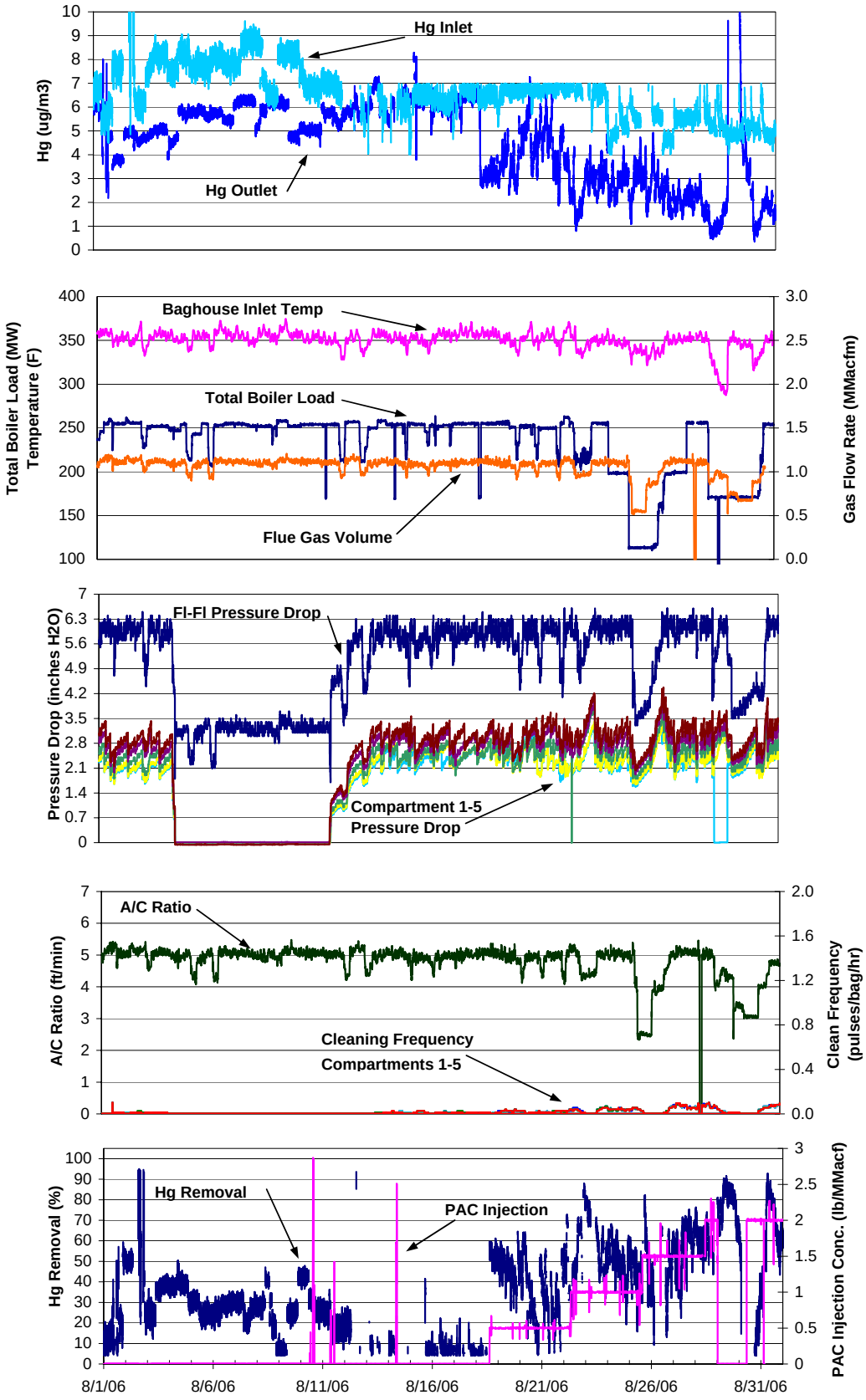

Hg (ug/m3)
Hg Inlet
Baghouse offline due to hopper fires
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Gas Flow Rate (MMacfm)
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
Baghouse offline due to hopper fires
PAC Injection
PAC Injection Conc.
(lb/MMacf)
3/1/06
3/6/06
3/11/06
3/16/06
3/21/06
3/26/06
3/31/06

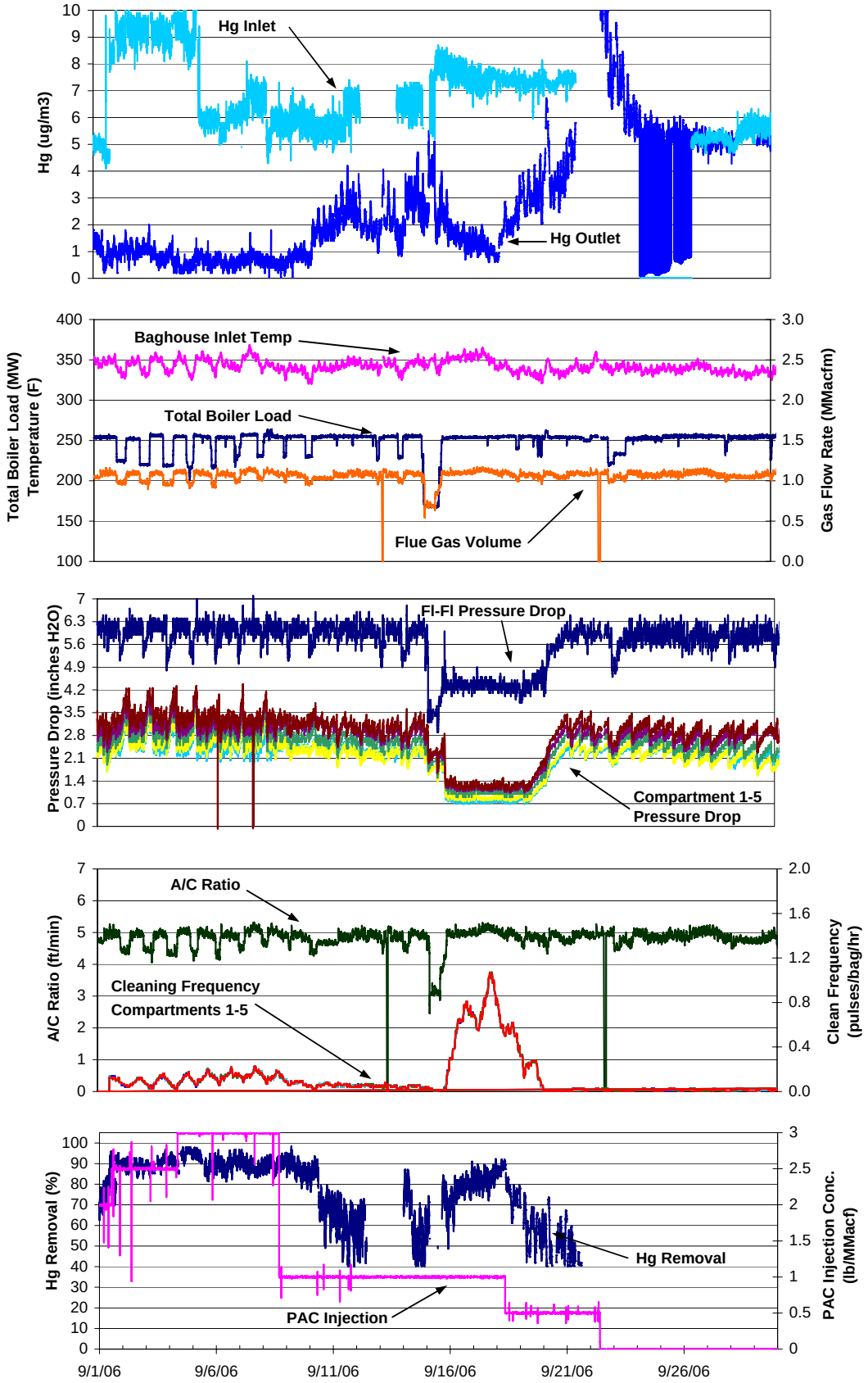

Hg Inlet
Baghouse offline due to hopper fires
Hg Outlet
Hg (ug/m3)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
Pressure Drop (inches H2O)
A/C Ratio
Cleaning Frequency
Compartments 1-5
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
Hg Removal
Baghouse offline due to hopper fires
PAC Injection
Hg Removal (%)
PAC Injection Conc.
(lb/MMacf)
4/1/06
4/6/06
4/11/06
4/16/06
4/21/06
4/26/06

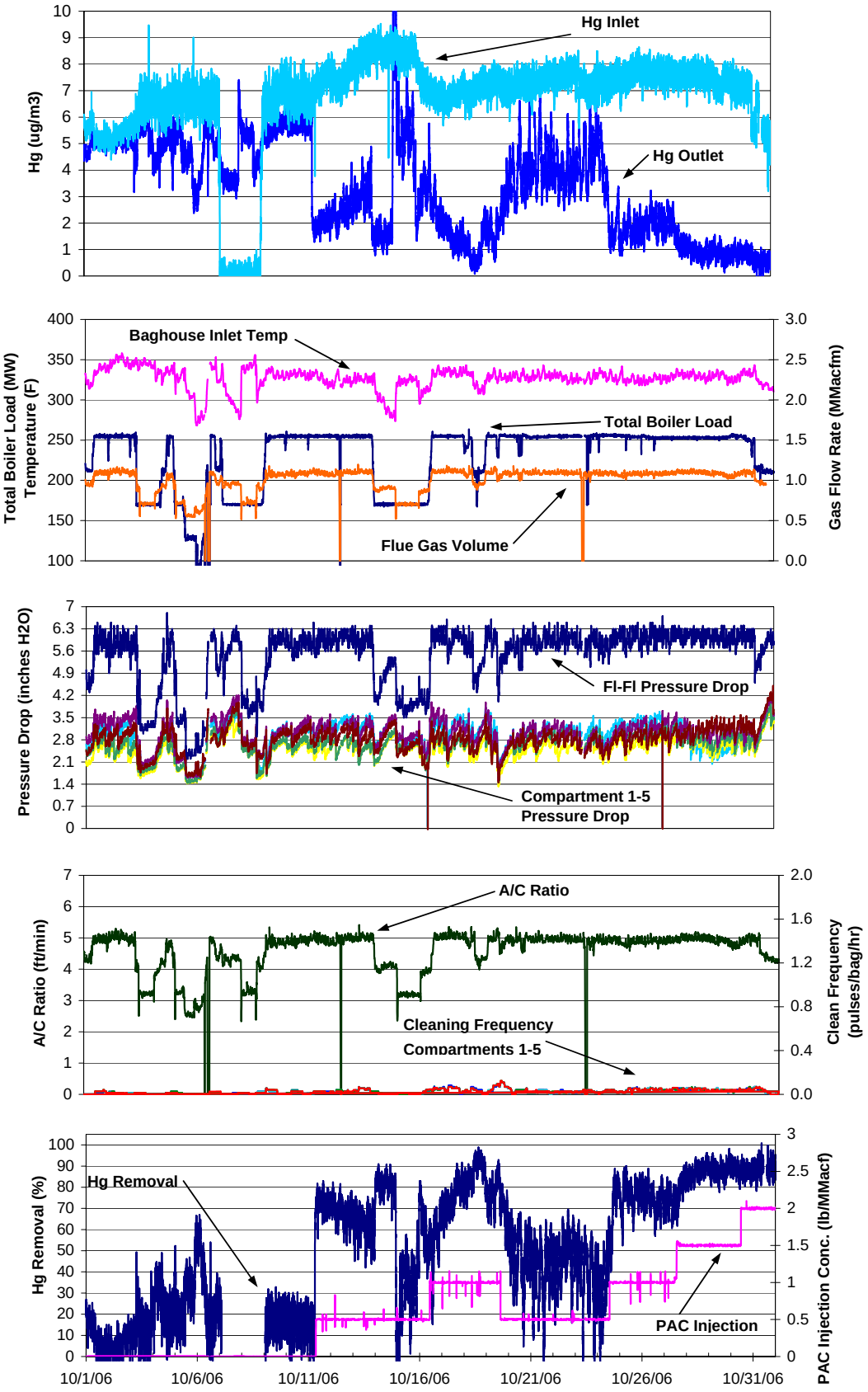

Hg (ug/m3)
Baghouse offline due to hopper fires
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
Cleaning Frequency
Compartments 1-5
A/C Ratio
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Baghouse offline due to hopper fires
Hg Removal
PAC Injection
5/1/06
5/6/06
5/11/06
5/16/06
5/21/06
5/26/06
5/31/06

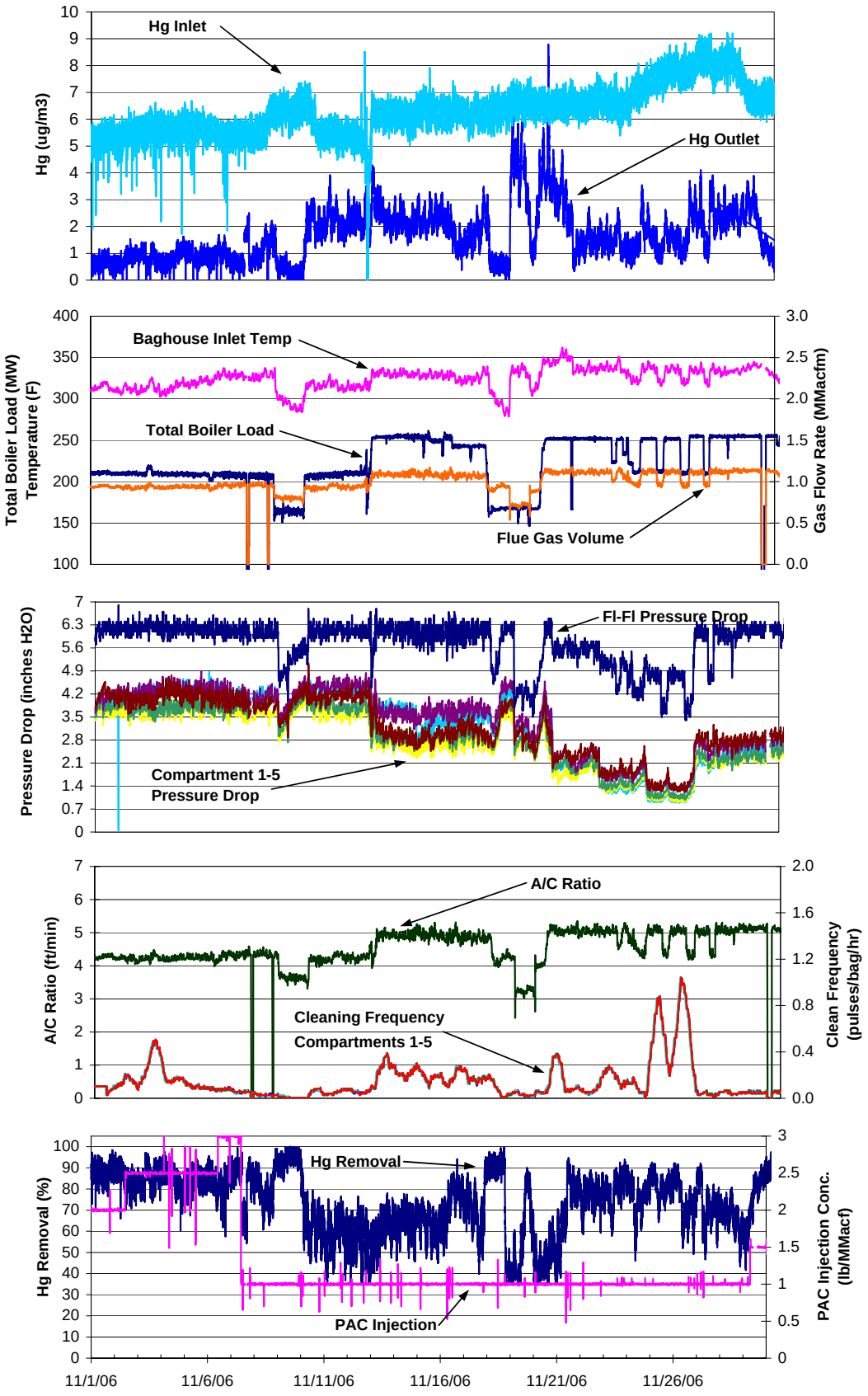

Hg (ug/m3)
Hg Outlet
Hg Inlet
Total Boiler Load (MW)
Temperature (F)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Gas Flow Rate (MMacfm)
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Cleaning Frequency
Compartments 1-5
A/C Ratio
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
PAC Injection
Hg Removal
PAC Injection Conc.
(lb/MMacf)
6/1/06
6/6/06
6/11/06
6/16/06
6/21/06
6/26/06

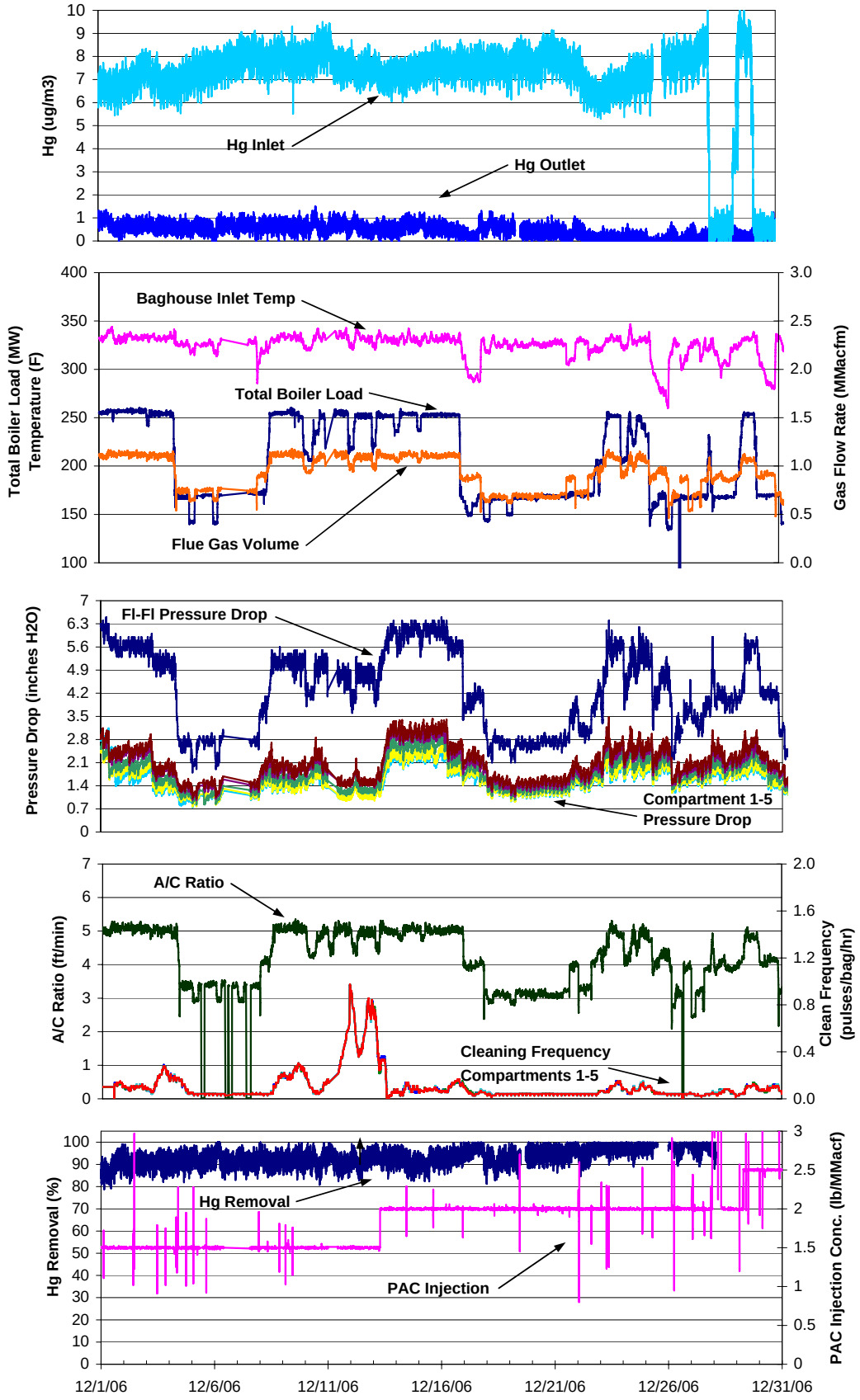

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
FI-FI Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
PAC Injection
Hg Removal
7/1/06
7/6/06
7/11/06
7/16/06
7/21/06
7/26/06
7/31/06

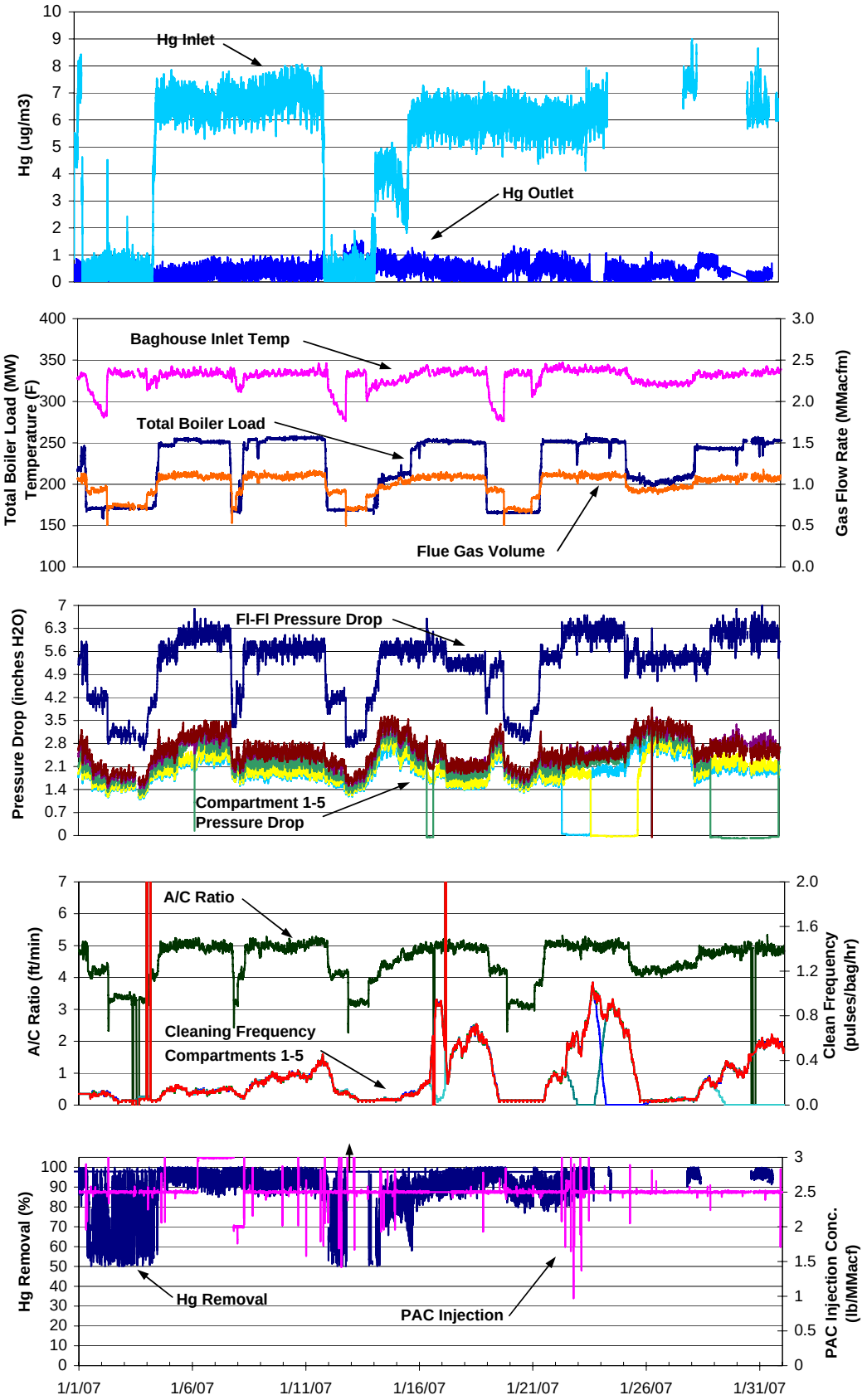

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc. (lb/MMacf)
8/1/06
8/6/06
8/11/06
8/16/06
8/21/06
8/26/06
8/31/06

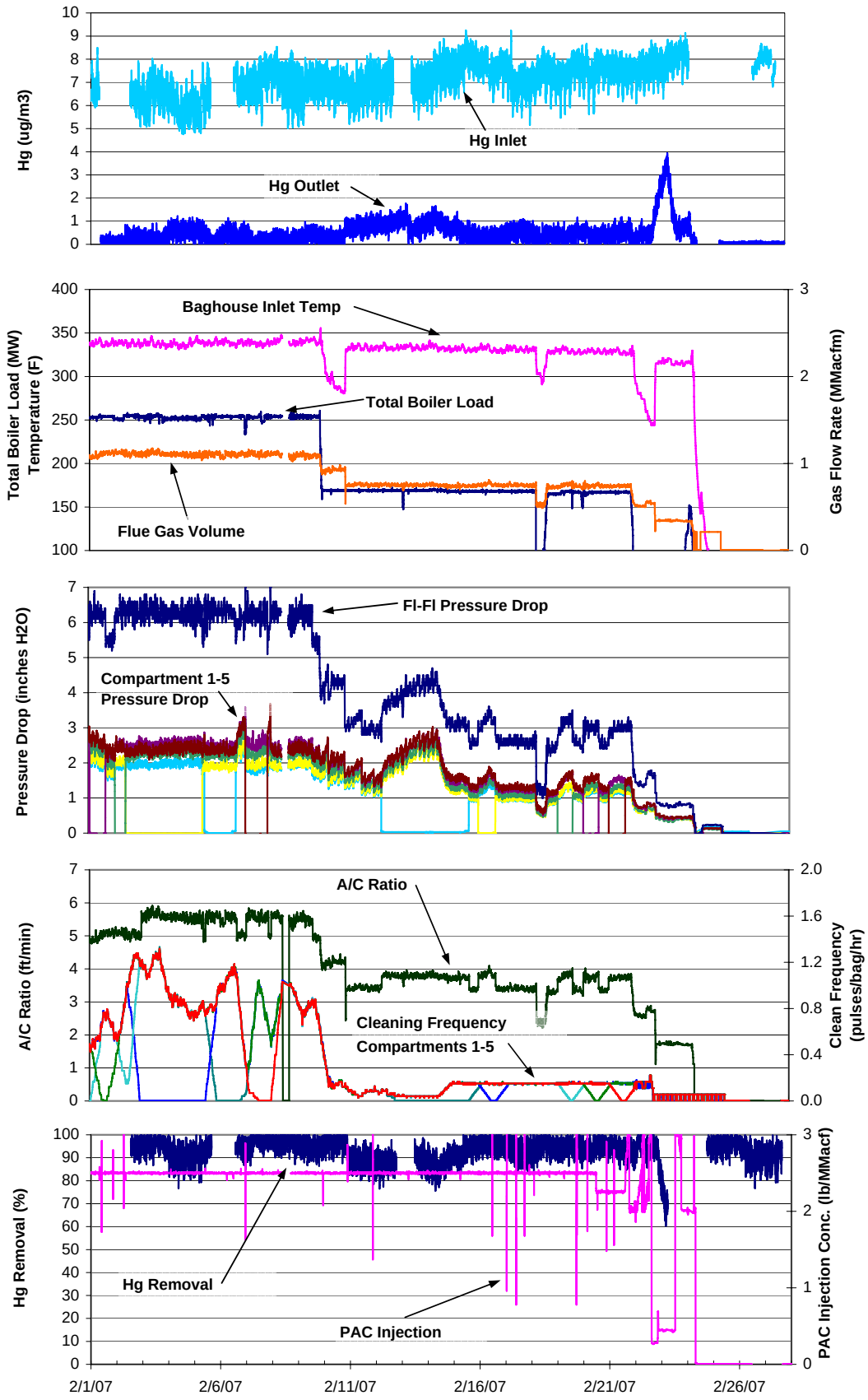

Hg Inlet
Hg Outlet
Hg (ug/m3)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
Pressure Drop (inches H2O)
A/C Ratio
Cleaning Frequency
Compartments 1-5
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
Hg Removal
PAC Injection
Hg Removal (%)
PAC Injection Conc.
(lb/MMacf)
9/1/06
9/6/06
9/11/06
9/16/06
9/21/06
9/26/06

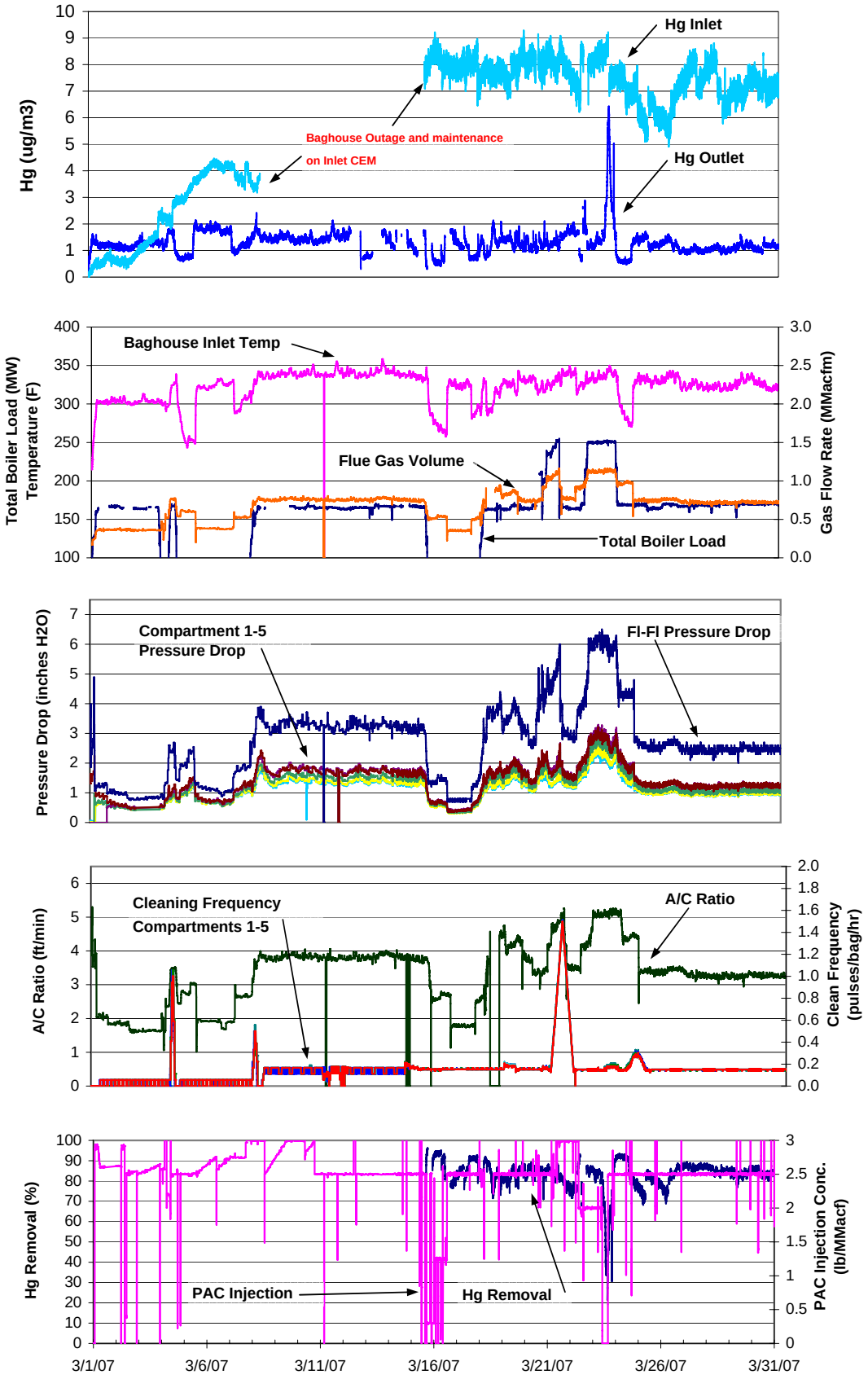

Hg Inlet
Hg Outlet
Hg (ug/m3)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
Pressure Drop (inches H2O)
A/C Ratio
Cleaning Frequency
Compartments 1-5
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
Hg Removal
PAC Injection
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
10/1/06
10/6/06
10/11/06
10/16/06
10/21/06
10/26/06
10/31/06

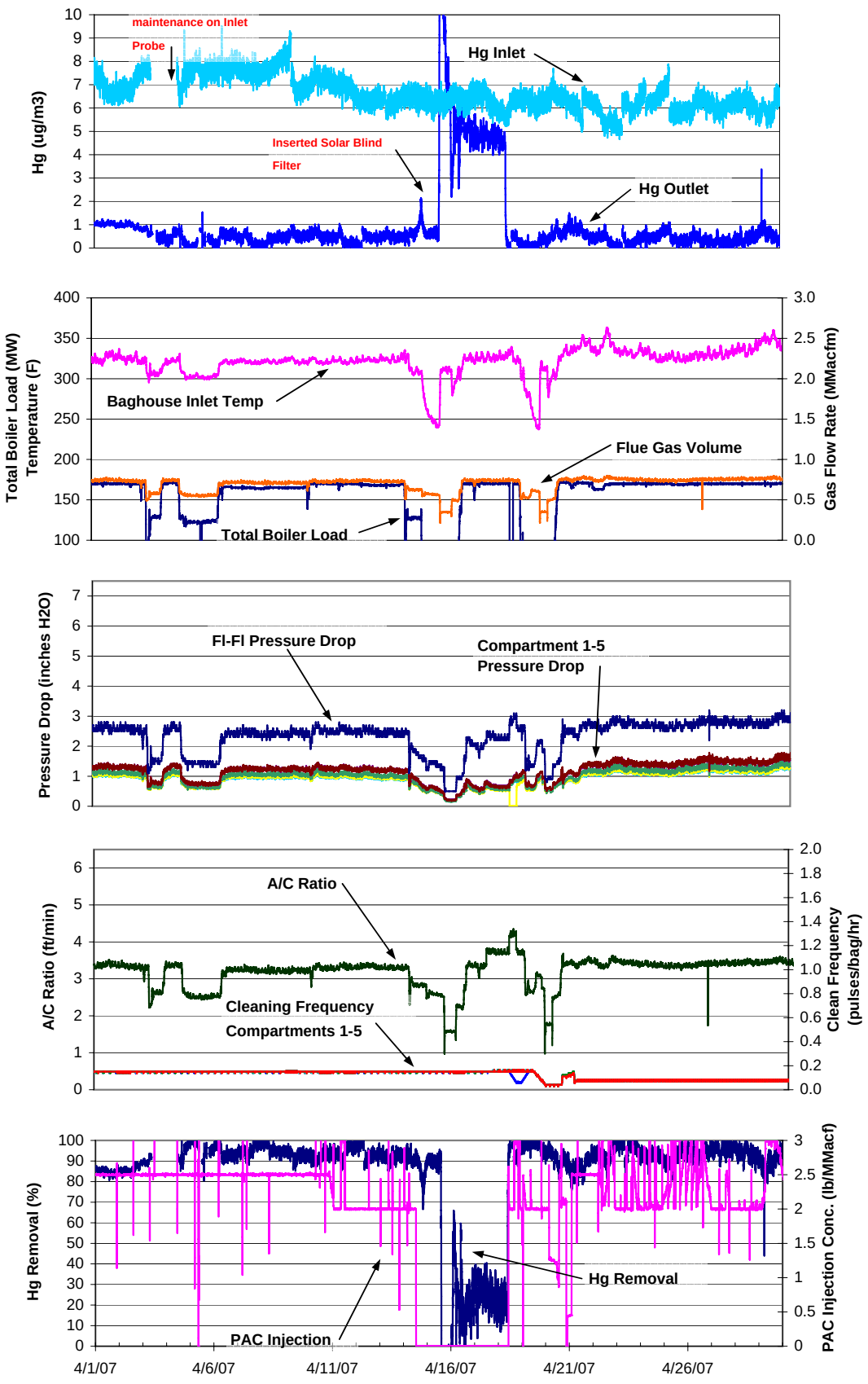

Hg Inlet
Hg Outlet
Hg (ug/m3)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
Pressure Drop (inches H2O)
A/C Ratio
Cleaning Frequency
Compartments 1-5
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
Hg Removal
PAC Injection
Hg Removal (%)
PAC Injection Conc.
(lb/MMacf)
11/1/06
11/6/06
11/11/06
11/16/06
11/21/06
11/26/06

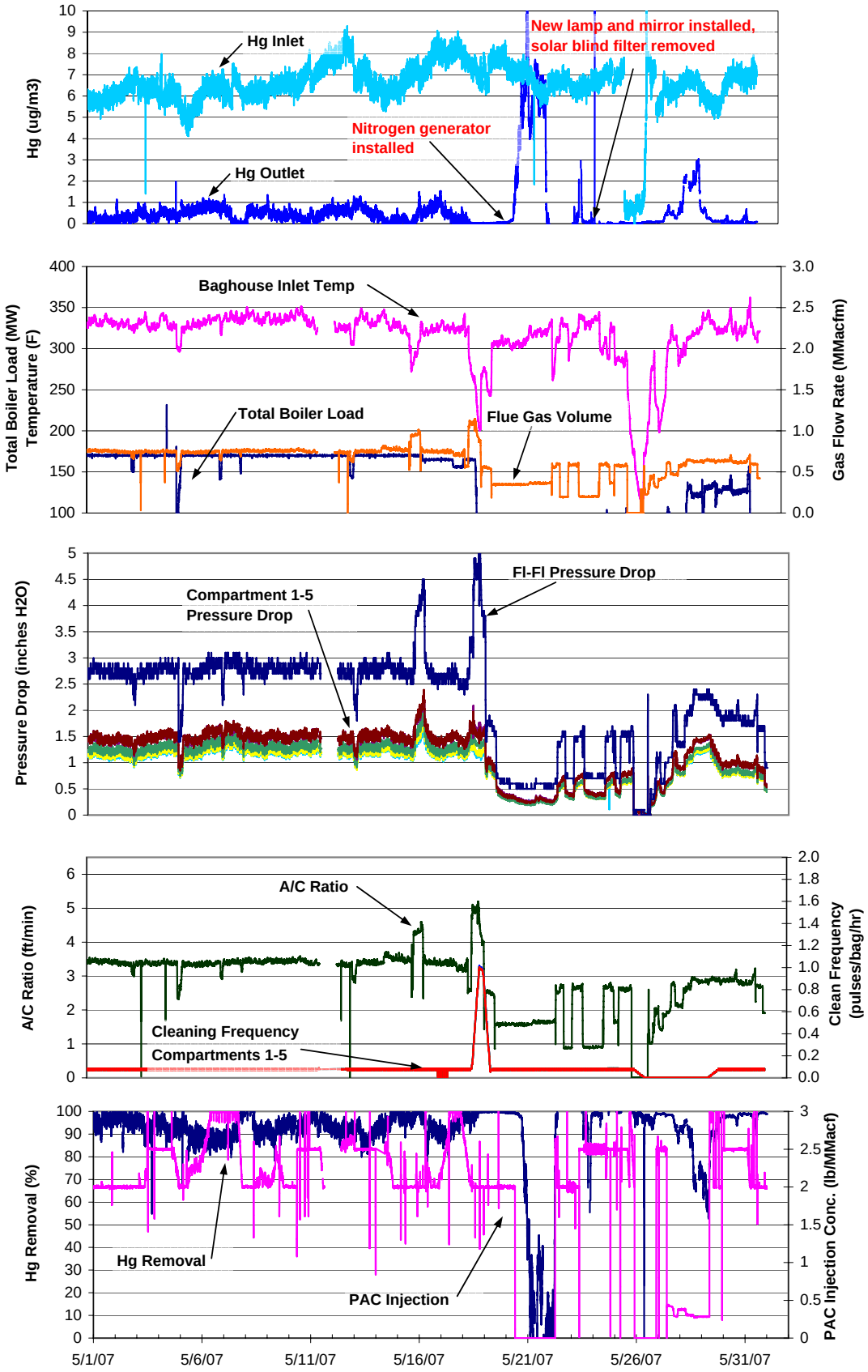

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Gas Flow Rate (MMacfm)
Pressure Drop (inches H2O)
FI-FI Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc. (lb/MMacf)
12/1/06
12/6/06
12/11/06
12/16/06
12/21/06
12/26/06
12/31/06

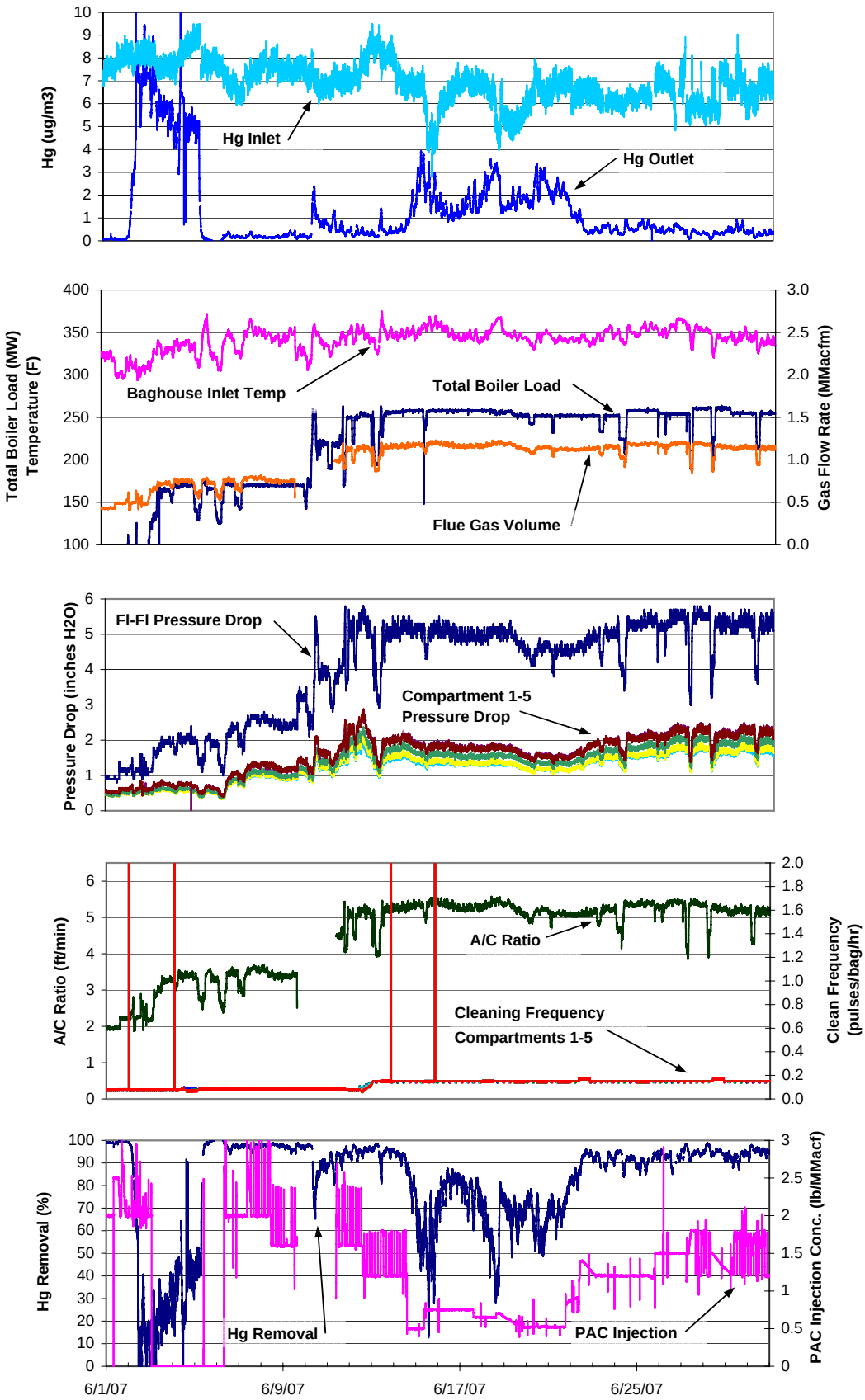

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc.
(lb/MMacf)
Hg Removal
PAC Injection
1/1/07
1/6/07
1/11/07
1/16/07
1/21/07
1/26/07
1/31/07

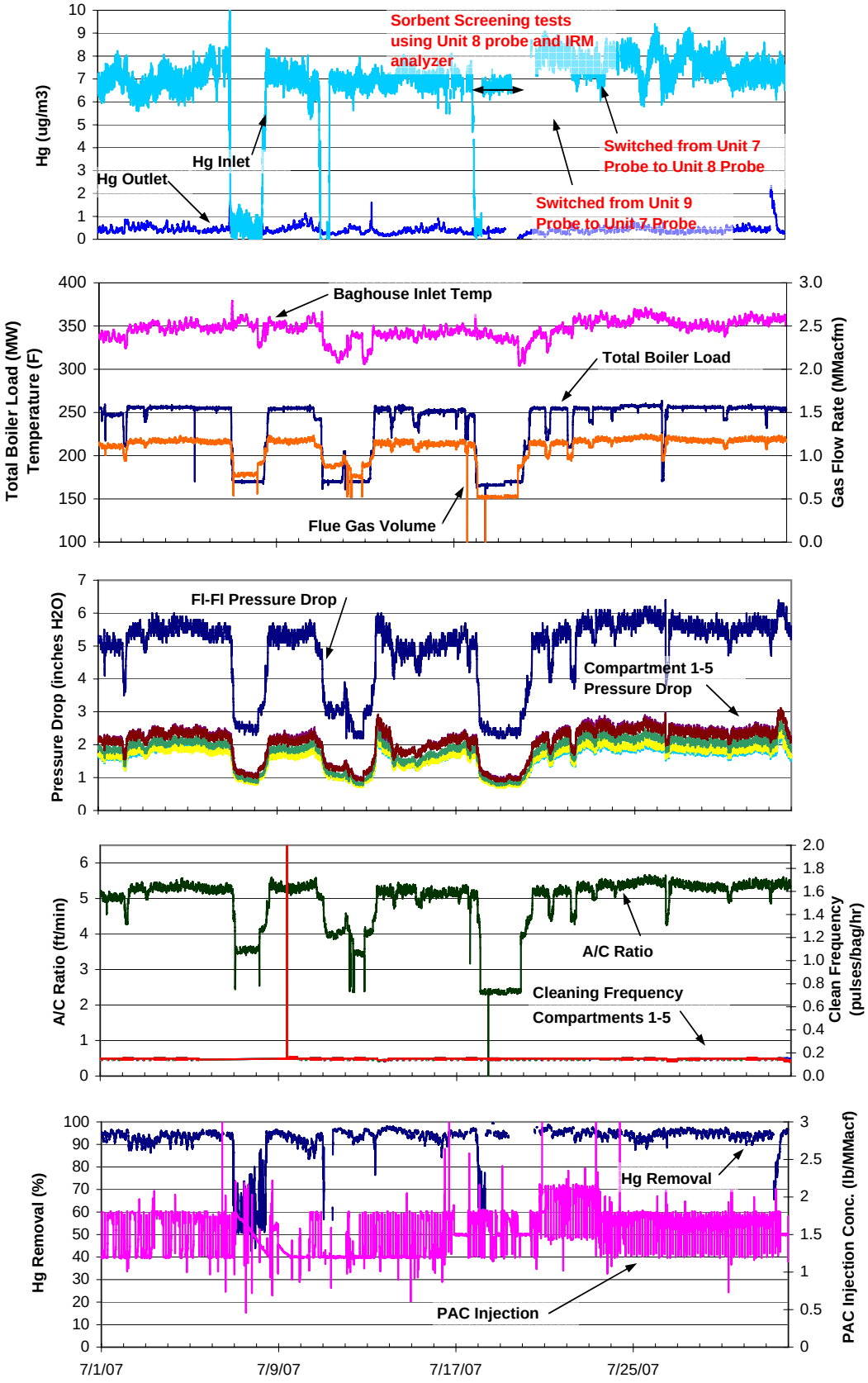

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
FI-FI Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
2/1/07
2/6/07
2/11/07
2/16/07
2/21/07
2/26/07

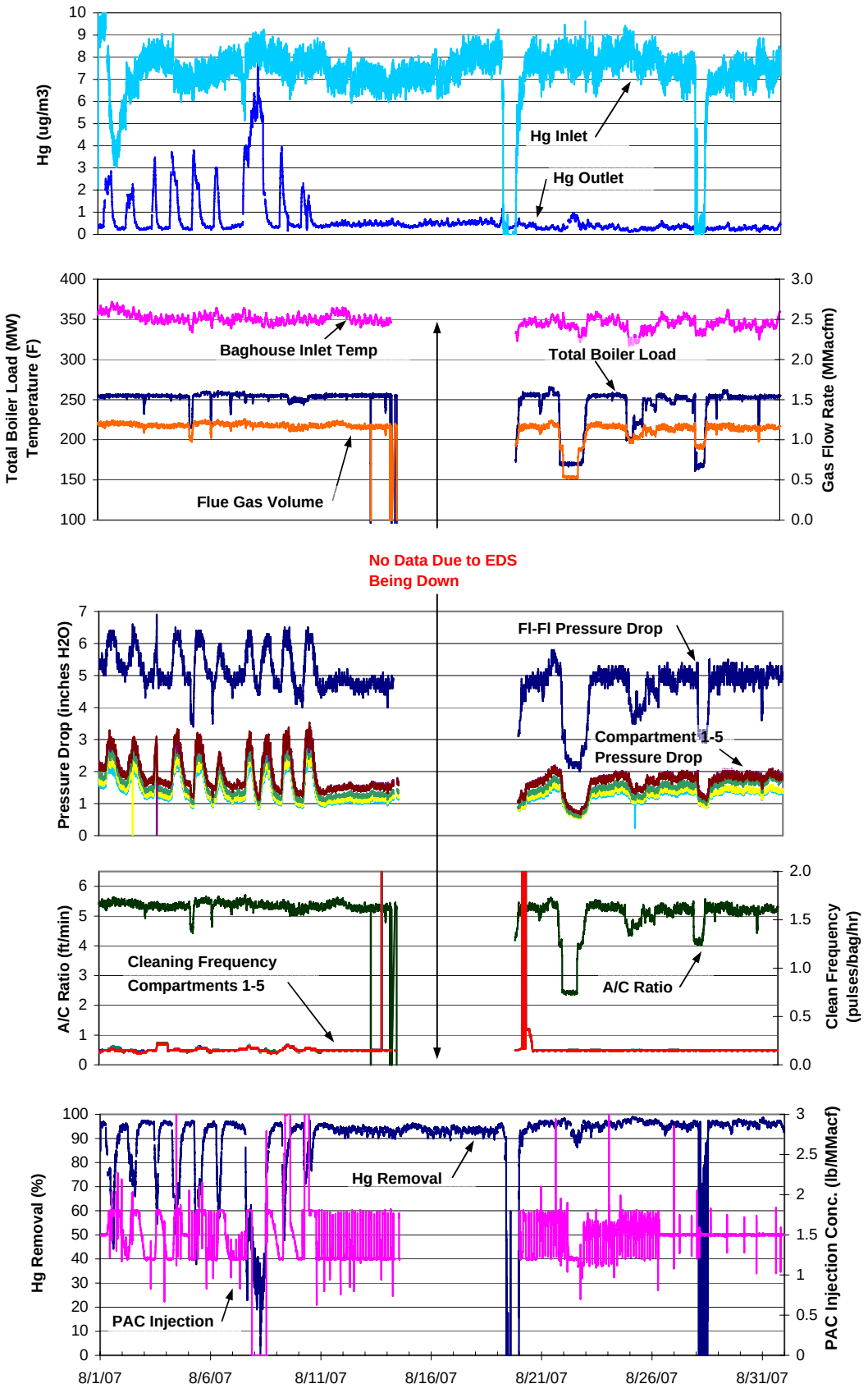

Hg (ug/m3)
Hg Inlet
Baghouse Outage and maintenance
on Inlet CEM
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Flue Gas Volume
Total Boiler Load
Pressure Drop (inches H2O)
Compartment 1-5
Pressure Drop
Fl-Fl Pressure Drop
A/C Ratio (ft/min)
Cleaning Frequency
Compartments 1-5
A/C Ratio
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
PAC Injection Conc.
(lb/MMacf)
PAC Injection
Hg Removal
3/1/07
3/6/07
3/11/07
3/16/07
3/21/07
3/26/07
3/31/07

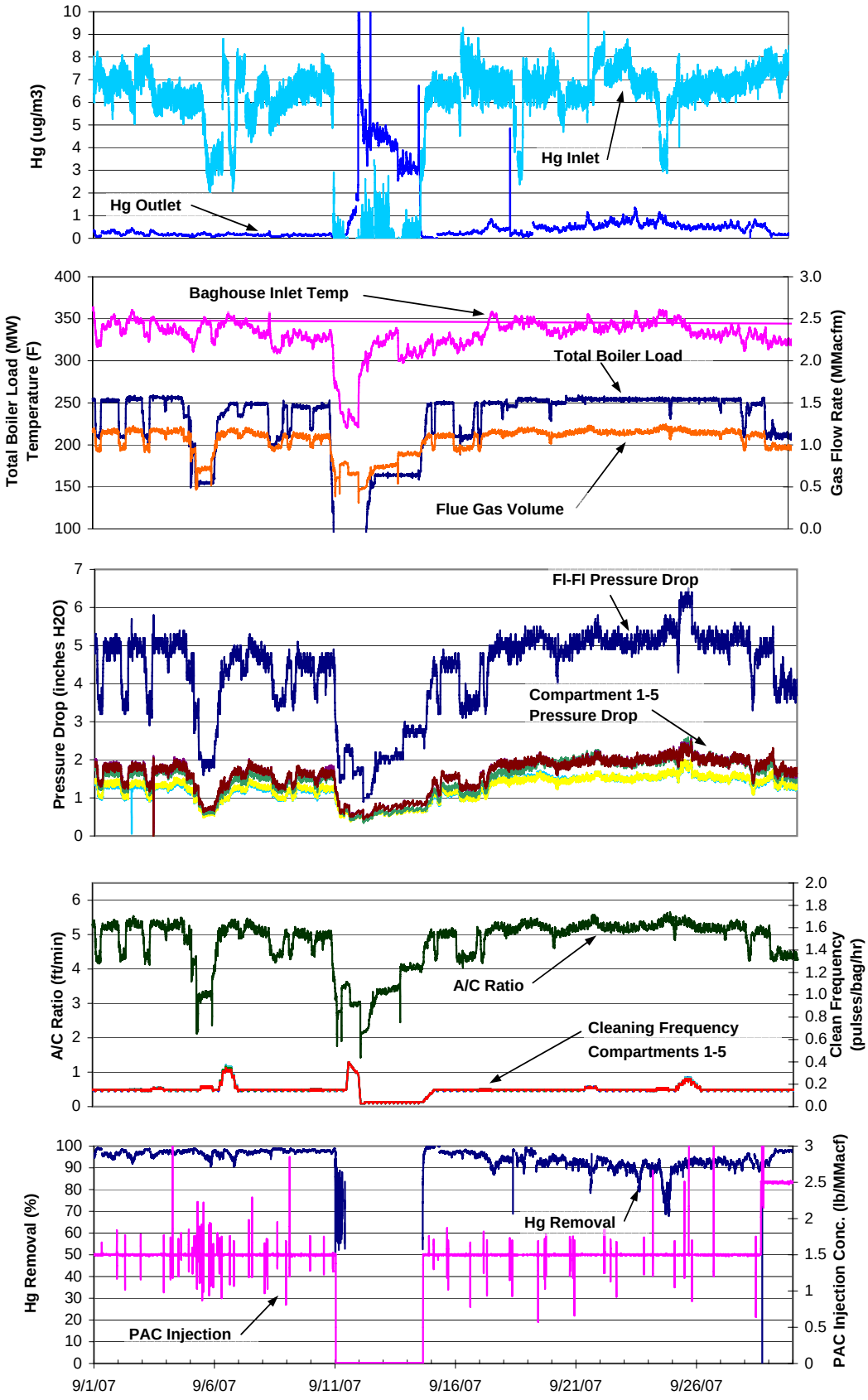

Hg (ug/m3)
maintenance on Inlet
Probe
Hg Inlet
Inserted Solar Blind
Filter
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Flue Gas Volume
Total Boiler Load
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
4/1/07
4/6/07
4/11/07
4/16/07
4/21/07
4/26/07

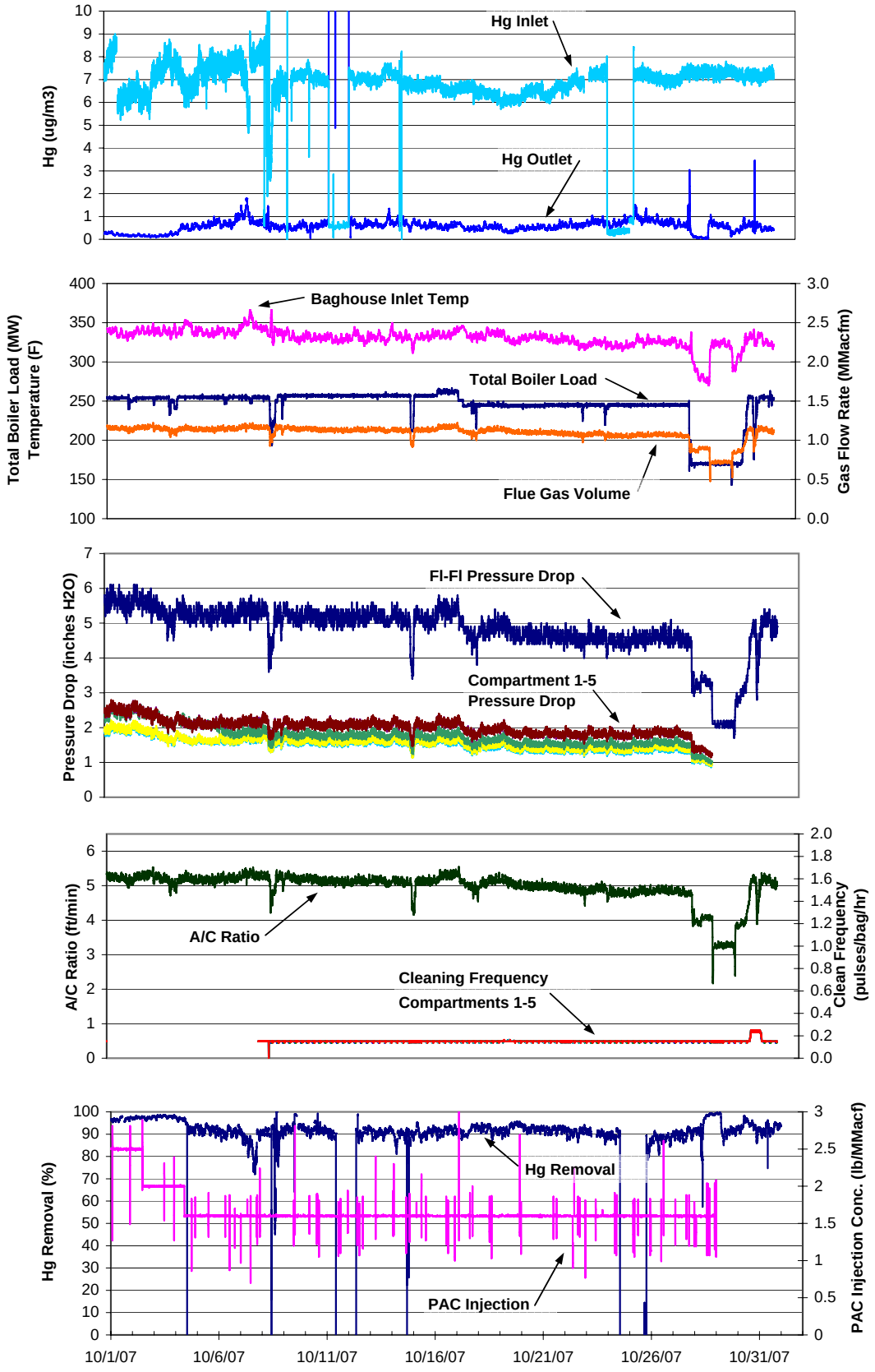

Hg (ug/m3)
Hg Inlet
Hg Outlet
Nitrogen generator installed
New lamp and mirror installed, solar blind filter removed
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Compartment 1-5 Pressure Drop
Fl-Fl Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
5/1/07
5/6/07
5/11/07
5/16/07
5/21/07
5/26/07
5/31/07

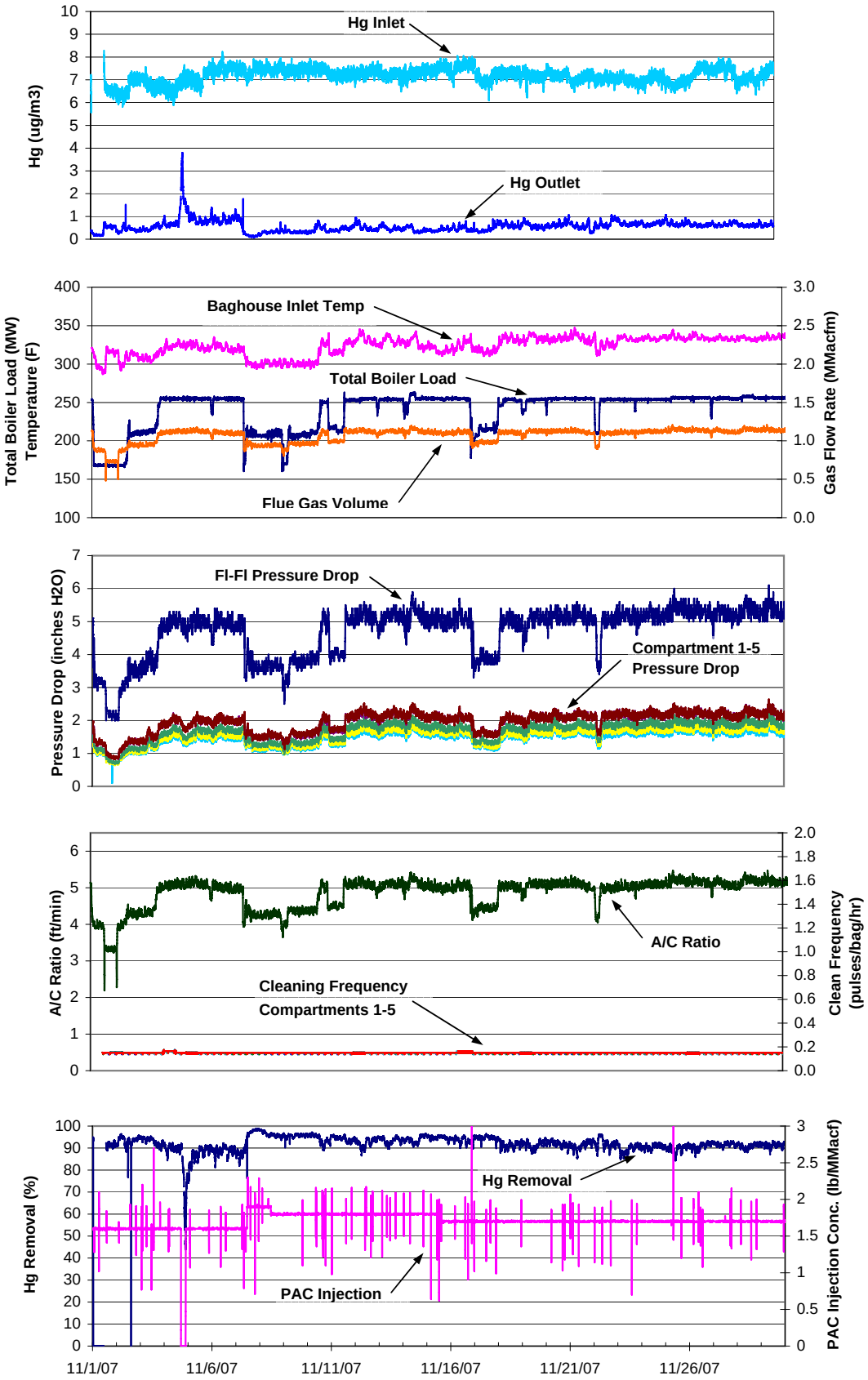

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
6/1/07
6/9/07
6/17/07
6/25/07

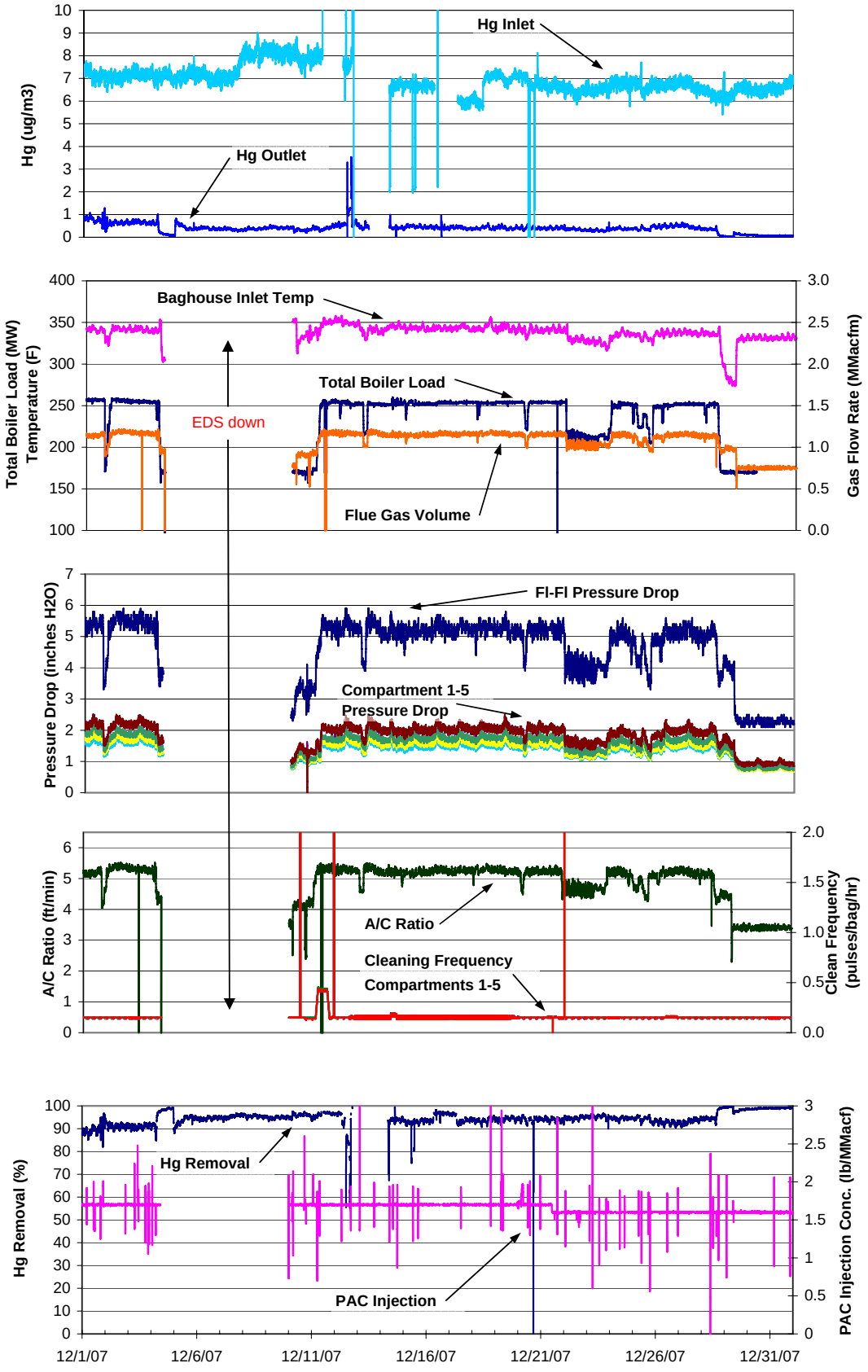

Hg (ug/m3)
Sorbent Screening tests using Unit 8 probe and IRM analyzer
Hg Inlet
Hg Outlet
Switched from Unit 7 Probe to Unit 8 Probe
Switched from Unit 9 Probe to Unit 7 Probe
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5 Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
7/1/07
7/9/07
7/17/07
7/25/07

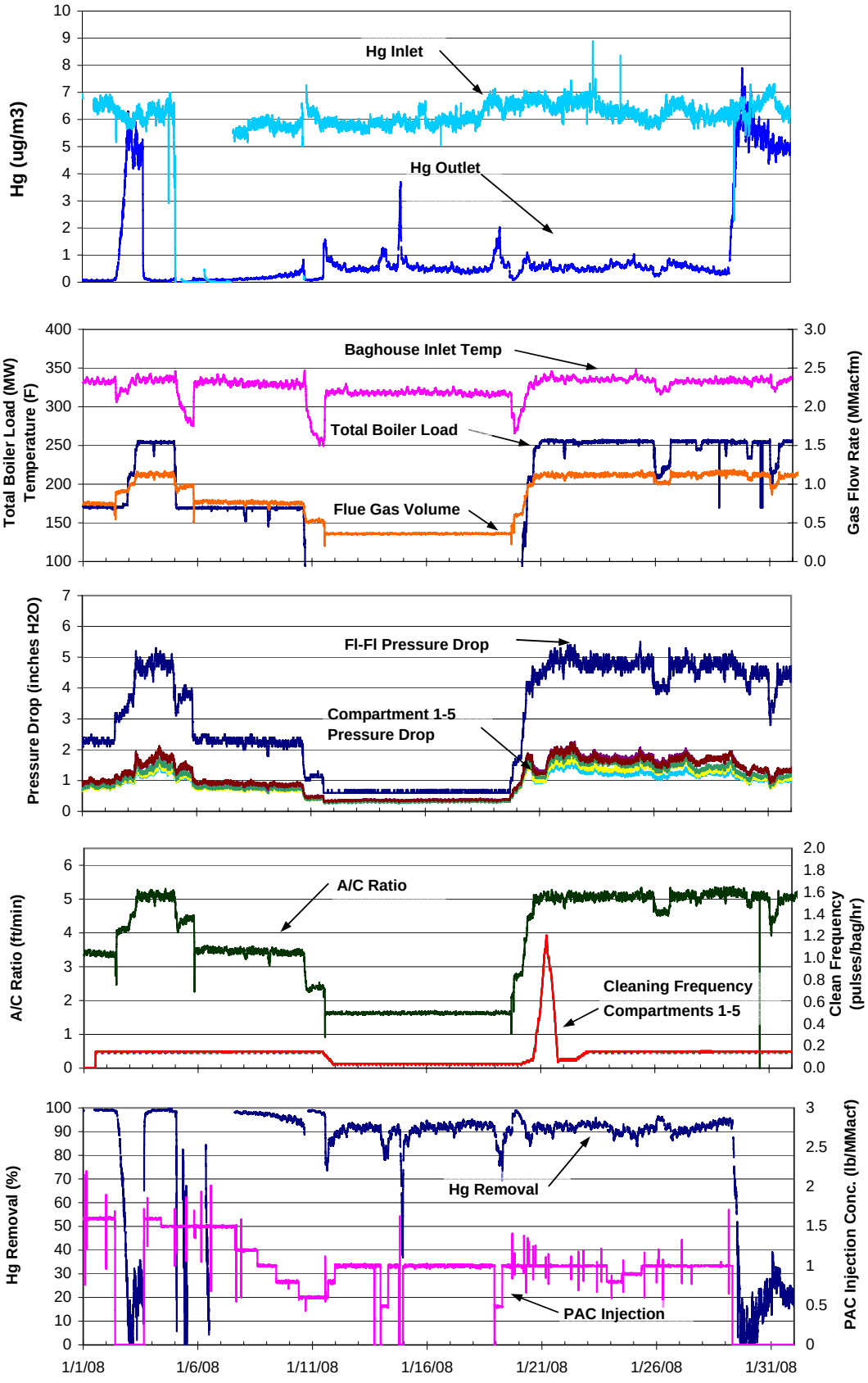

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Gas Flow Rate (MMacfm)
No Data Due to EDS
Being Down
Pressure Drop (inches H2O)
FI-FI Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Cleaning Frequency
Compartments 1-5
A/C Ratio
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc. (lb/MMacf)
8/1/07
8/6/07
8/11/07
8/16/07
8/21/07
8/26/07
8/31/07

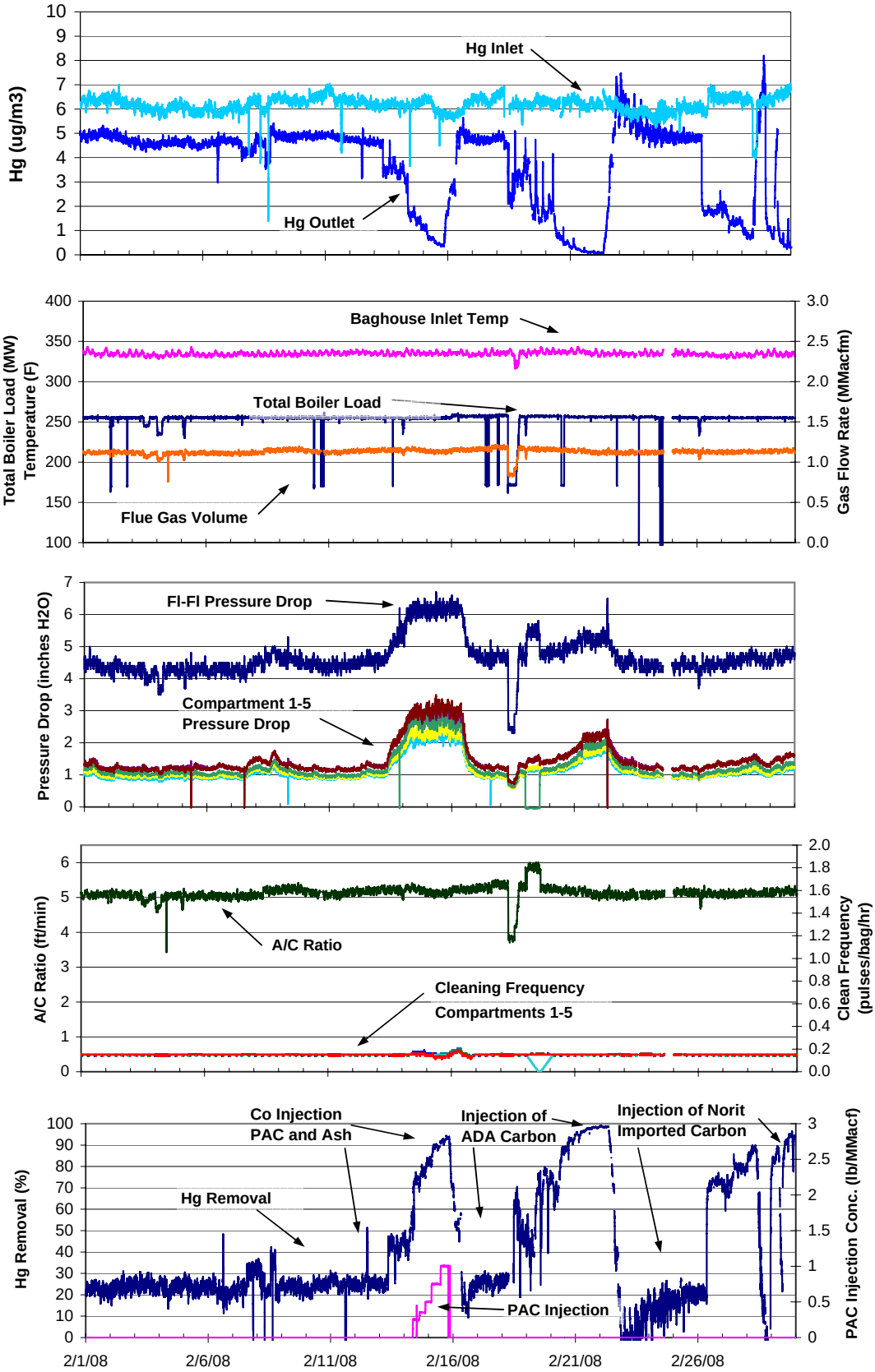

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
9/1/07
9/6/07
9/11/07
9/16/07
9/21/07
9/26/07

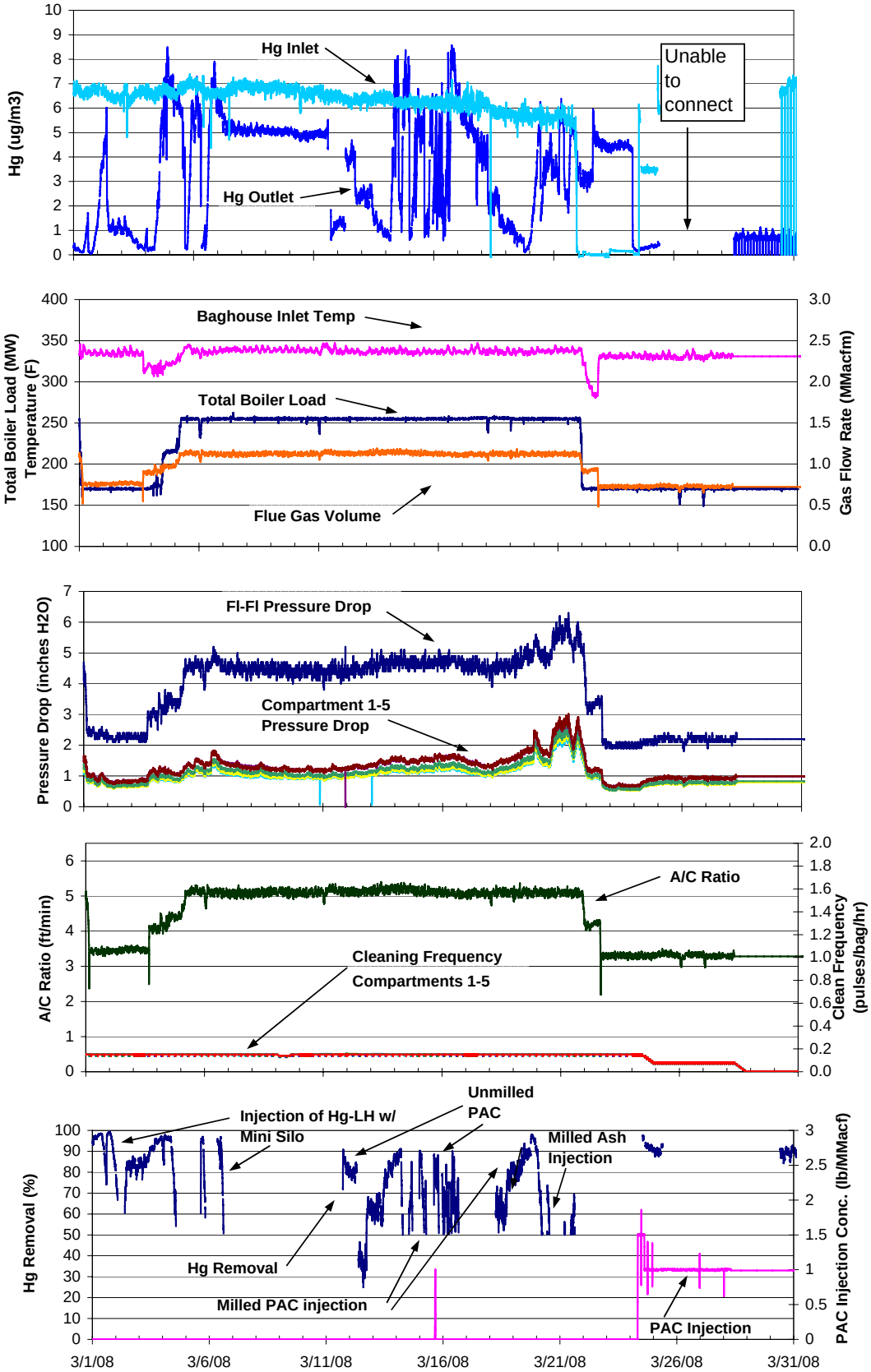

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
10/1/07
10/6/07
10/11/07
10/16/07
10/21/07
10/26/07
10/31/07

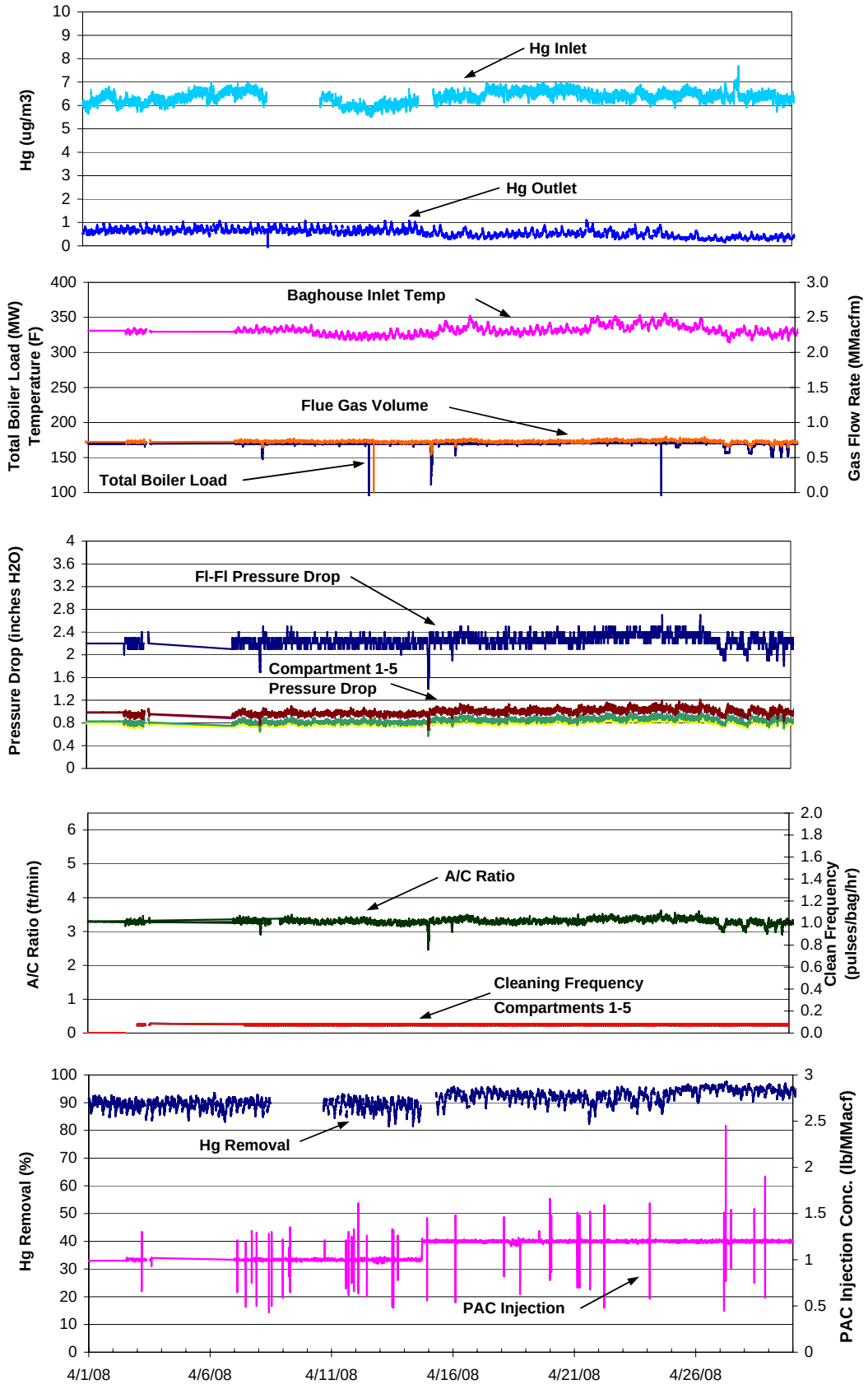

Hg Inlet
Hg Outlet
Hg (ug/m3)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
Pressure Drop (inches H2O)
A/C Ratio
Cleaning Frequency
Compartments 1-5
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
Hg Removal
PAC Injection
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
11/1/07
11/6/07
11/11/07
11/16/07
11/21/07
11/26/07

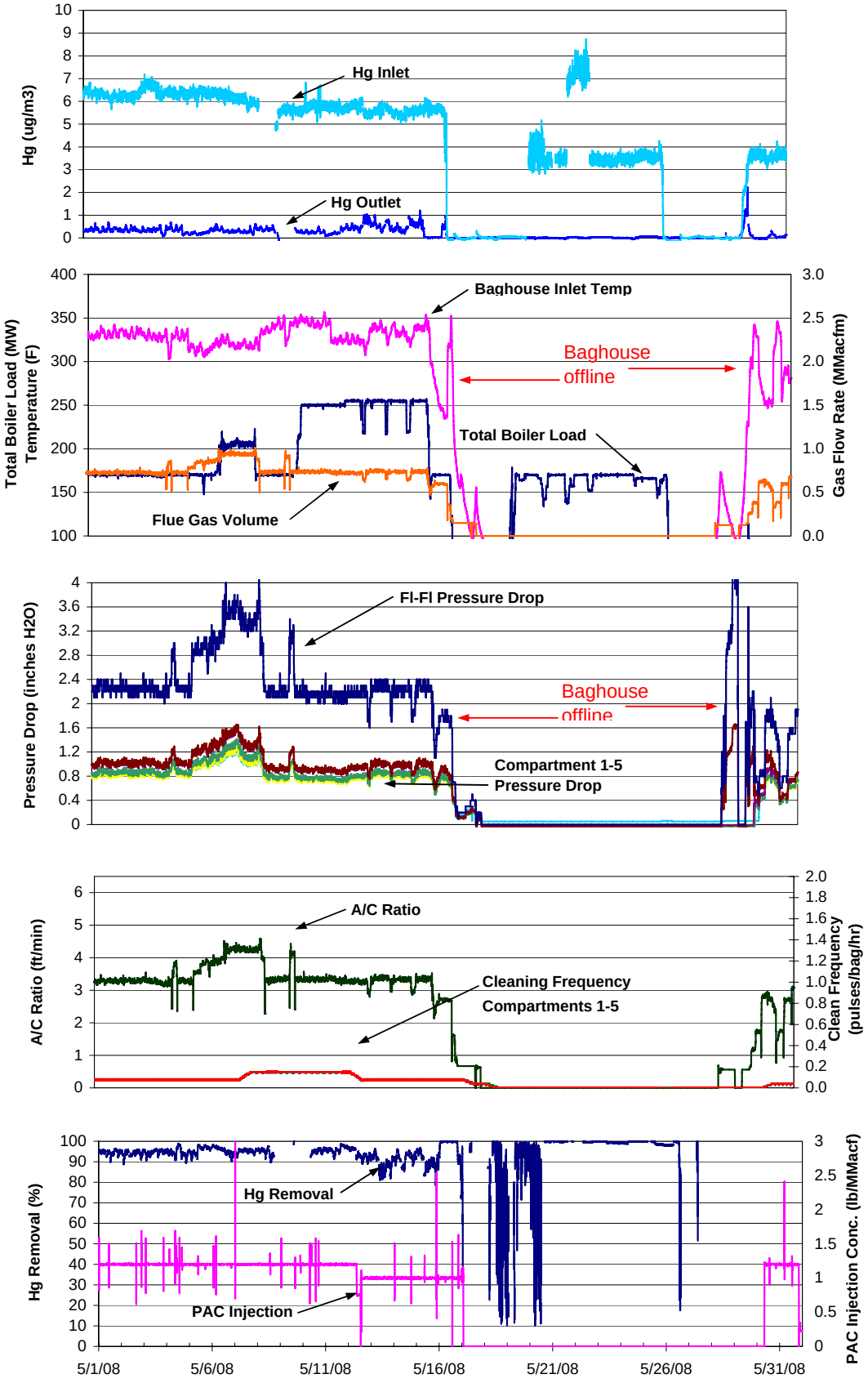

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
EDS down
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
12/1/07
12/6/07
12/11/07
12/16/07
12/21/07
12/26/07
12/31/07

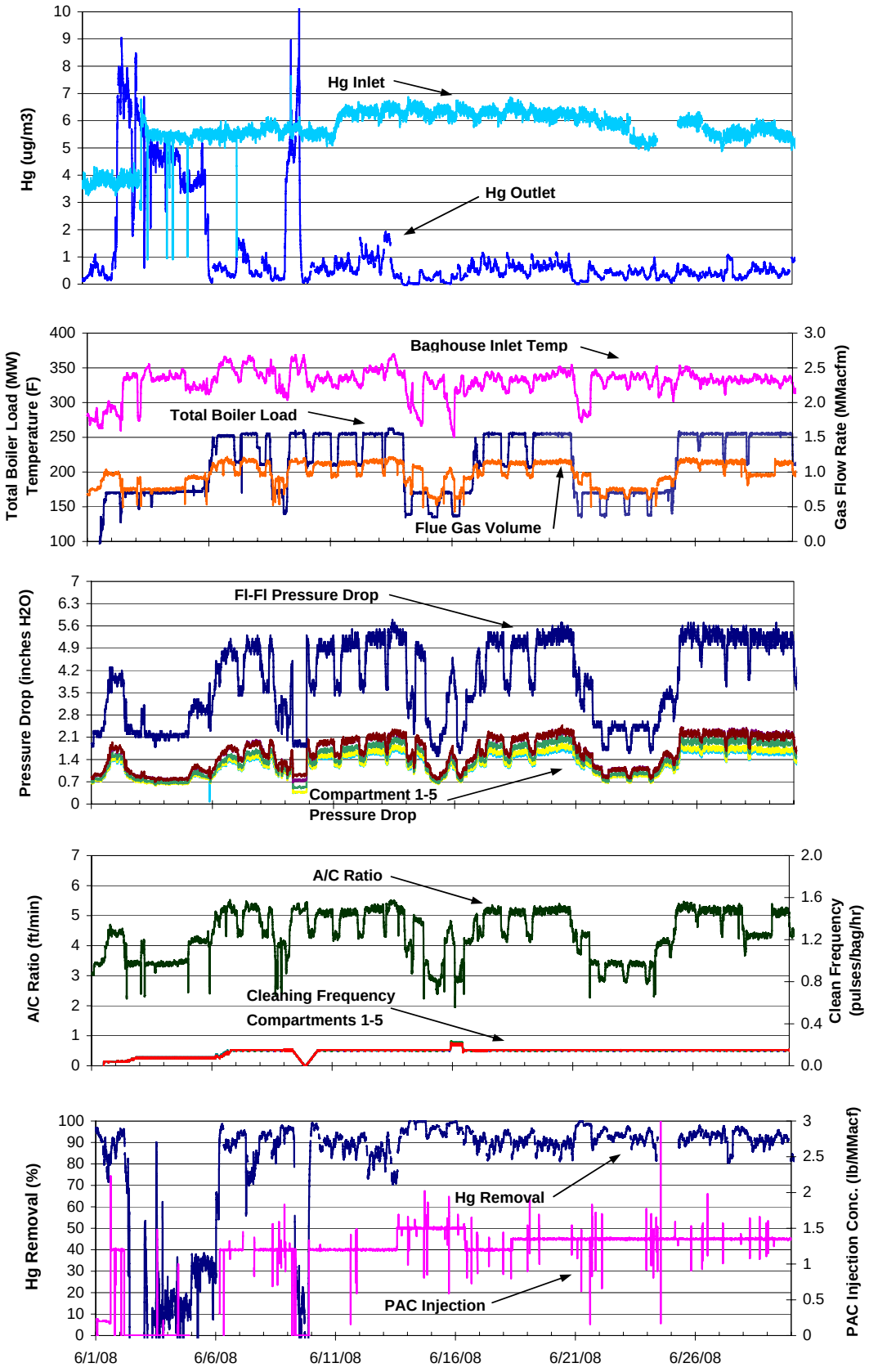

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Clean Frequency
(pulses/bag/hr)
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
Hg Removal
PAC Injection Conc. (lb/MMacf)
PAC Injection
1/1/08
1/6/08
1/11/08
1/16/08
1/21/08
1/26/08
1/31/08

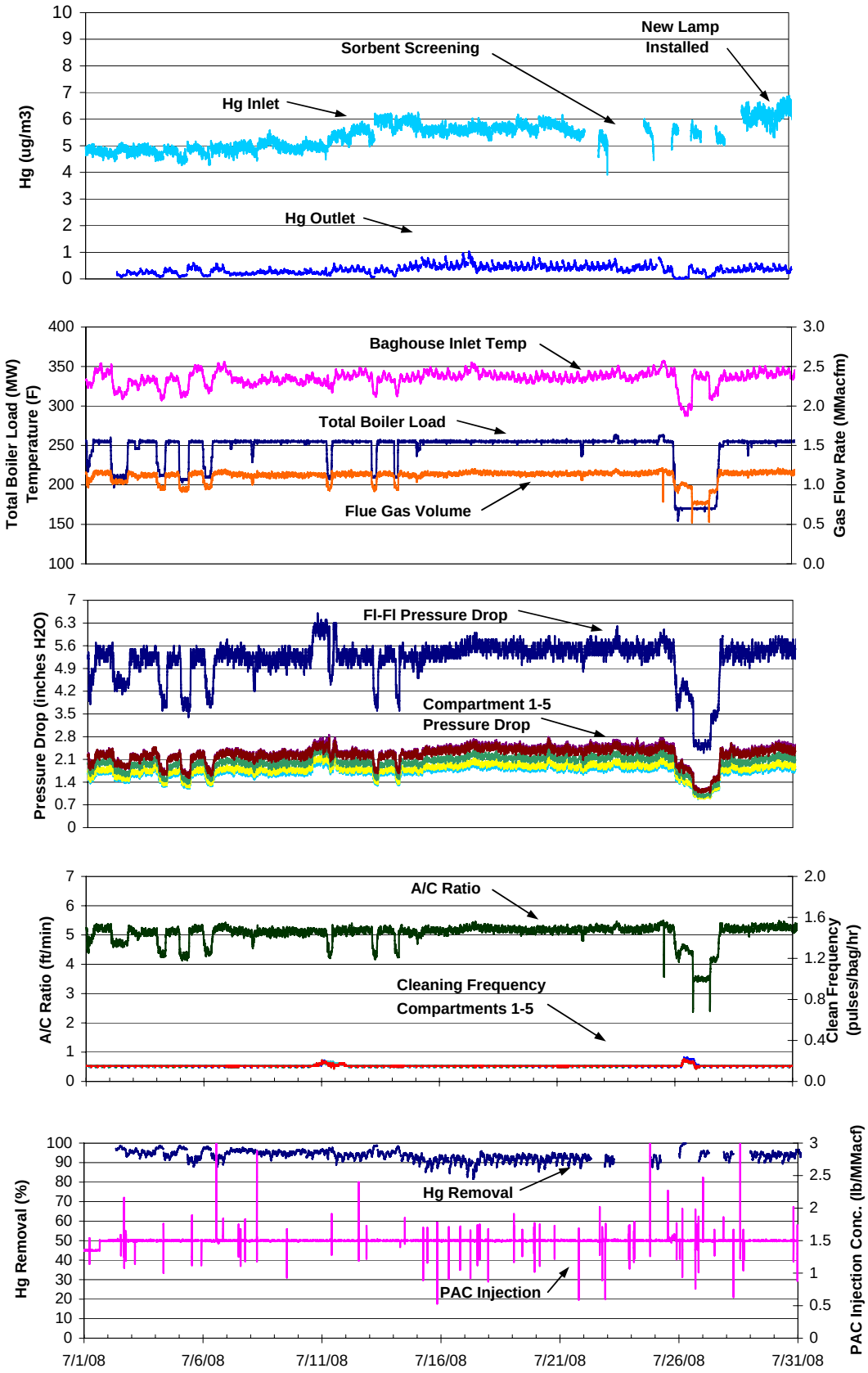

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Co Injection
PAC and Ash
Injection of
ADA Carbon
Injection of Norit
Imported Carbon
Hg Removal
PAC Injection
2/1/08
2/6/08
2/11/08
2/16/08
2/21/08
2/26/08

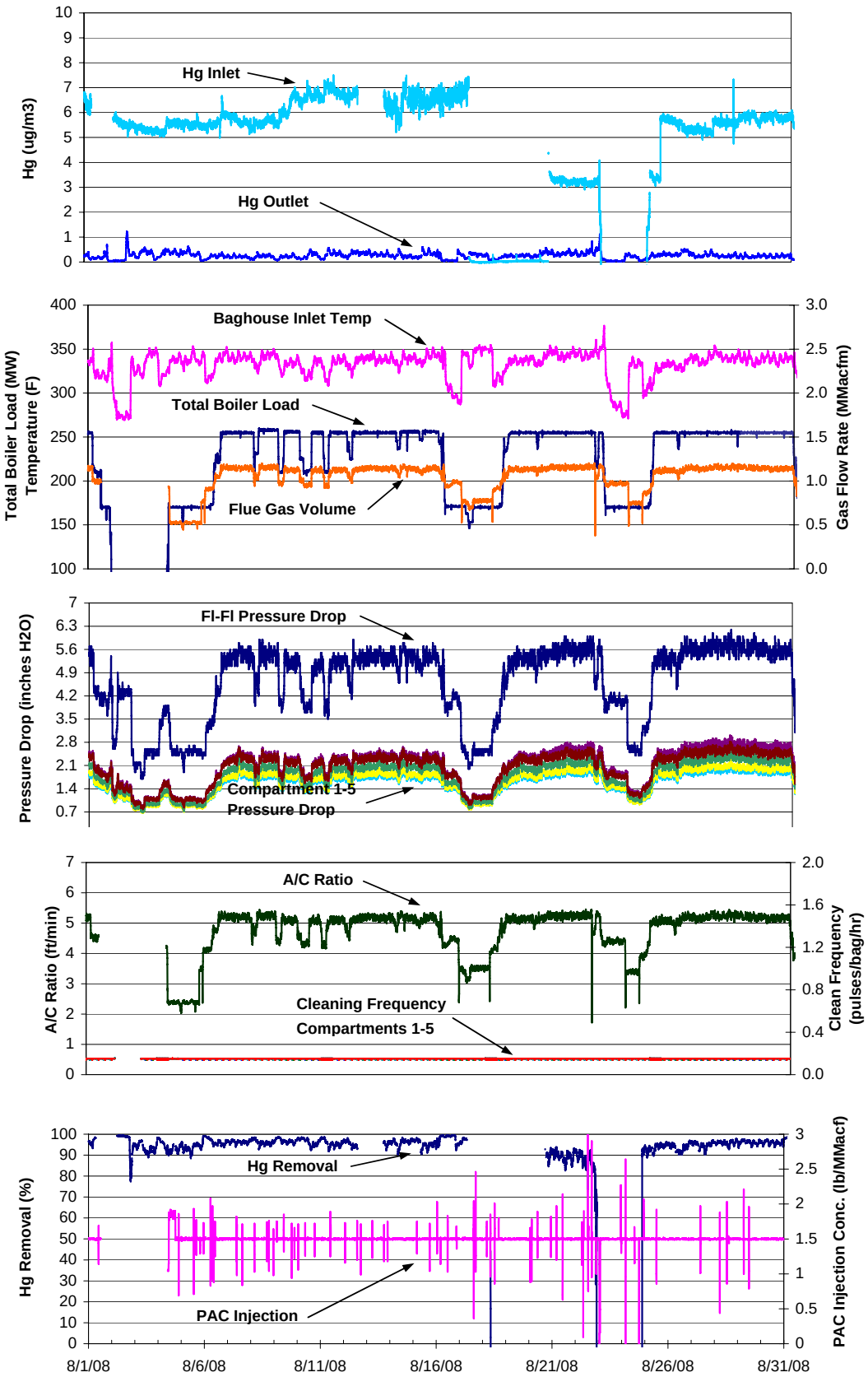

Hg (ug/m3)
Hg Inlet
Hg Outlet
Unable to connect
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5 Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Injection of Hg-LH w/ Mini Silo
Unmilled PAC
Milled Ash Injection
Hg Removal
Milled PAC injection
PAC Injection
3/1/08
3/6/08
3/11/08
3/16/08
3/21/08
3/26/08
3/31/08

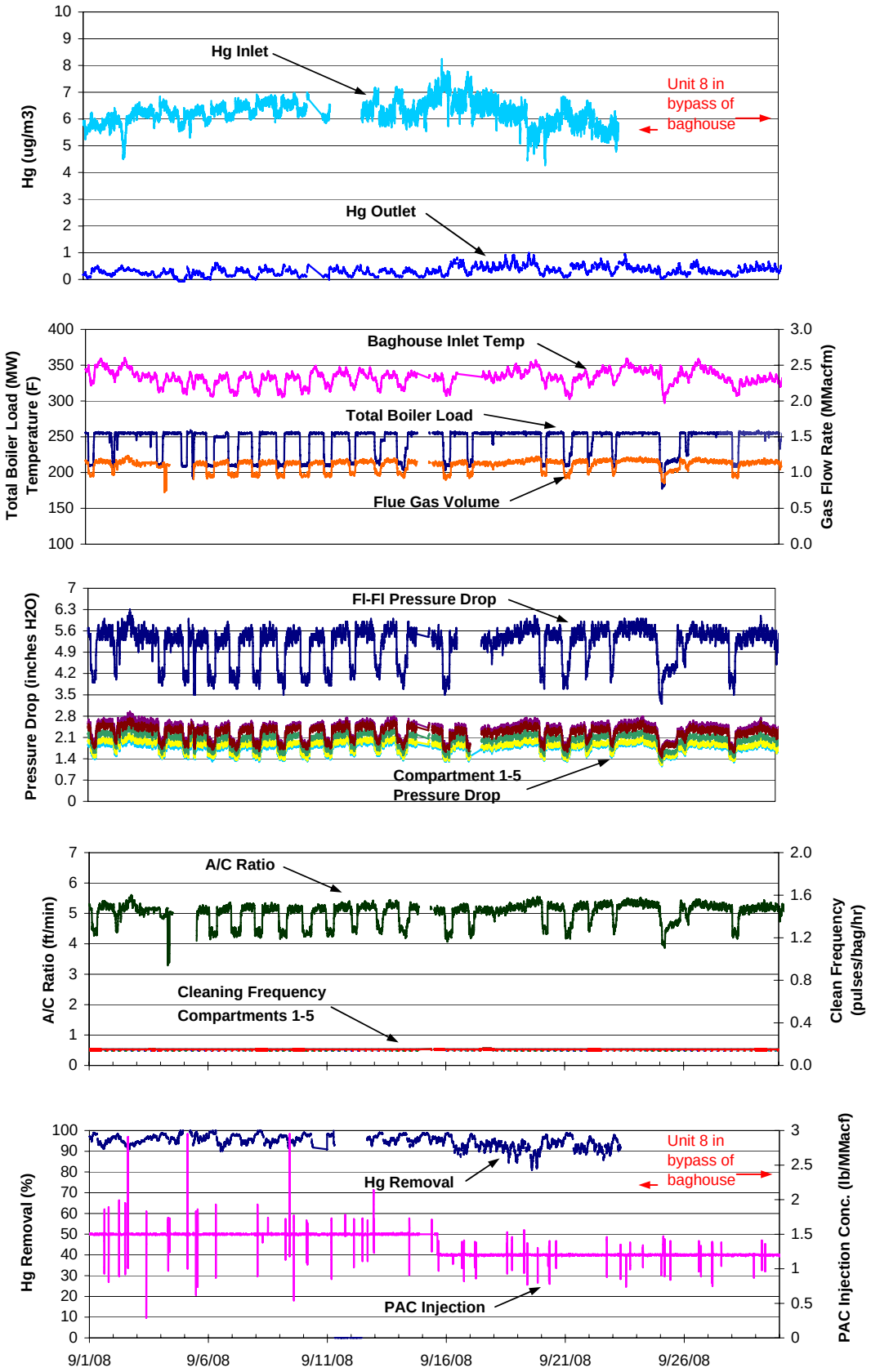

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Flue Gas Volume
Total Boiler Load
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
4/1/08
4/6/08
4/11/08
4/16/08
4/21/08
4/26/08

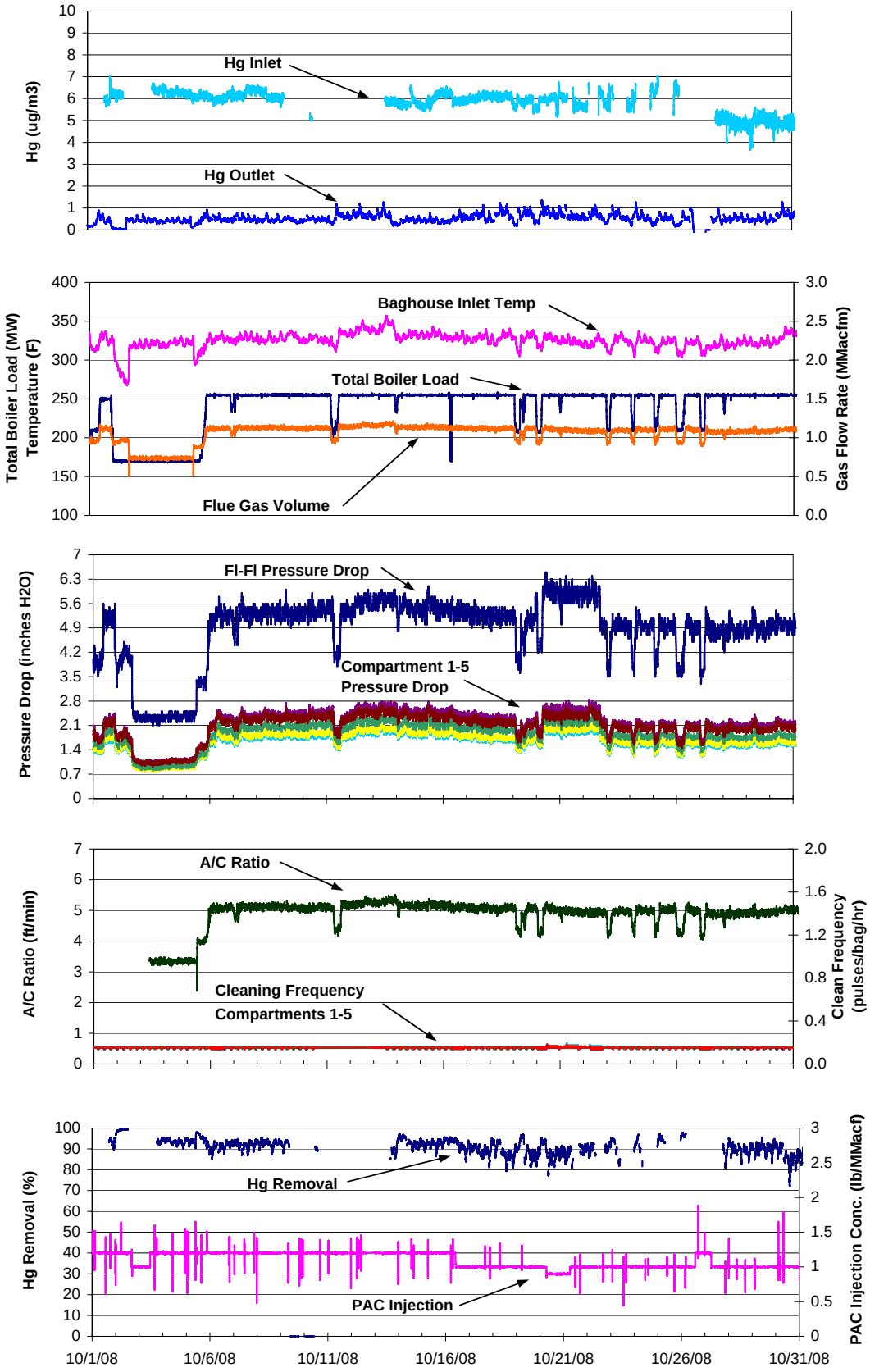

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Baghouse
offline
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Baghouse
offline
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
5/1/08
5/6/08
5/11/08
5/16/08
5/21/08
5/26/08
5/31/08

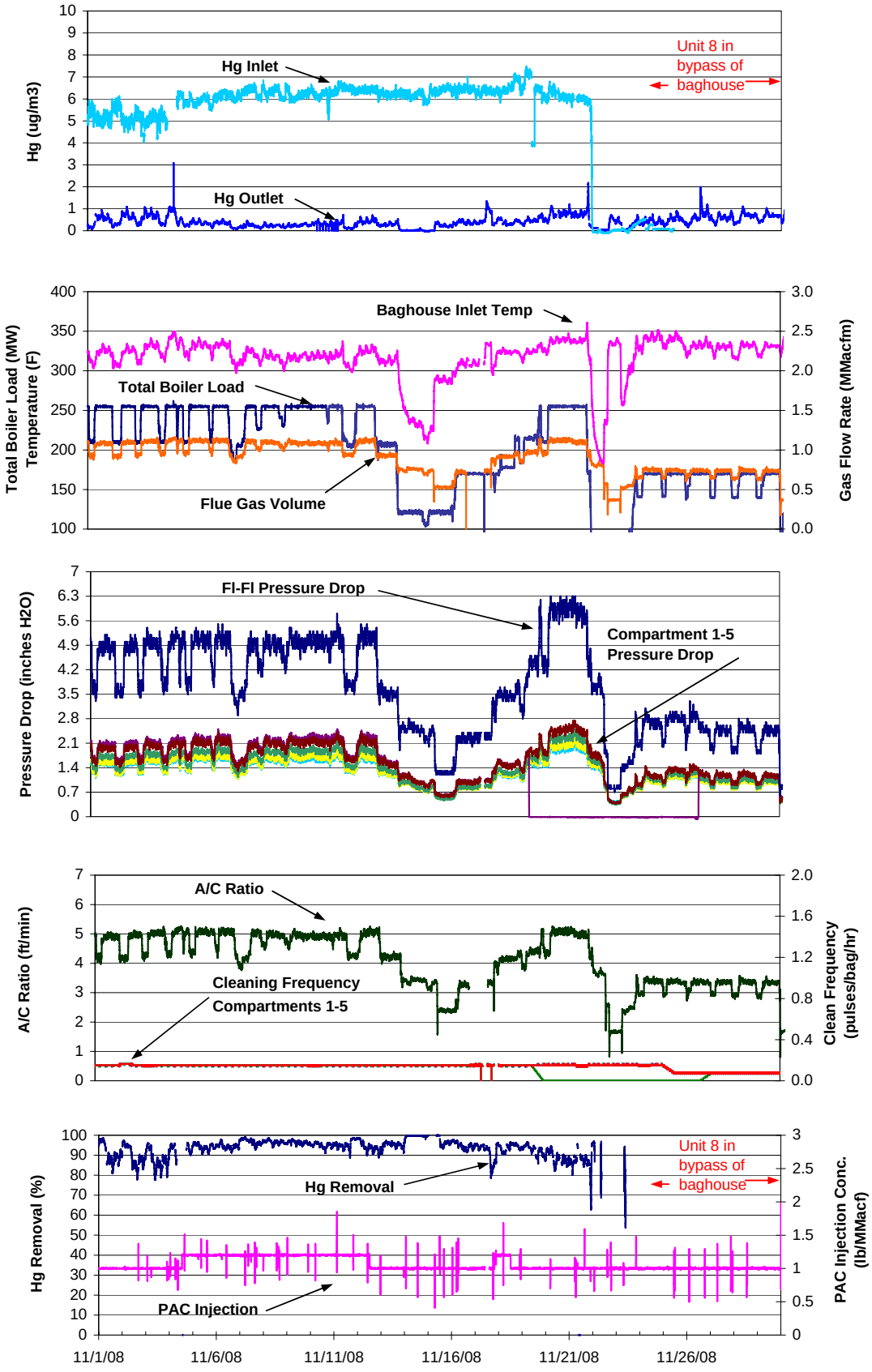

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc. (lb/MMacf)
6/1/08
6/6/08
6/11/08
6/16/08
6/21/08
6/26/08

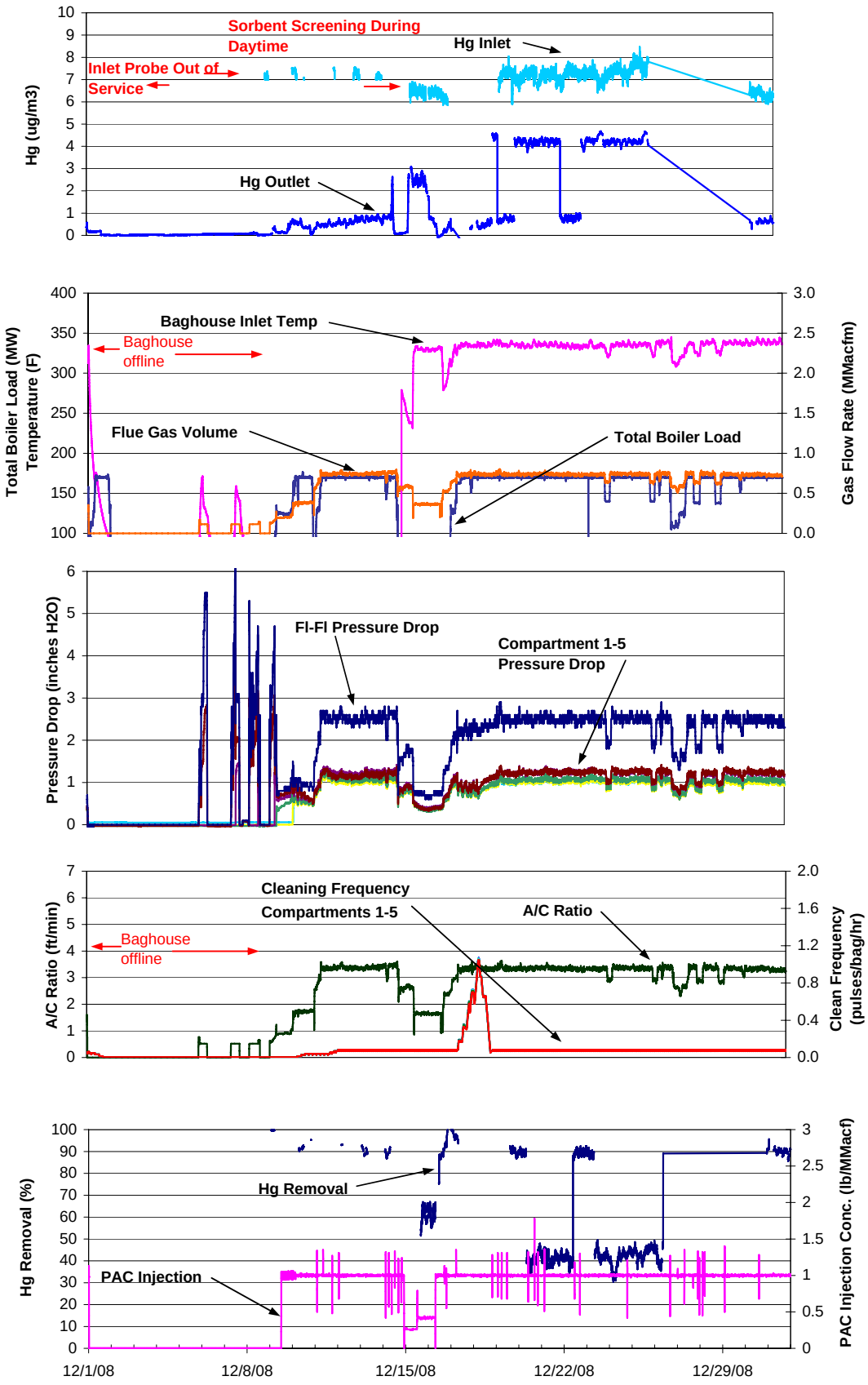

Hg (ug/m3)
Sorbent Screening
New Lamp Installed
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5 Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
7/1/08
7/6/08
7/11/08
7/16/08
7/21/08
7/26/08
7/31/08

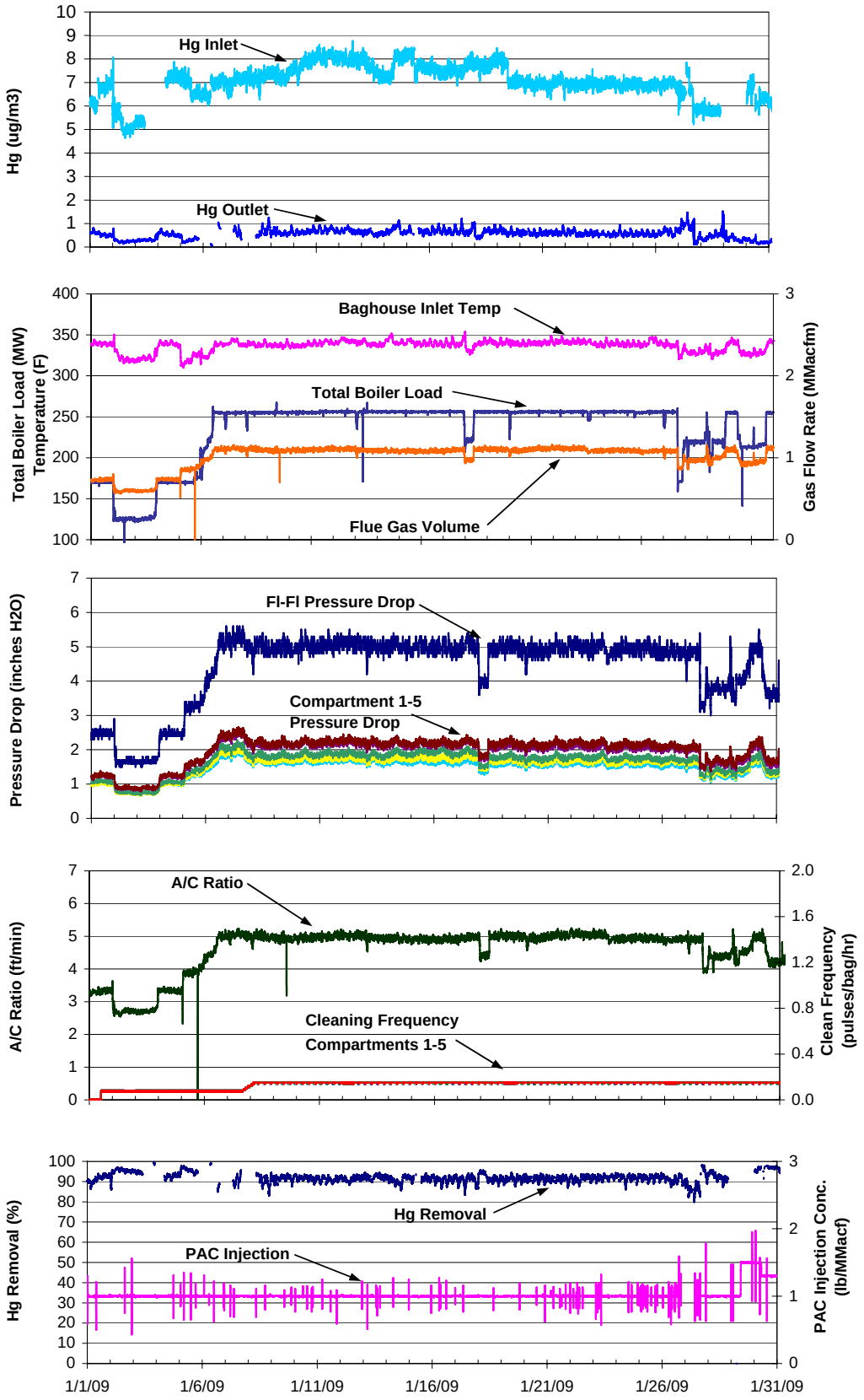

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
8/1/08
8/6/08
8/11/08
8/16/08
8/21/08
8/26/08
8/31/08

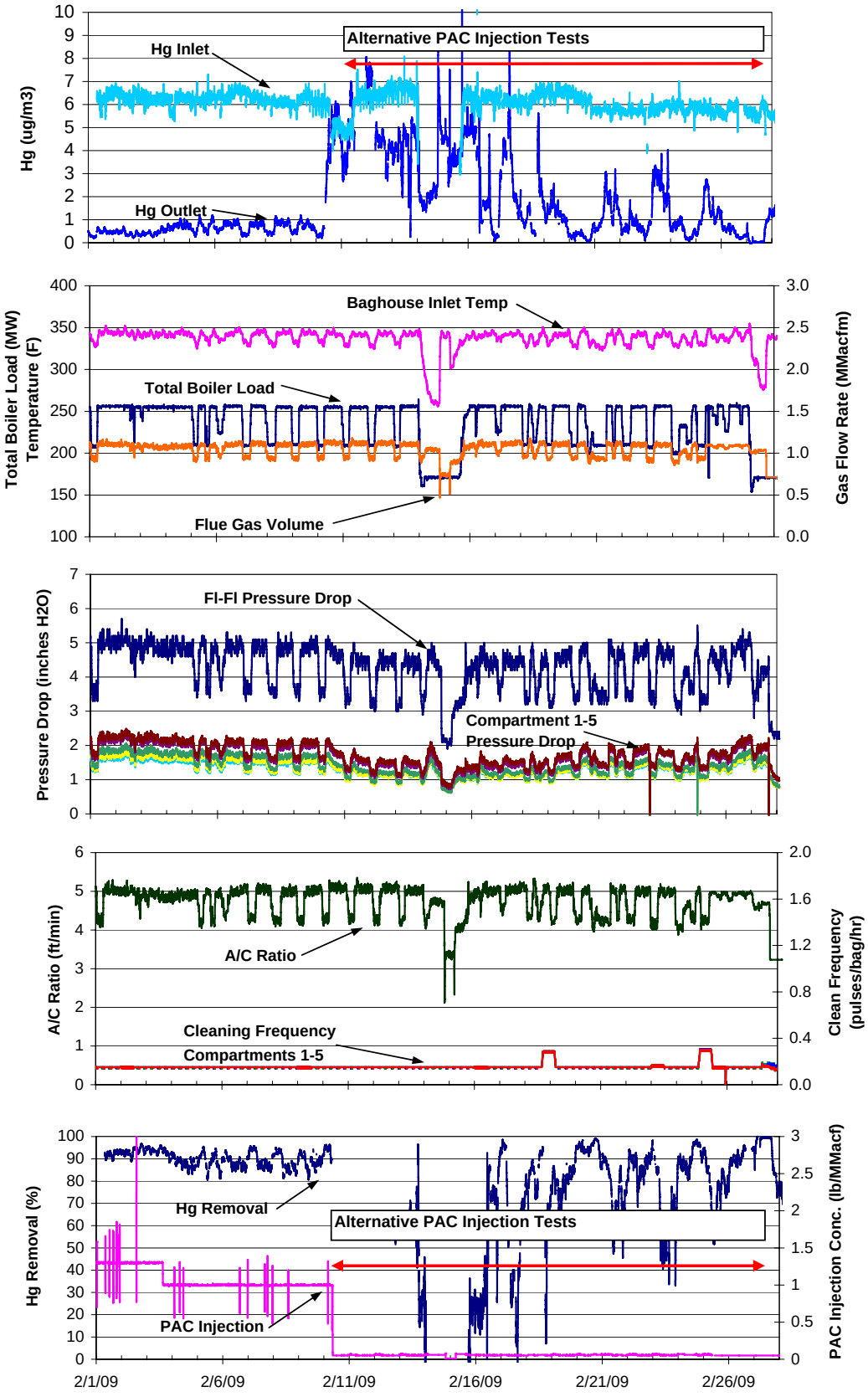

Hg (ug/m3)
Hg Inlet
Hg Outlet
Unit 8 in bypass of baghouse
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5 Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
9/1/08
9/6/08
9/11/08
9/16/08
9/21/08
9/26/08

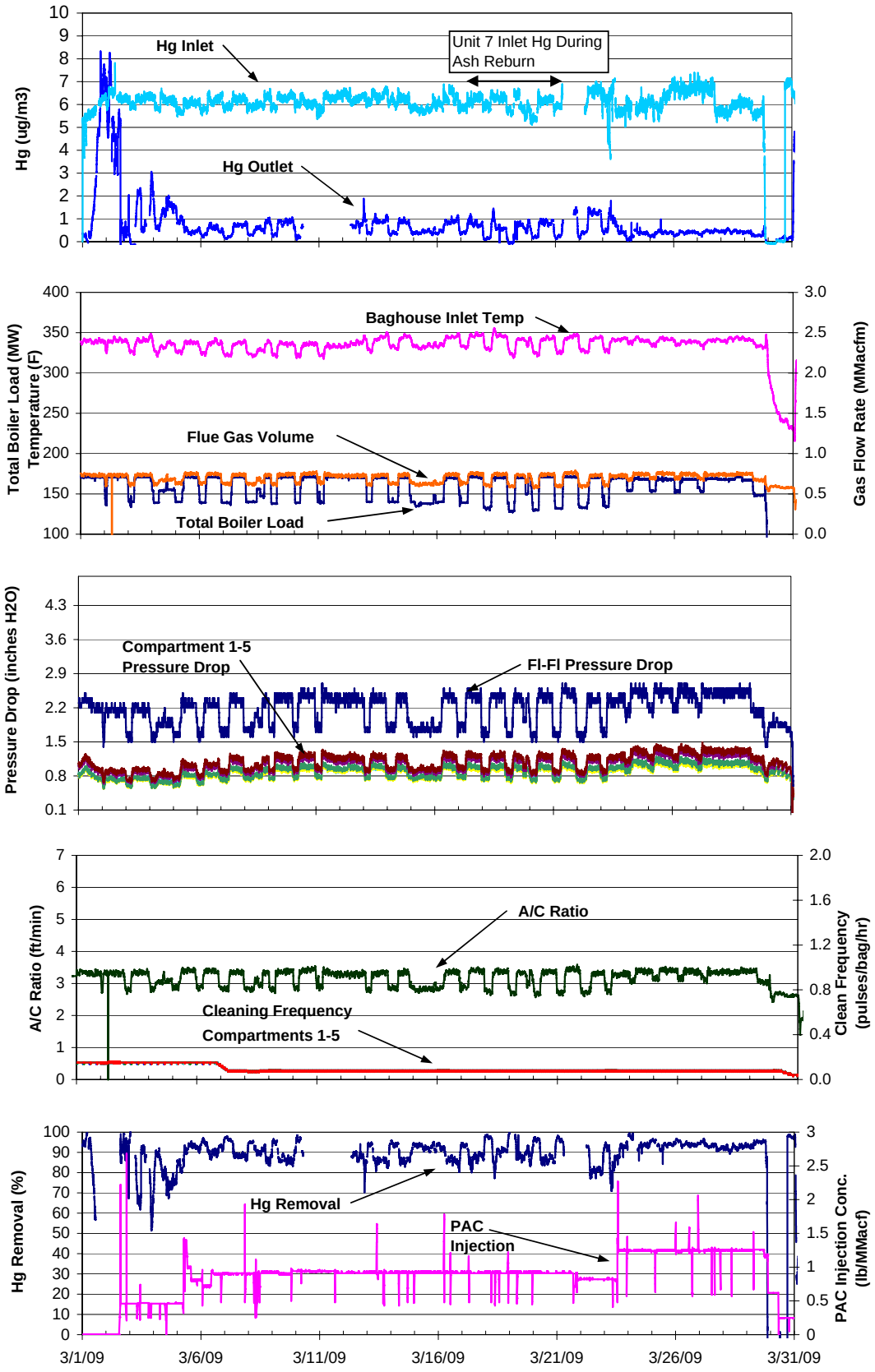

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
10/1/08
10/6/08
10/11/08
10/16/08
10/21/08
10/26/08
10/31/08

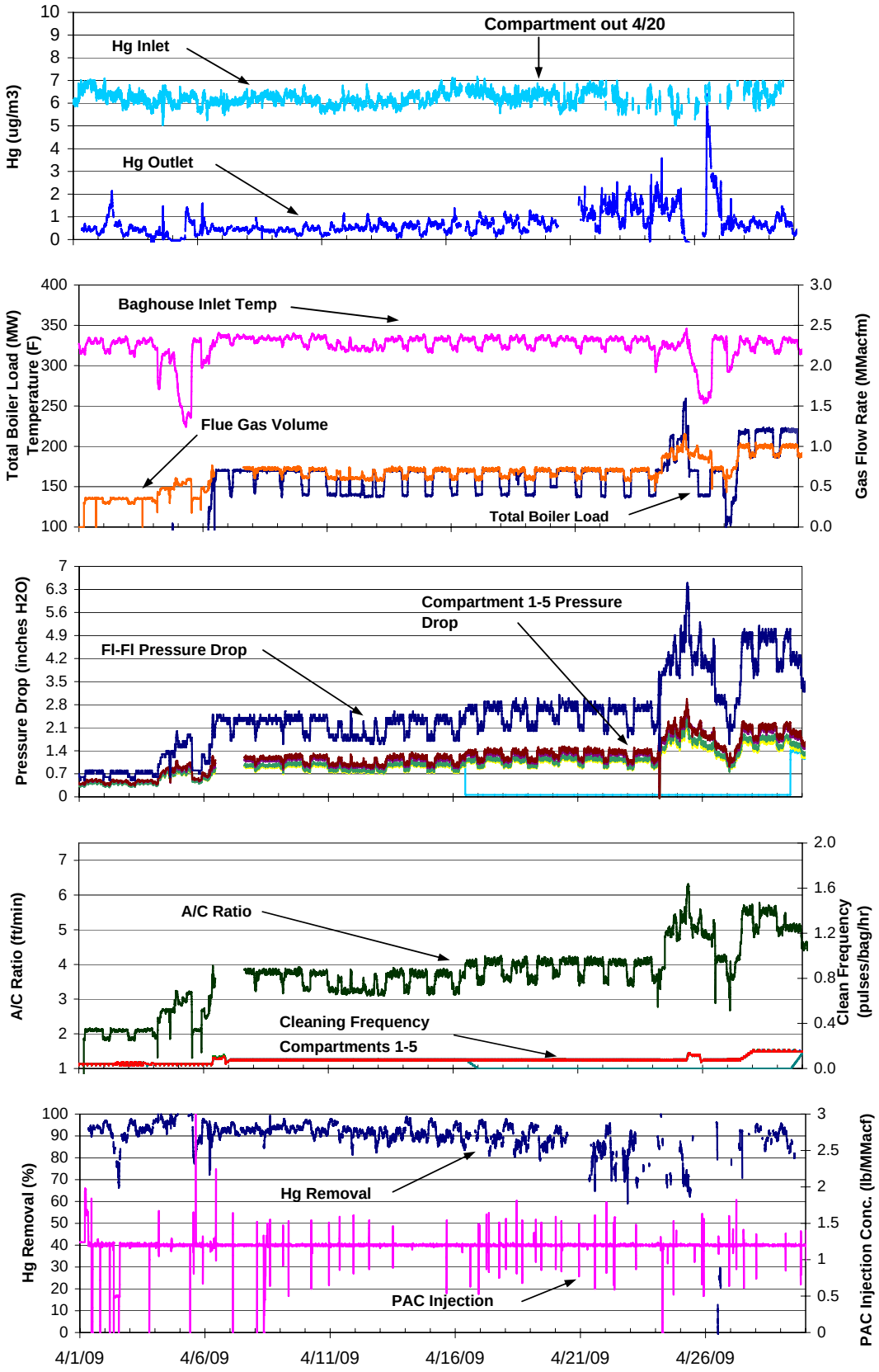

Hg (ug/m3)
Hg Inlet
Hg Outlet
Unit 8 in bypass of baghouse
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5 Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
Unit 8 in bypass of baghouse
11/1/08
11/6/08
11/11/08
11/16/08
11/21/08
11/26/08

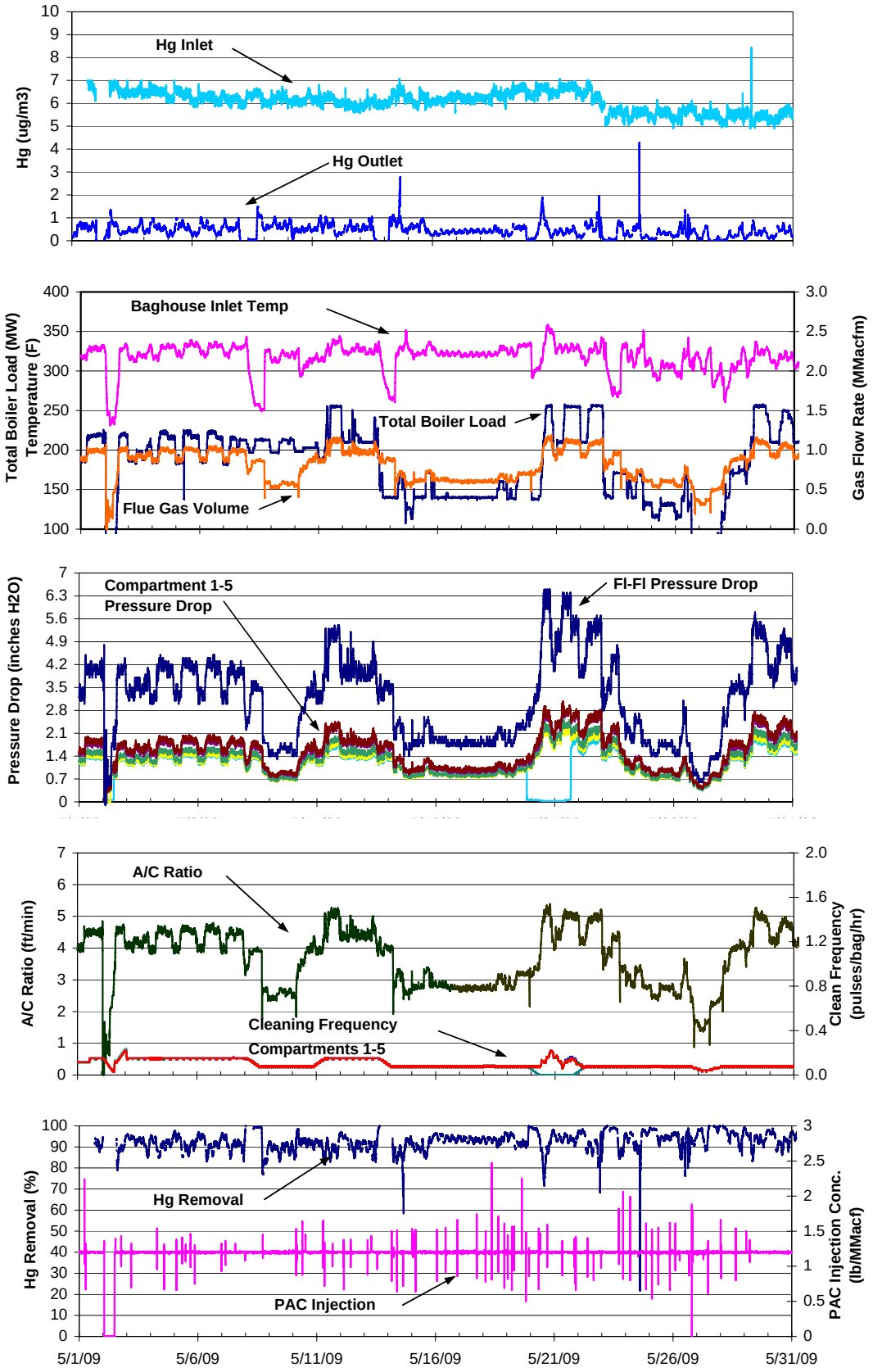

Hg (ug/m3)
Sorbent Screening During Daytime
Hg Inlet
Inlet Probe Out of Service
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Baghouse offline
Flue Gas Volume
Total Boiler Load
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5 Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
Cleaning Frequency Compartments 1-5
A/C Ratio
Baghouse offline
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
12/1/08
12/8/08
12/15/08
12/22/08
12/29/08

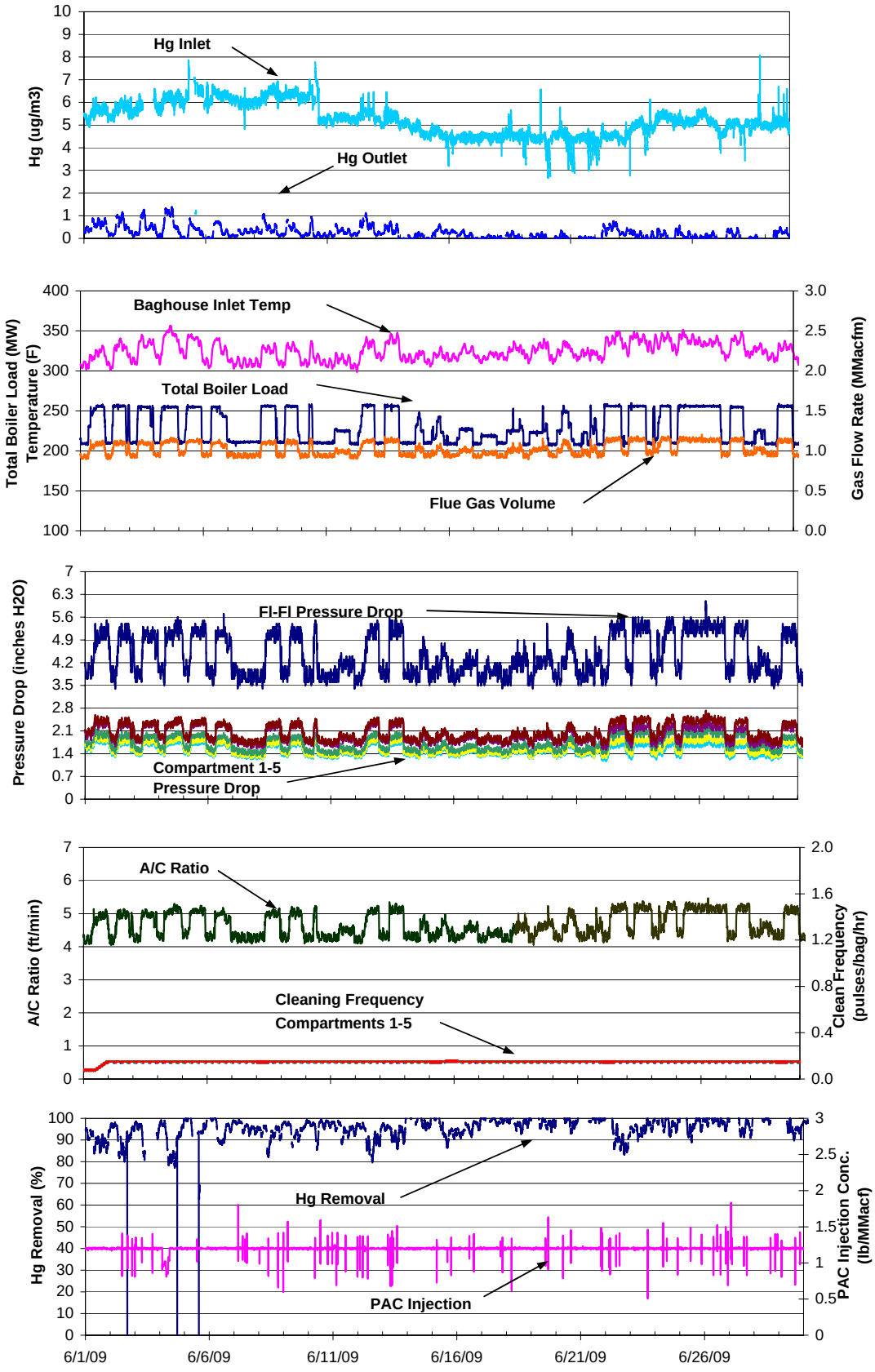

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc.
(lb/MMacf)
1/1/09
1/6/09
1/11/09
1/16/09
1/21/09
1/26/09
1/31/09

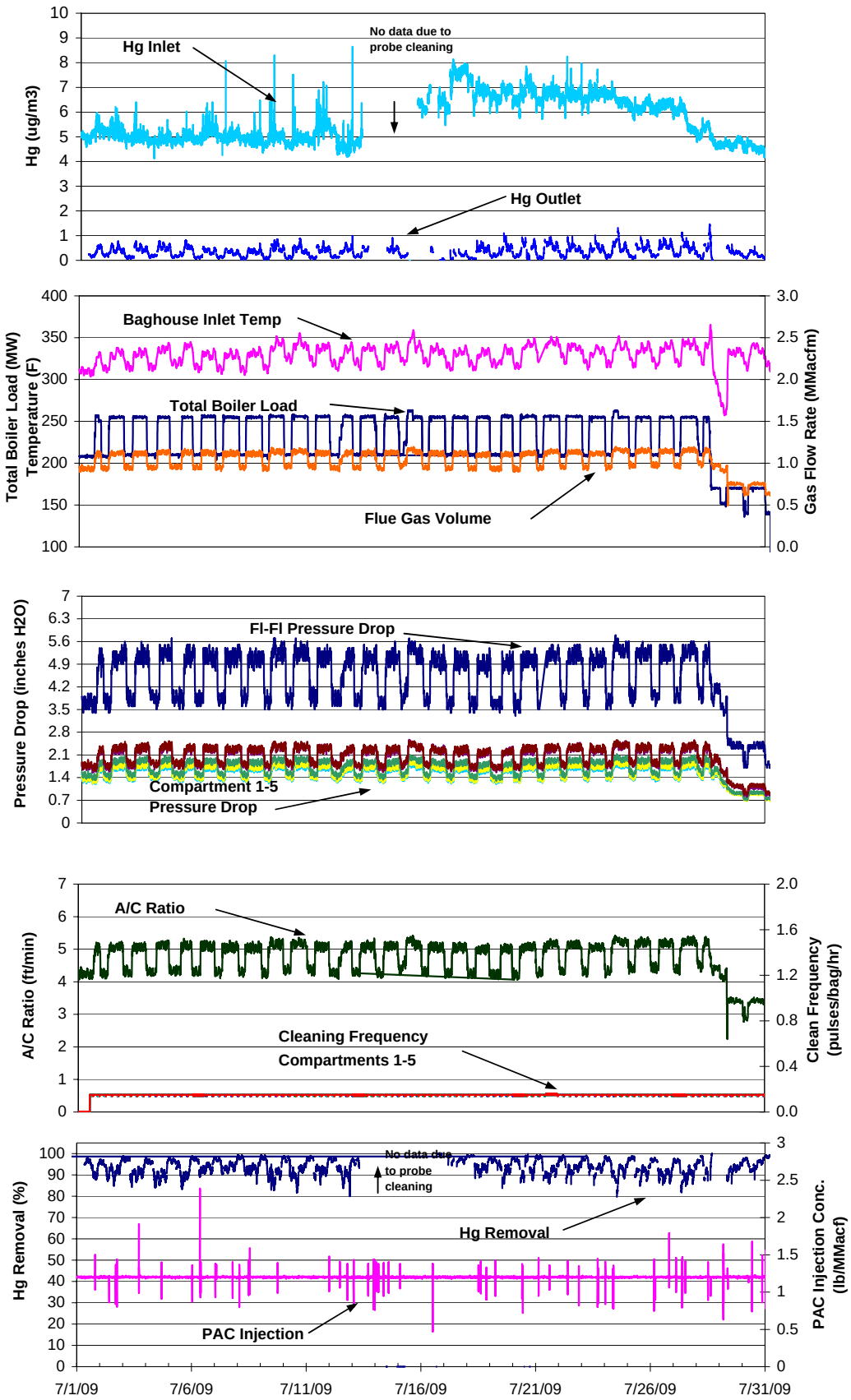

Hg (ug/m3)
Hg Inlet
Hg Outlet
Alternative PAC Injection Tests
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
Alternative PAC Injection Tests
PAC Injection
2/1/09
2/6/09
2/11/09
2/16/09
2/21/09
2/26/09

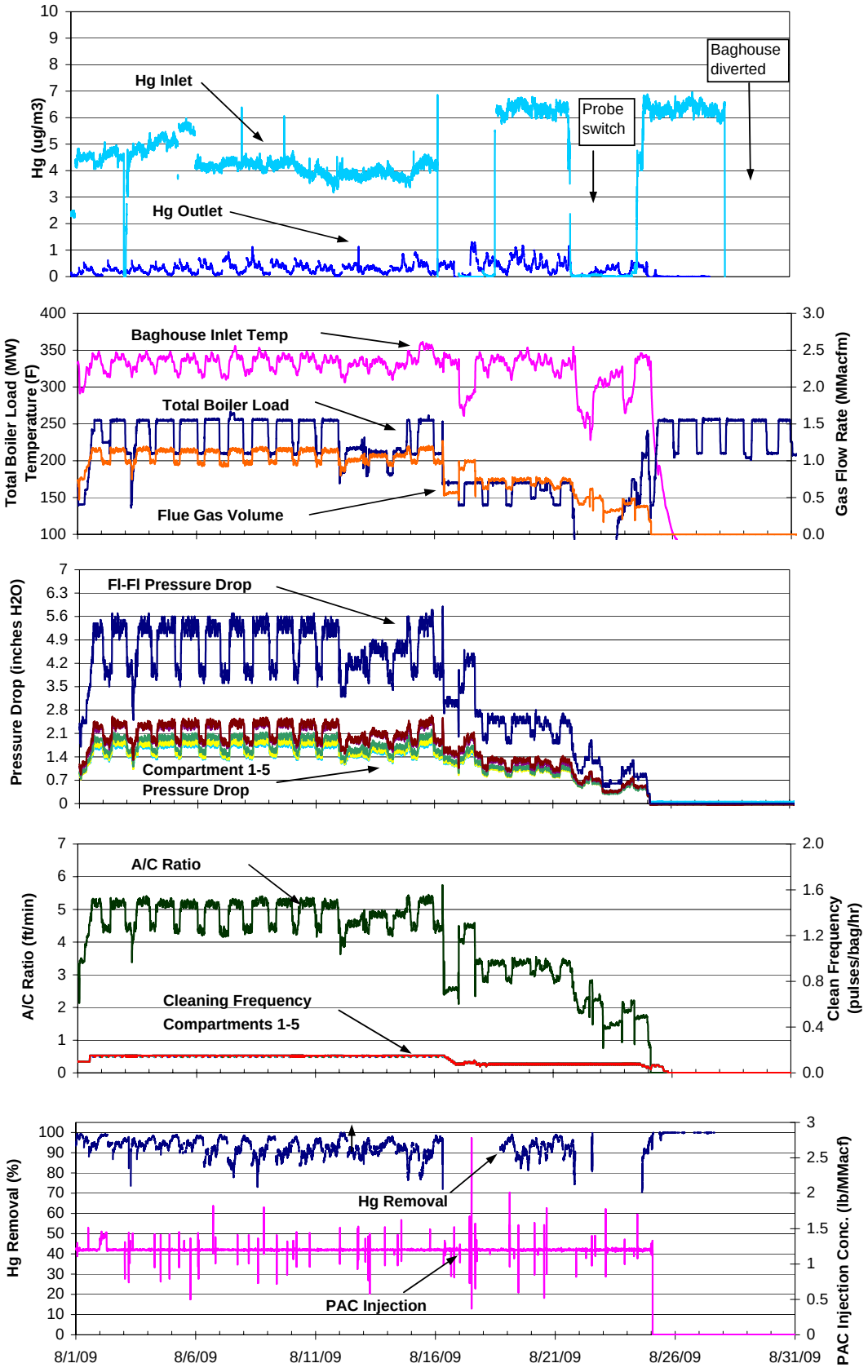

Hg (ug/m3)
Hg Inlet
Unit 7 Inlet Hg During Ash Reburn
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Flue Gas Volume
Total Boiler Load
Pressure Drop (inches H2O)
Compartment 1-5 Pressure Drop
Fl-Fl Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
3/1/09
3/6/09
3/11/09
3/16/09
3/21/09
3/26/09
3/31/09

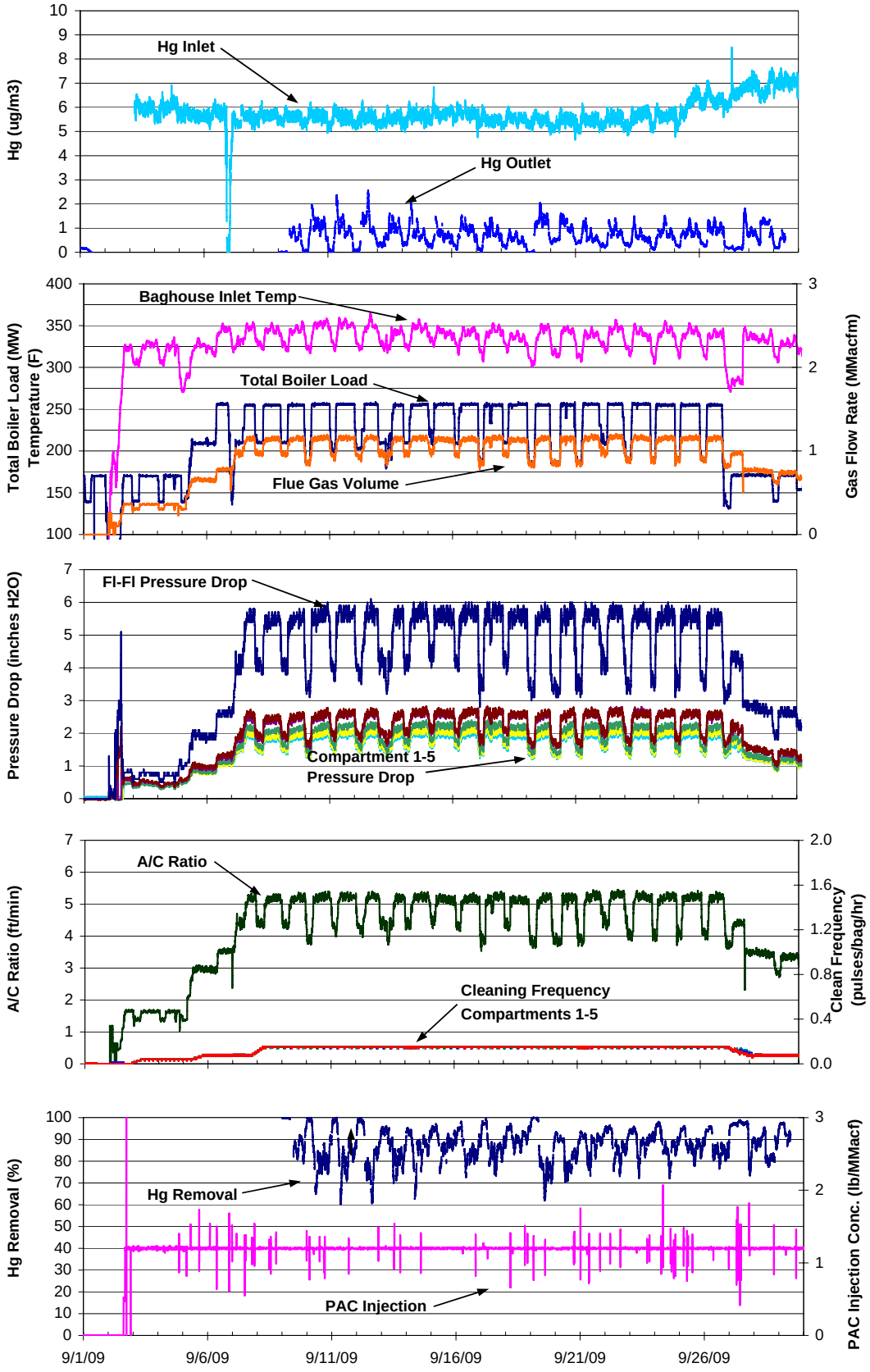

Hg (ug/m3)
Compartment out 4/20
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Baghouse Inlet Temp
Flue Gas Volume
Total Boiler Load
Gas Flow Rate (MMacfm)
Pressure Drop (inches H2O)
Compartment 1-5 Pressure Drop
Fl-Fl Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency Compartments 1-5
Clean Frequency (pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc. (lb/MMacf)
4/1/09
4/6/09
4/11/09
4/16/09
4/21/09
4/26/09


Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Gas Flow Rate (MMacfm)
Pressure Drop (inches H2O)
Compartment 1-5
Pressure Drop
Fl-Fl Pressure Drop
A/C Ratio (ft/min)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Clean Frequency
(pulses/bag/hr)
Hg Removal (%)
Hg Removal
PAC Injection
PAC Injection Conc.
(lb/MMacf)
5/1/09
5/6/09
5/11/09
5/16/09
5/21/09
5/26/09
5/31/09

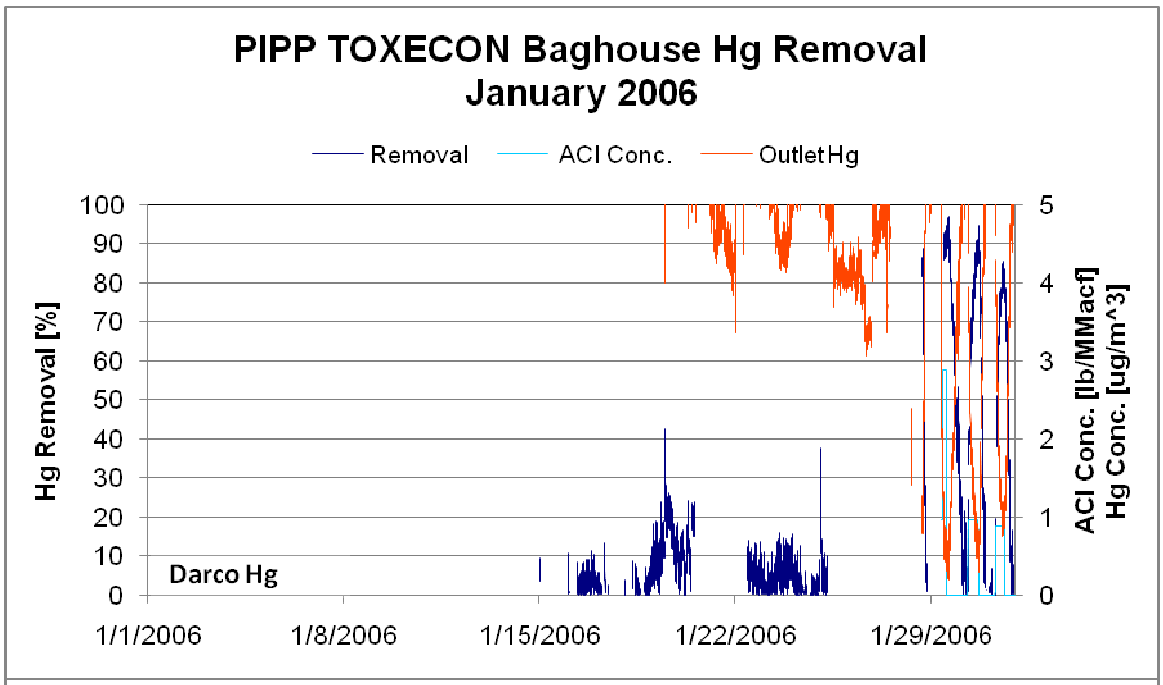

Hg Inlet
Hg Outlet
Hg (ug/m3)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
Pressure Drop (inches H2O)
A/C Ratio
Cleaning Frequency
Compartments 1-5
A/C Ratio (ft/min)
Clean Frequency
(pulses/bag/hr)
Hg Removal
PAC Injection
Hg Removal (%)
PAC Injection Conc.
(lb/MMacf)
6/1/09
6/6/09
6/11/09
6/16/09
6/21/09
6/26/09

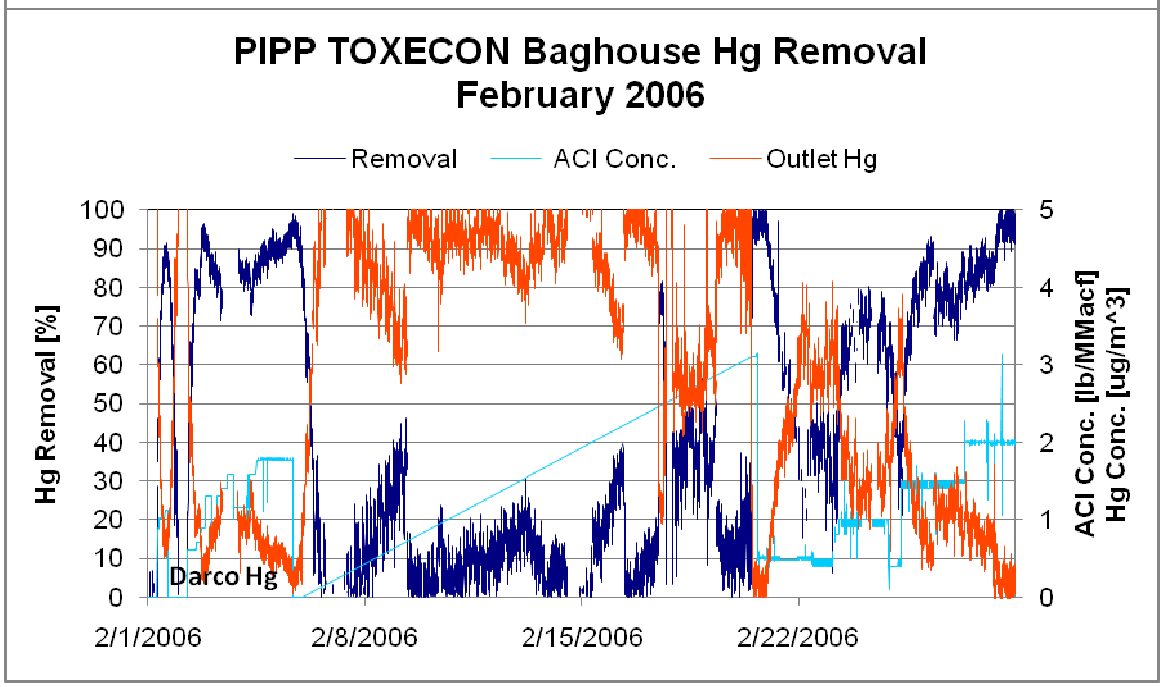

Hg (ug/m3)
Hg Inlet
No data due to probe cleaning
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
No data due to probe cleaning
Hg Removal
PAC Injection
7/1/09
7/6/09
7/11/09
7/16/09
7/21/09
7/26/09
7/31/09

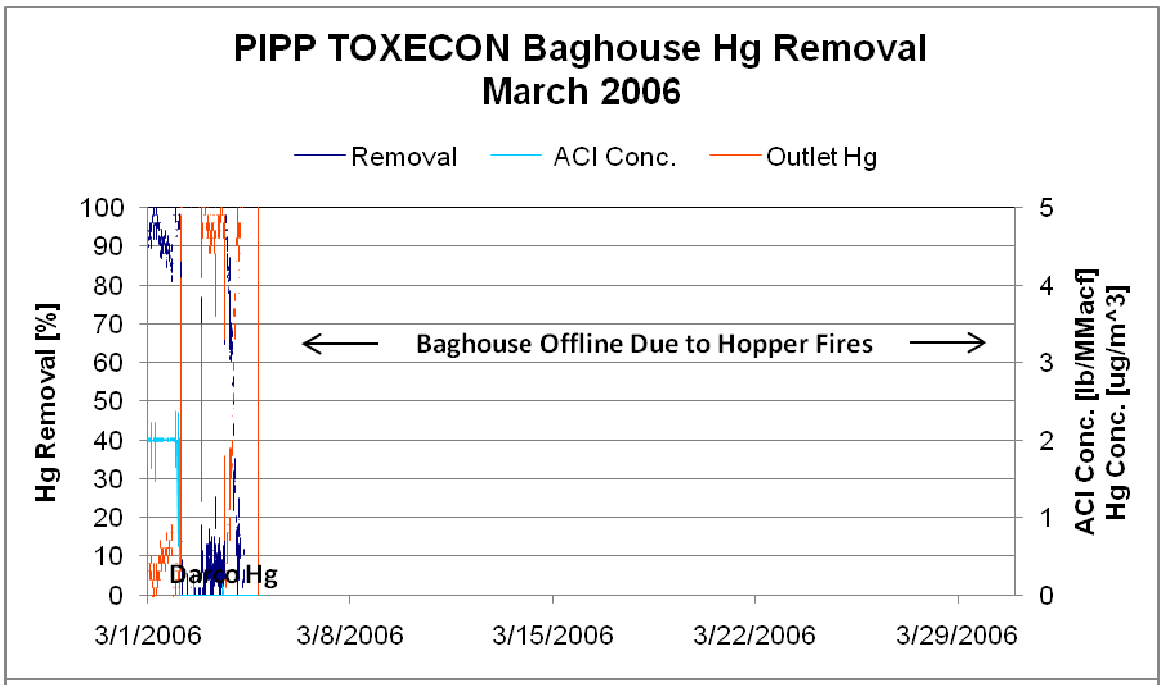

Hg (ug/m3)
Hg Inlet
Hg Outlet
Probe switch
Baghouse diverted
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5 Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
8/1/09
8/6/09
8/11/09
8/16/09
8/21/09
8/26/09
8/31/09

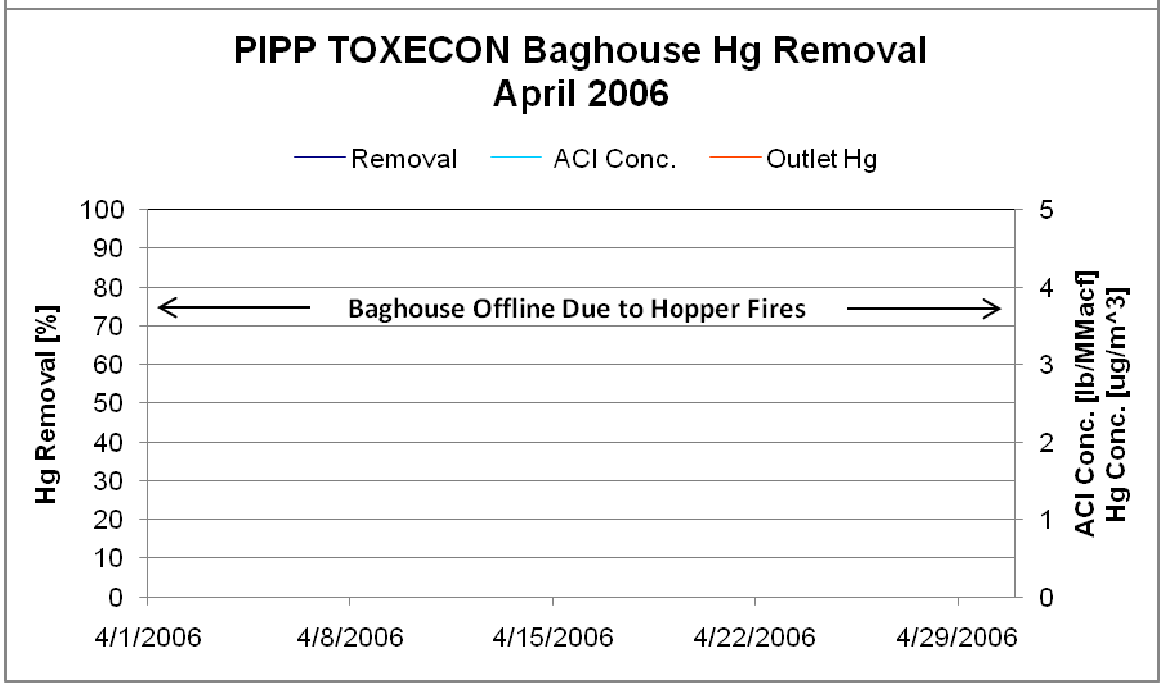

Hg (ug/m3)
Hg Inlet
Hg Outlet
Total Boiler Load (MW)
Temperature (F)
Gas Flow Rate (MMacfm)
Baghouse Inlet Temp
Total Boiler Load
Flue Gas Volume
Pressure Drop (inches H2O)
Fl-Fl Pressure Drop
Compartment 1-5
Pressure Drop
A/C Ratio (ft/min)
Clean Frequency (pulses/bag/hr)
A/C Ratio
Cleaning Frequency
Compartments 1-5
Hg Removal (%)
PAC Injection Conc. (lb/MMacf)
Hg Removal
PAC Injection
9/1/09
9/6/09
9/11/09
9/16/09
9/21/09
9/26/09

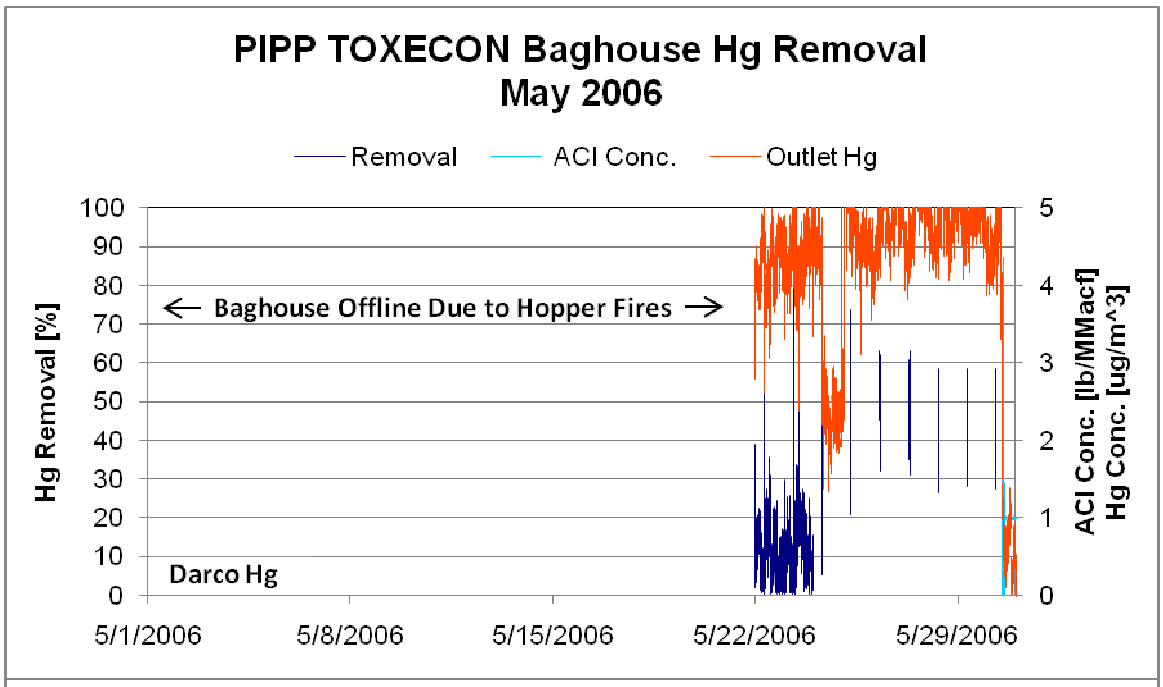
Appendix I. Monthly Mercury Removal Graphs

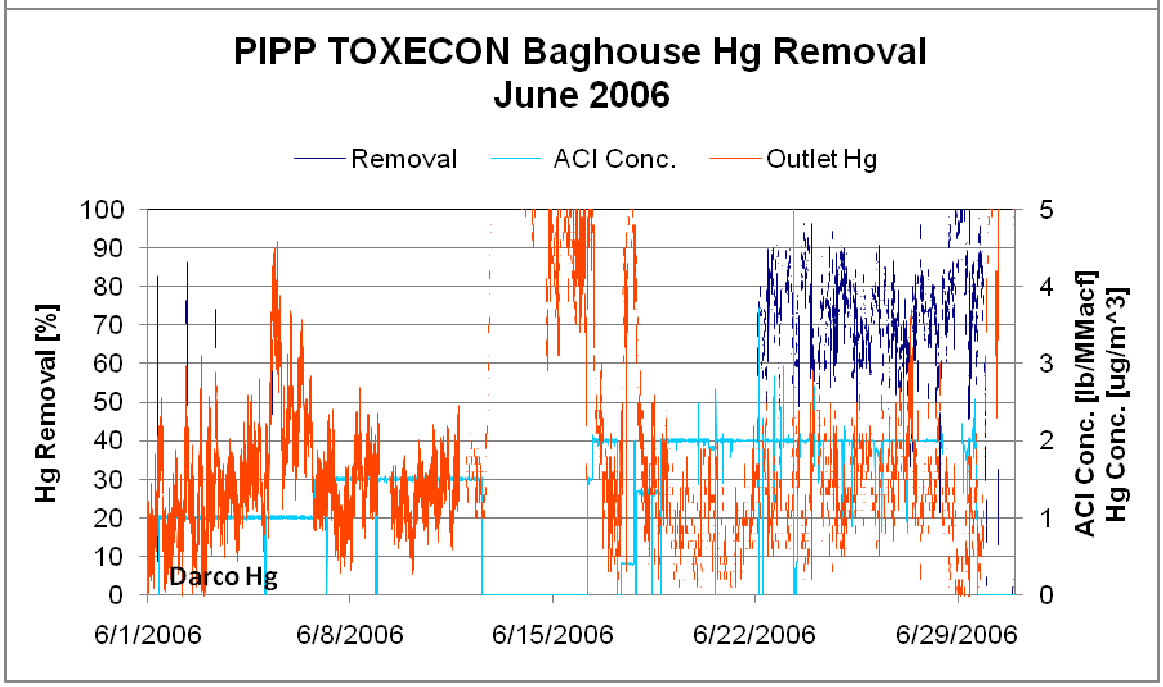

PIPP TOXECON Baghouse Hg Removal
January 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
1/1/2006
1/8/2006
1/15/2006
1/22/2006
1/29/2006

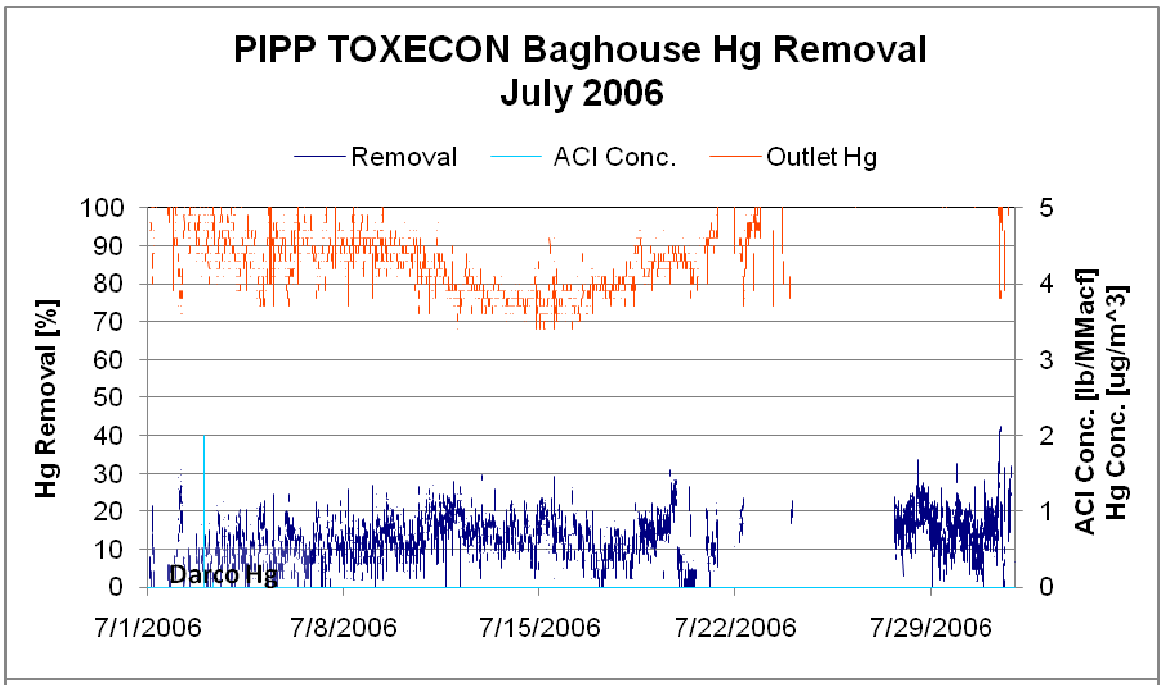

PIPP TOXECON Baghouse Hg Removal
February 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
2/1/2006
2/8/2006
2/15/2006
2/22/2006

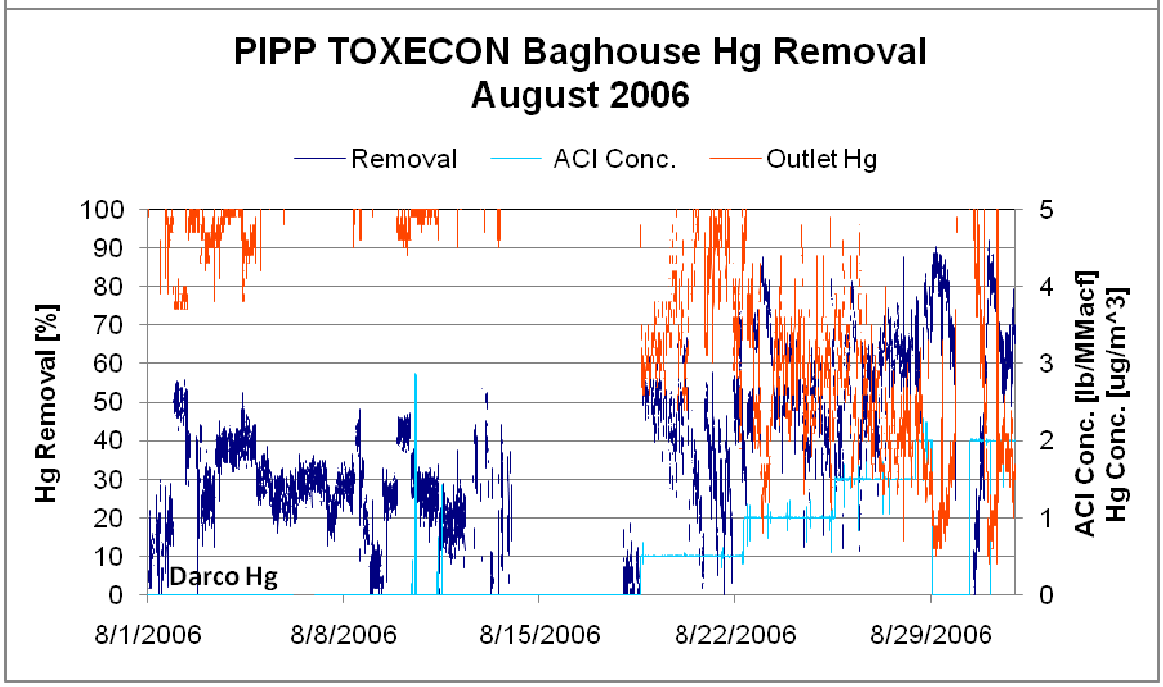

PIPP TOXECON Baghouse Hg Removal
March 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Baghouse Offline Due to Hopper Fires
Dark Hg
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
3/1/2006
3/8/2006
3/15/2006
3/22/2006
3/29/2006

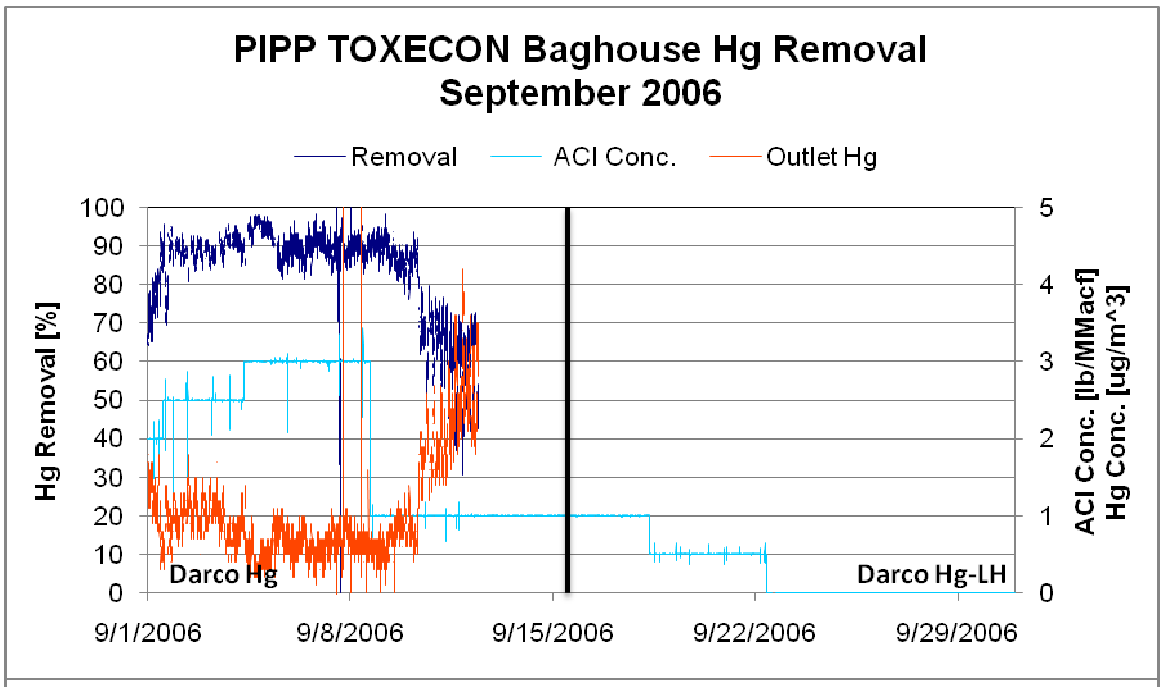

PIPP TOXECON Baghouse Hg Removal
April 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Baghouse Offline Due to Hopper Fires
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
4/1/2006
4/8/2006
4/15/2006
4/22/2006
4/29/2006

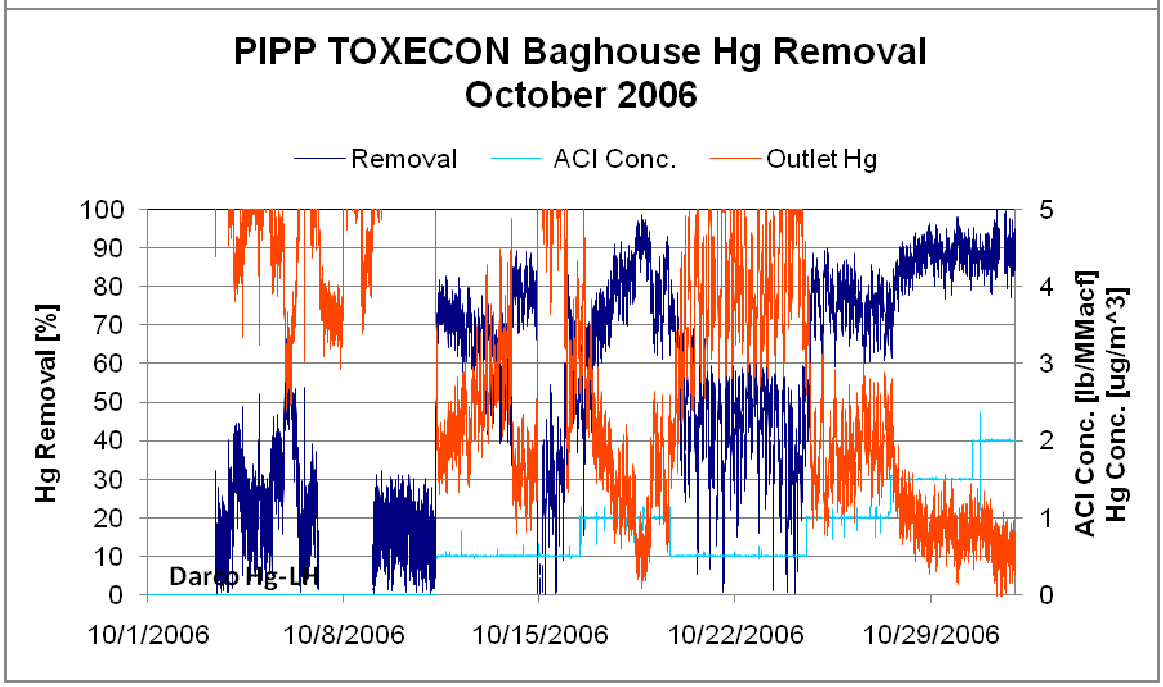

PIPP TOXECON Baghouse Hg Removal
May 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Baghouse Offline Due to Hopper Fires
Darco Hg
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
5/1/2006
5/8/2006
5/15/2006
5/22/2006
5/29/2006

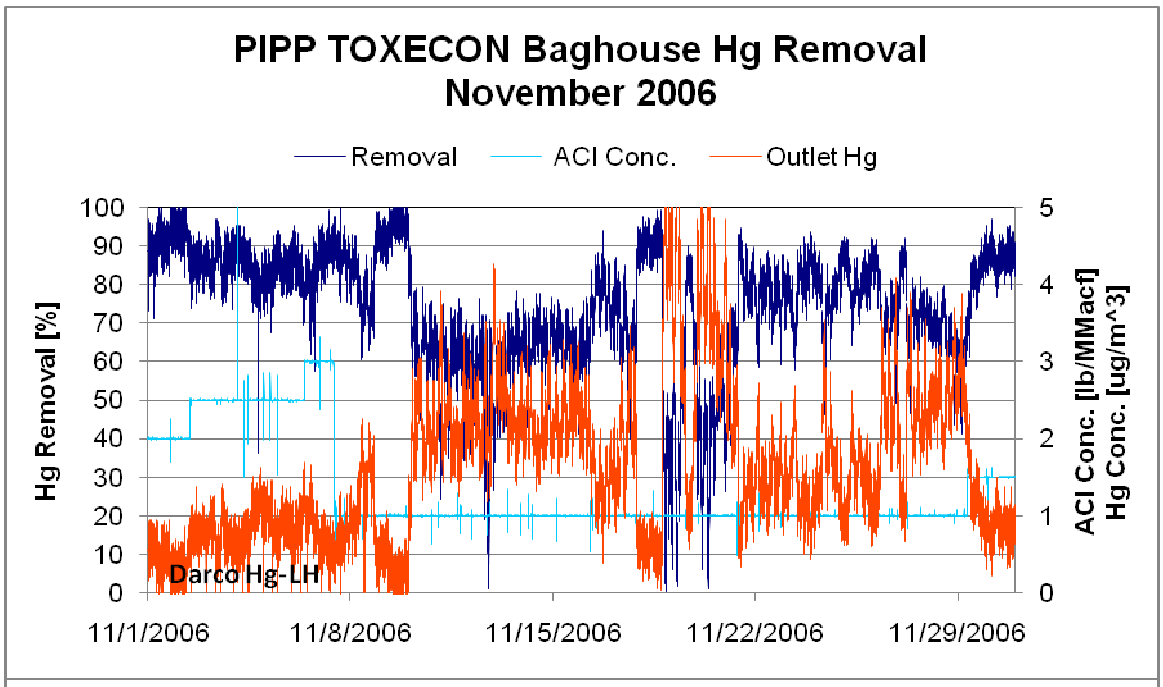

PIPP TOXECON Baghouse Hg Removal
June 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
6/1/2006
6/8/2006
6/15/2006
6/22/2006
6/29/2006

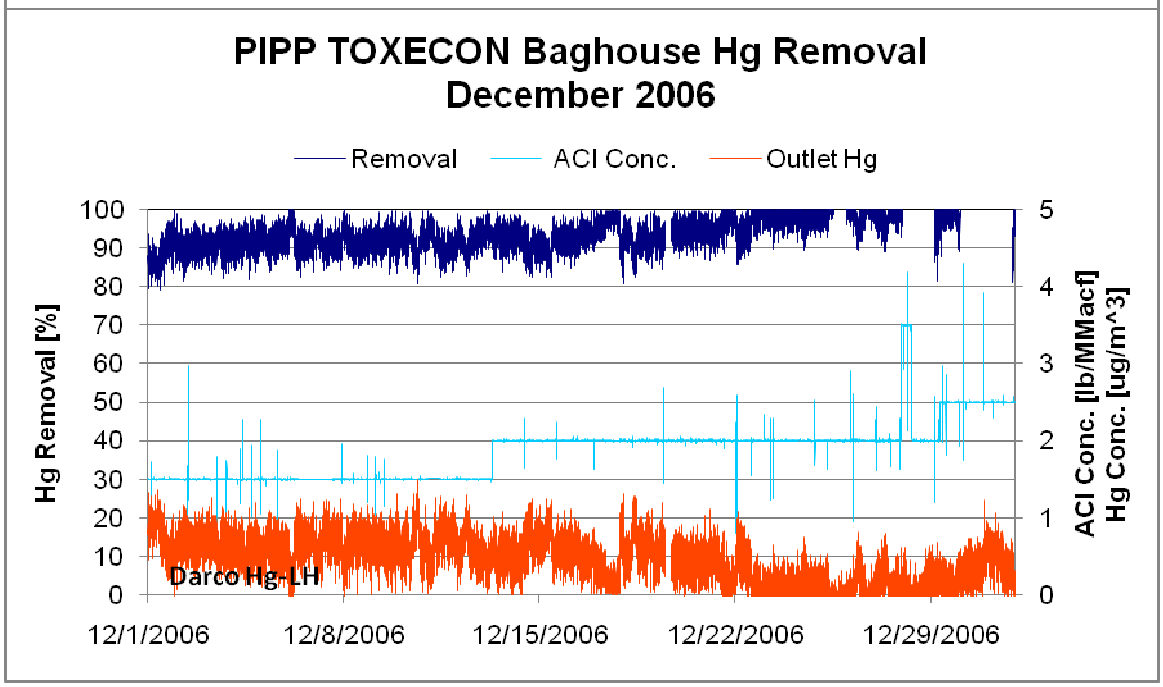

PIPP TOXECON Baghouse Hg Removal
July 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
7/1/2006
7/8/2006
7/15/2006
7/22/2006
7/29/2006

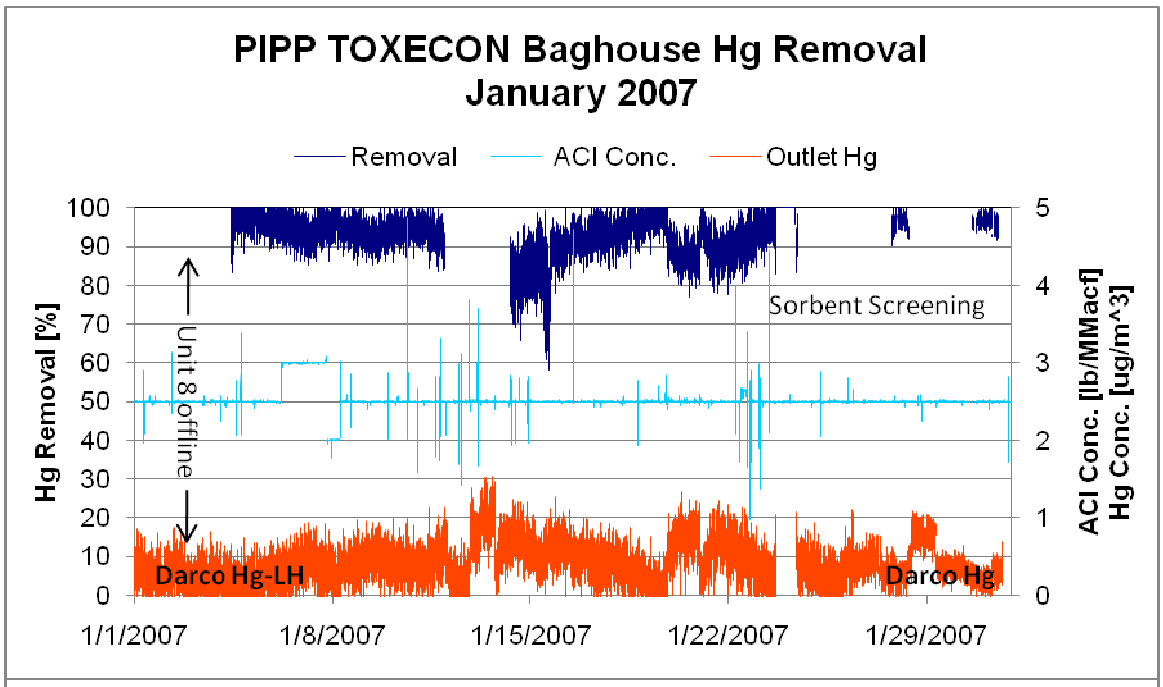

PIPP TOXECON Baghouse Hg Removal
August 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
8/1/2006
8/8/2006
8/15/2006
8/22/2006
8/29/2006

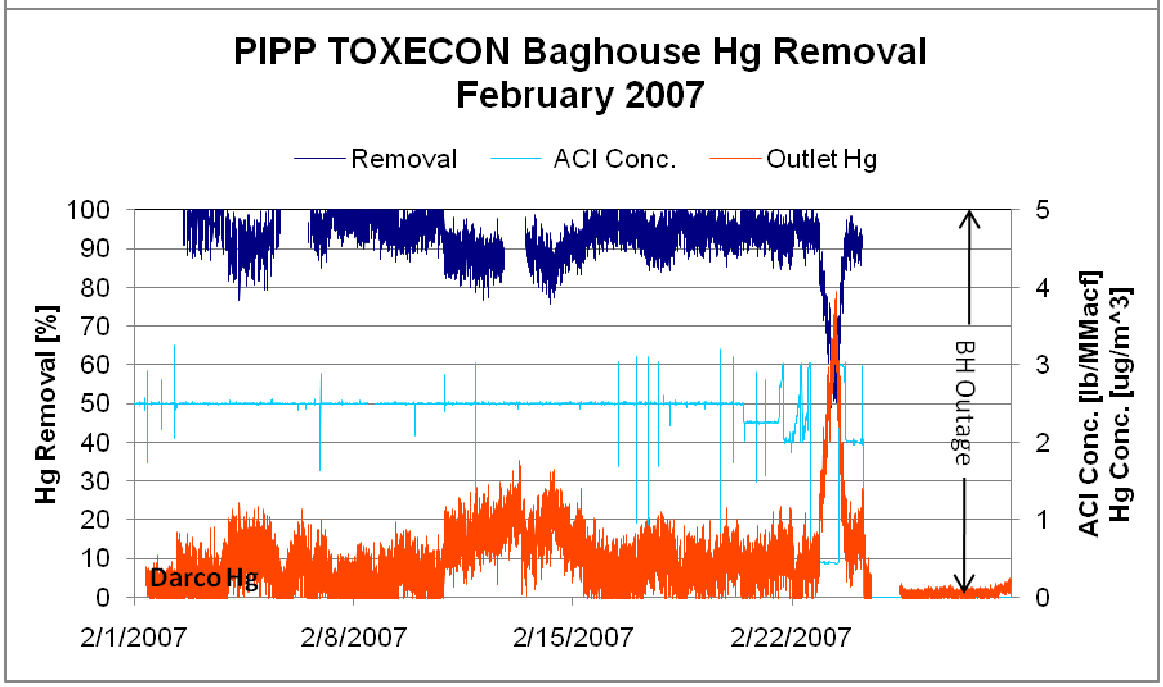

PIPP TOXECON Baghouse Hg Removal
September 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
Darco Hg-LH
9/1/2006
9/8/2006
9/15/2006
9/22/2006
9/29/2006

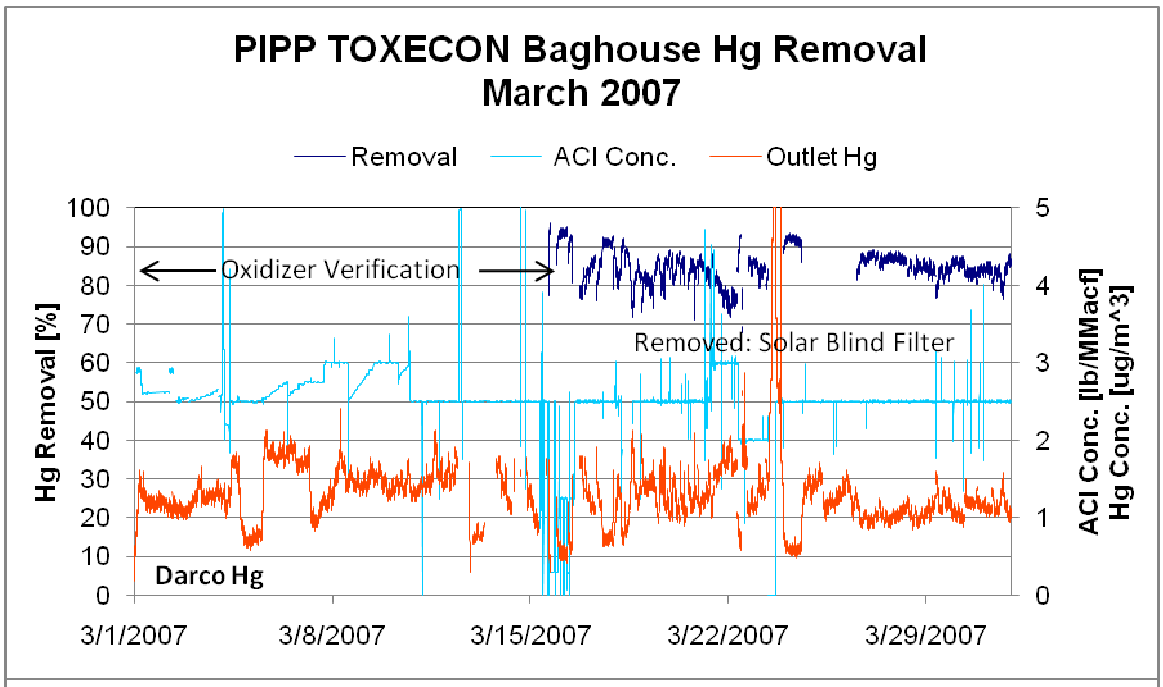

PIPP TOXECON Baghouse Hg Removal
October 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
10/1/2006
10/8/2006
10/15/2006
10/22/2006
10/29/2006

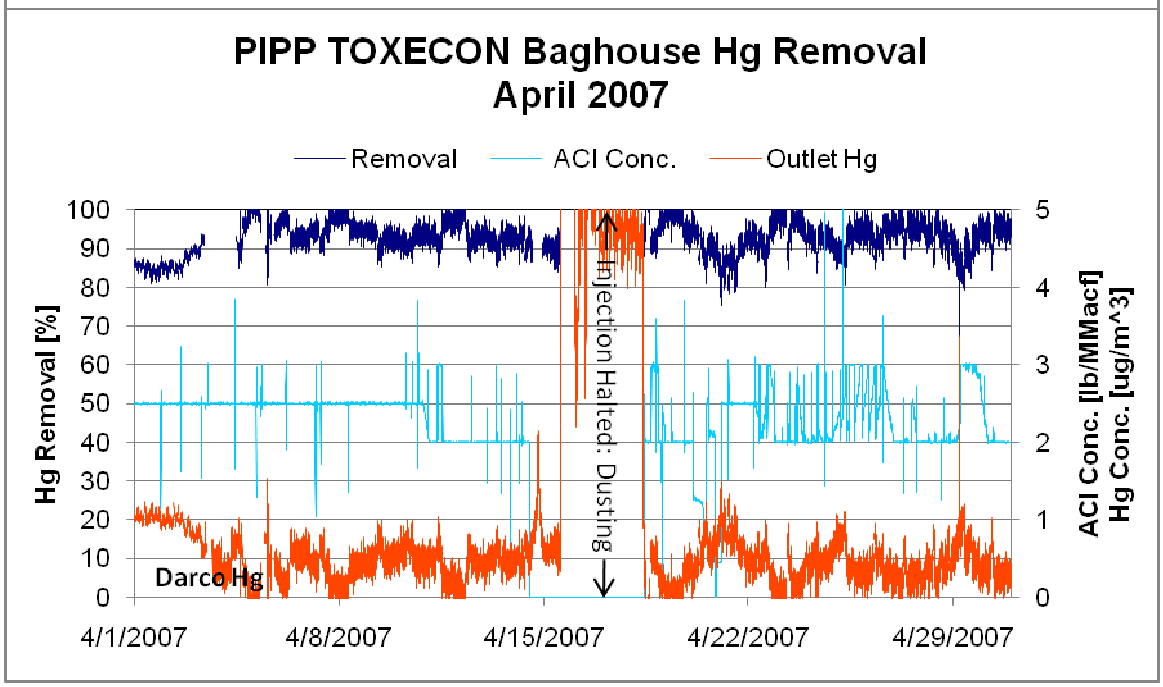

PIPP TOXECON Baghouse Hg Removal
November 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
11/1/2006
11/8/2006
11/15/2006
11/22/2006
11/29/2006

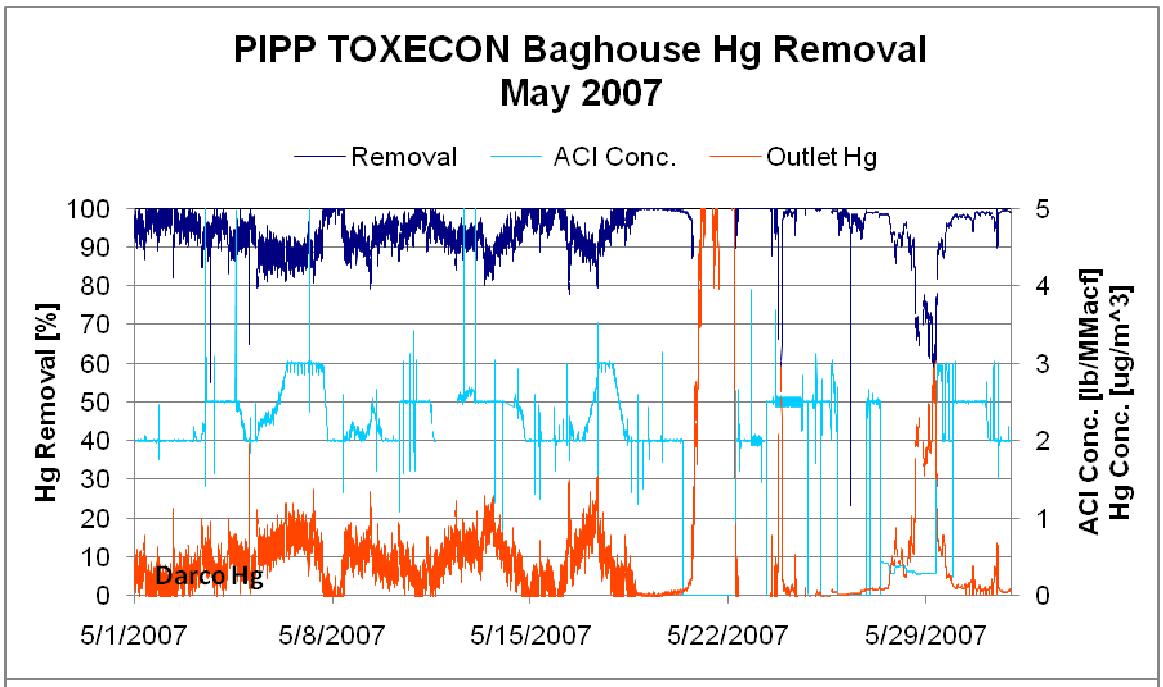

PIPP TOXECON Baghouse Hg Removal
December 2006
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
12/1/2006
12/8/2006
12/15/2006
12/22/2006
12/29/2006

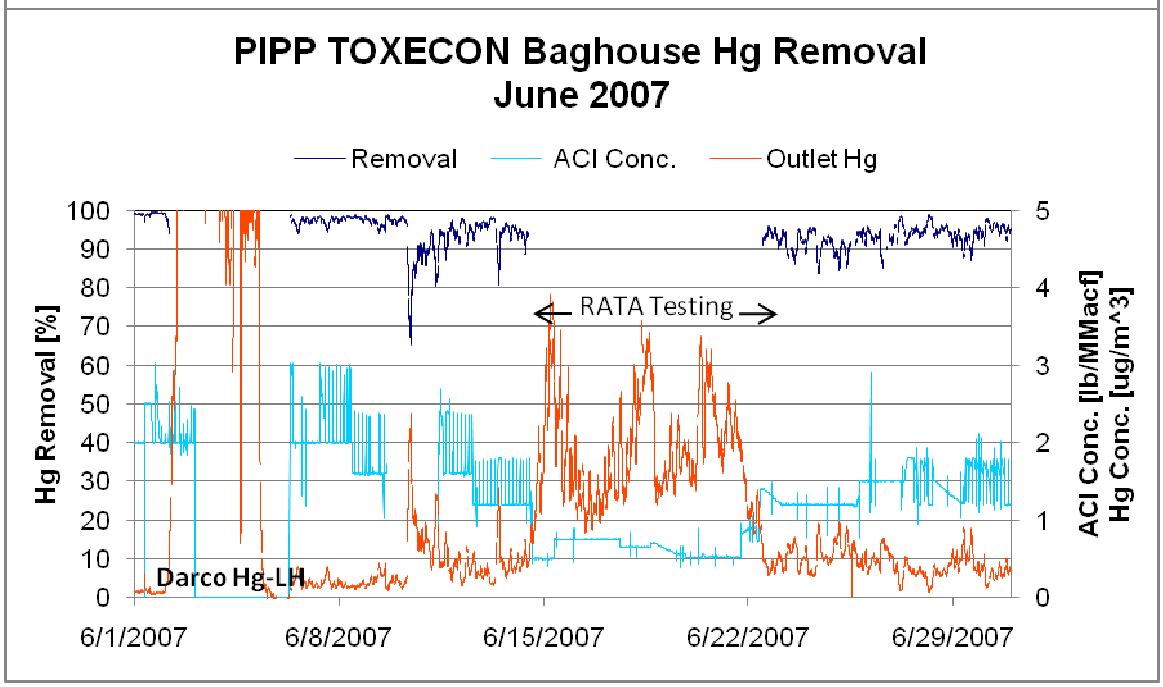

PIPP TOXECON Baghouse Hg Removal
January 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Unit 8 offline
Sorbent Screening
Darco Hg-LH
Darco Hg
1/1/2007
1/8/2007
1/15/2007
1/22/2007
1/29/2007

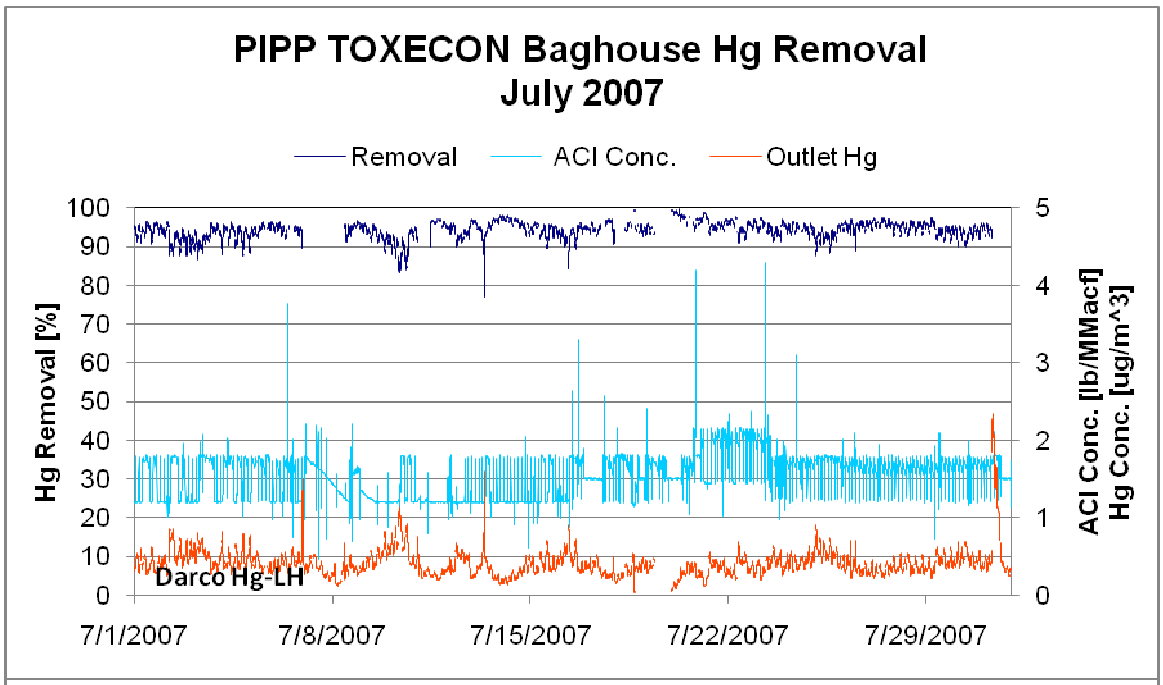

PIPP TOXECON Baghouse Hg Removal
February 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
BH Outage
Darco Hg
2/1/2007
2/8/2007
2/15/2007
2/22/2007

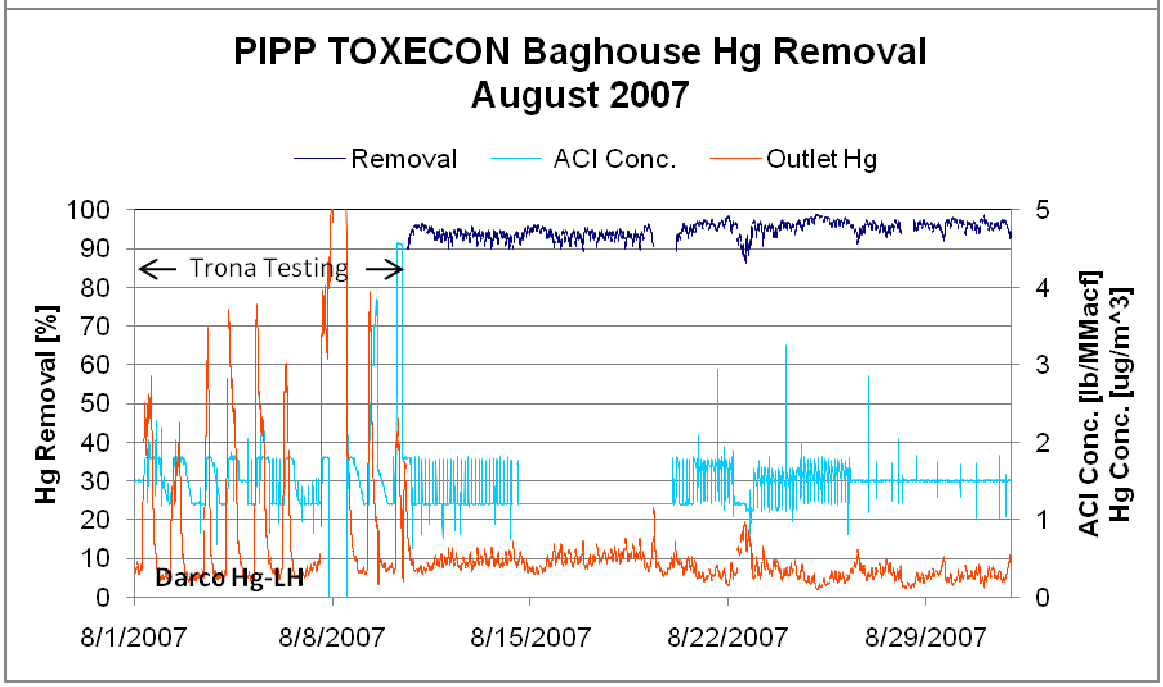

PIPP TOXECON Baghouse Hg Removal
March 2007
Removal
ACI Conc.
Outlet Hg
Oxidizer Verification
Removed: Solar Blind Filter
Darco Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
3/1/2007
3/8/2007
3/15/2007
3/22/2007
3/29/2007

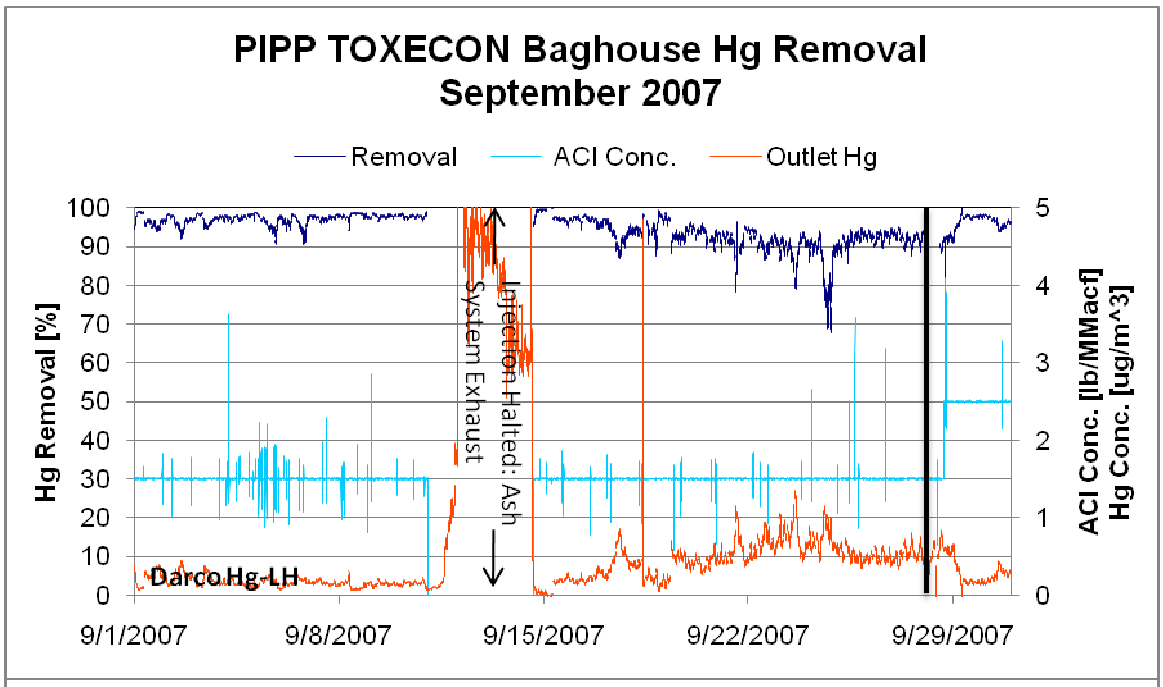

PIPP TOXECON Baghouse Hg Removal
April 2007
Removal
ACI Conc.
Outlet Hg
Injection Halted: Dusting
Darco Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
4/1/2007
4/8/2007
4/15/2007
4/22/2007
4/29/2007

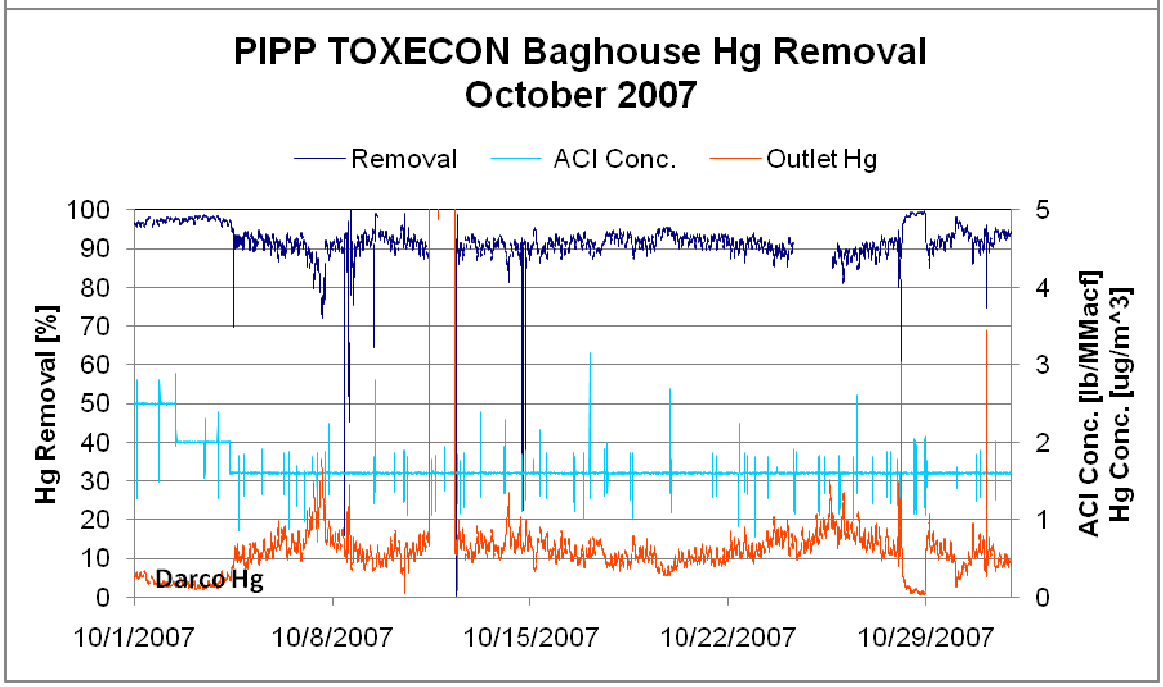

PIPP TOXECON Baghouse Hg Removal
May 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
5/1/2007
5/8/2007
5/15/2007
5/22/2007
5/29/2007

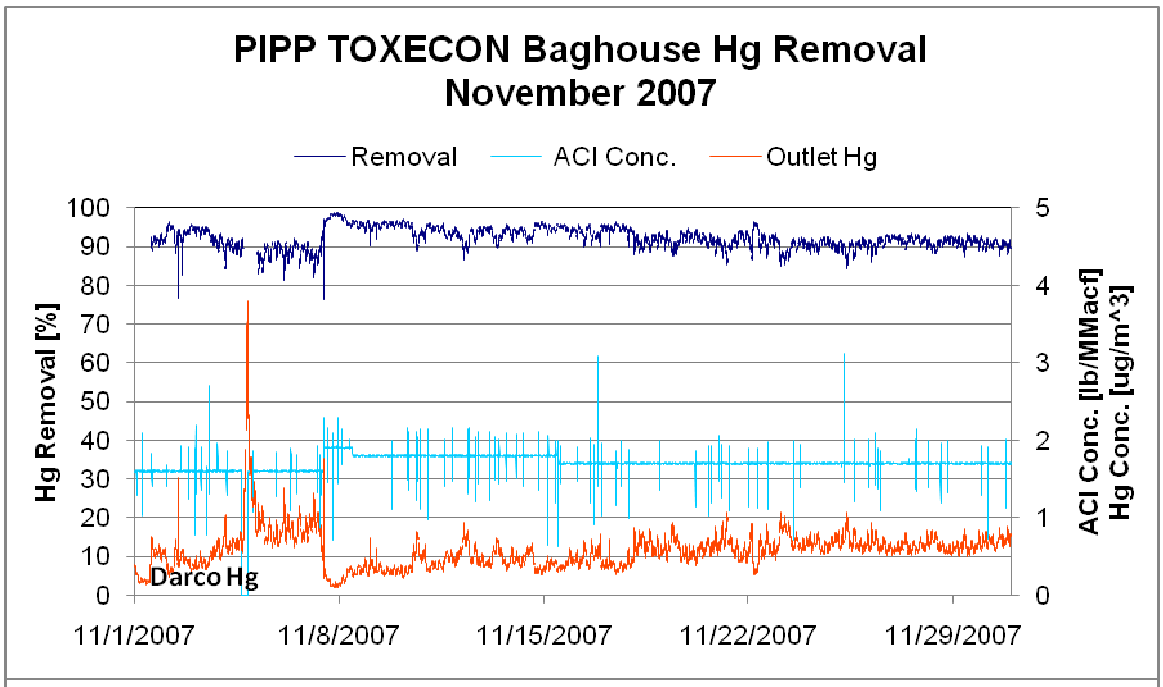

PIPP TOXECON Baghouse Hg Removal
June 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
RATA Testing
Darco Hg-LH
6/1/2007
6/8/2007
6/15/2007
6/22/2007
6/29/2007

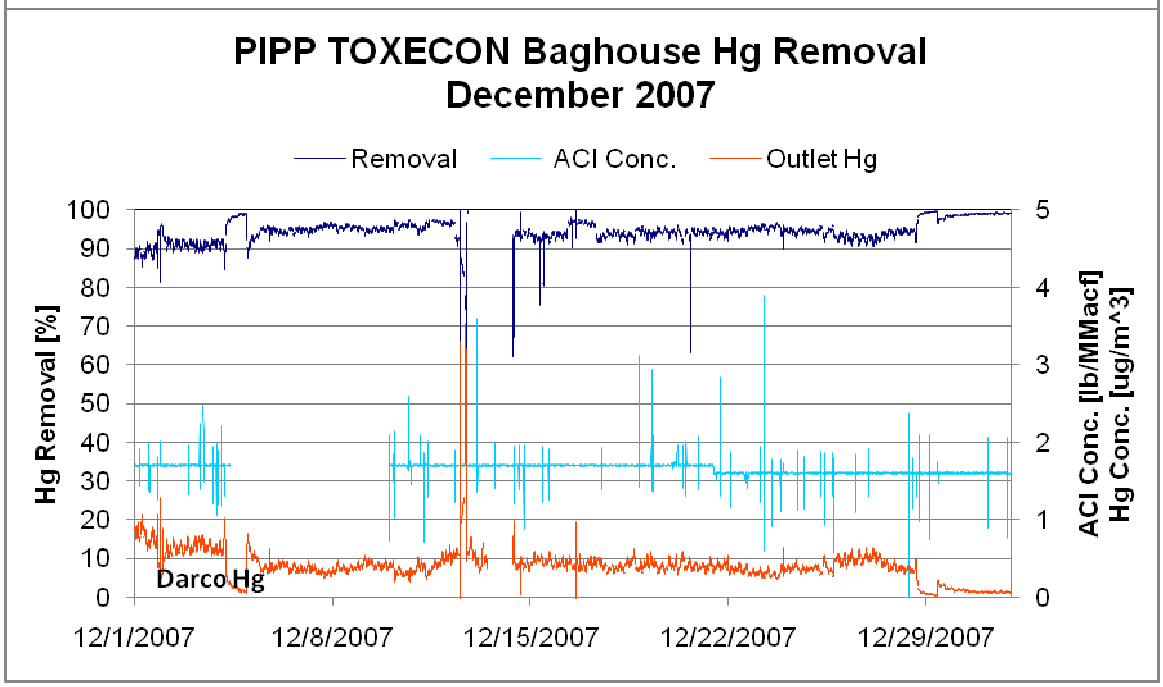

PIPP TOXECON Baghouse Hg Removal
July 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
7/1/2007
7/8/2007
7/15/2007
7/22/2007
7/29/2007

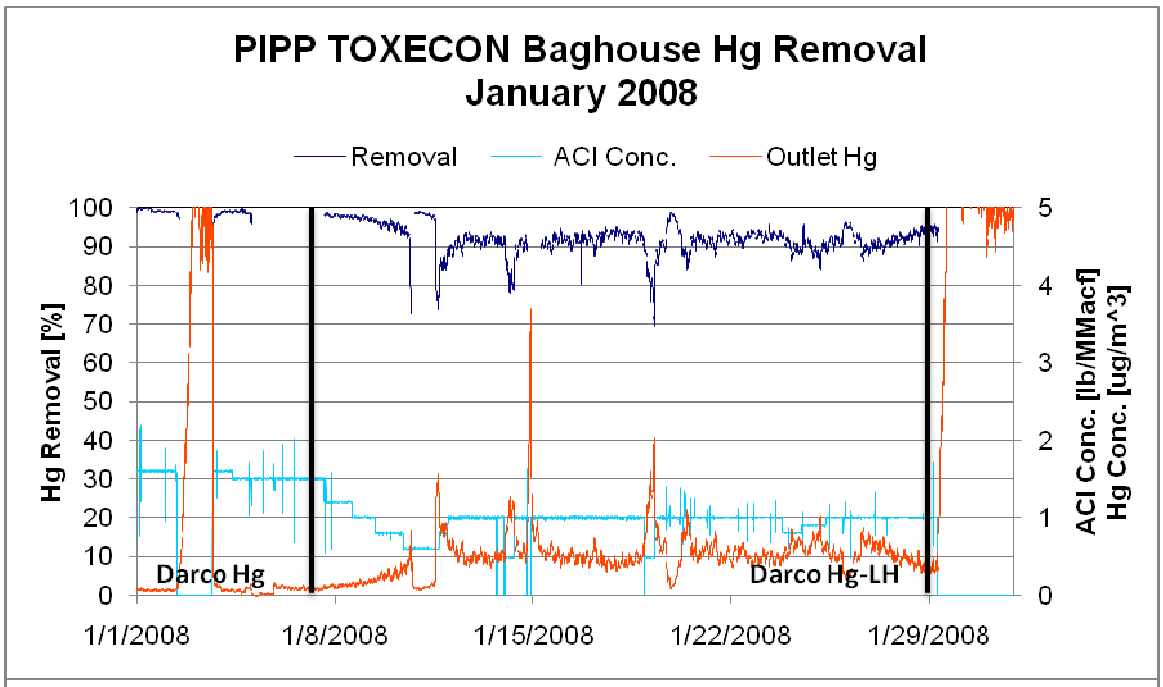

PIPP TOXECON Baghouse Hg Removal
August 2007
Removal
ACI Conc.
Outlet Hg
Trona Testing
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
8/1/2007
8/8/2007
8/15/2007
8/22/2007
8/29/2007

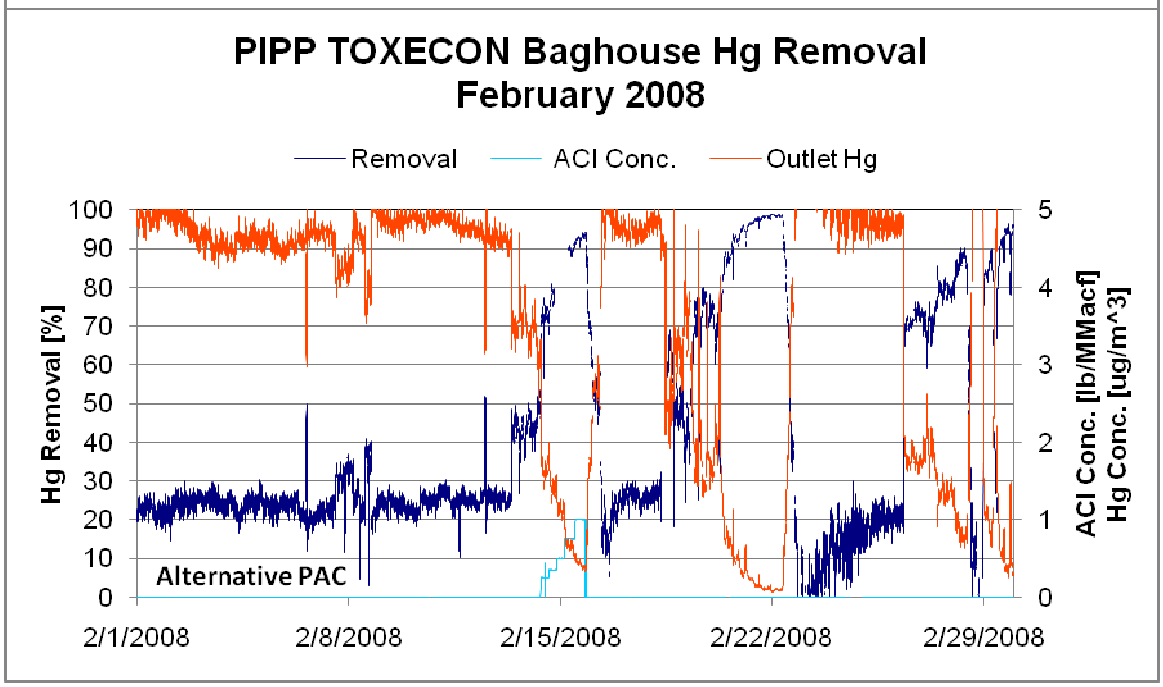

PIPP TOXECON Baghouse Hg Removal
September 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
System Exhaust
Injection Halted: Ash
Darco Hg-LH
9/1/2007
9/8/2007
9/15/2007
9/22/2007
9/29/2007

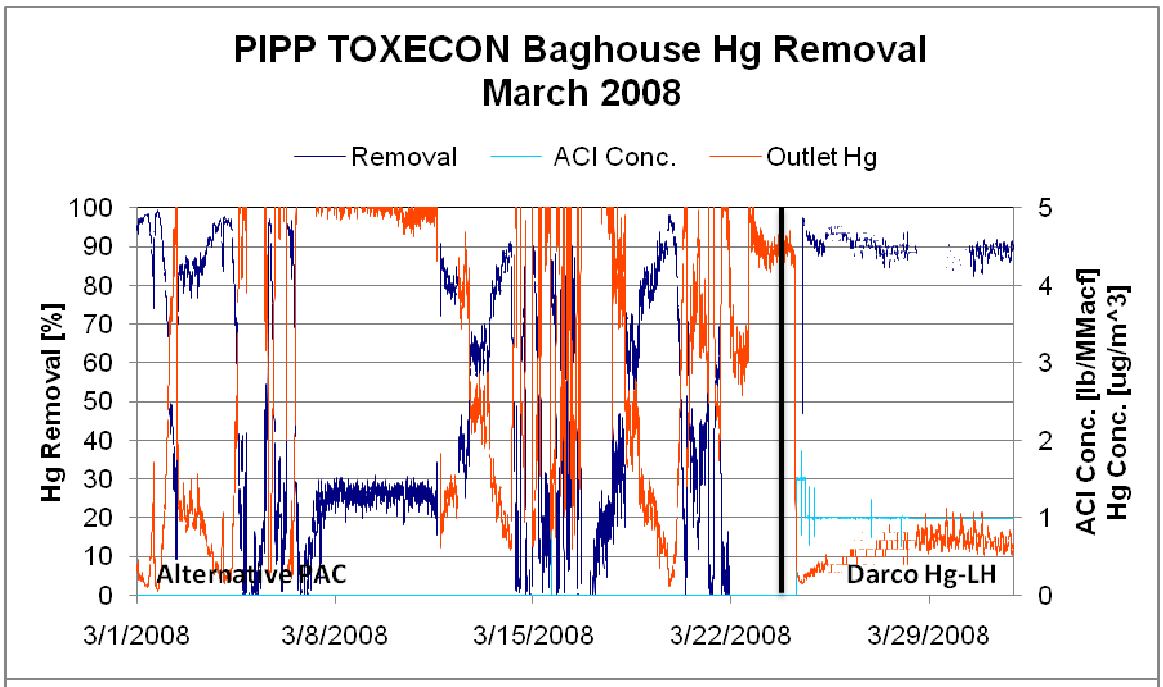

PIPP TOXECON Baghouse Hg Removal
October 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
10/1/2007
10/8/2007
10/15/2007
10/22/2007
10/29/2007

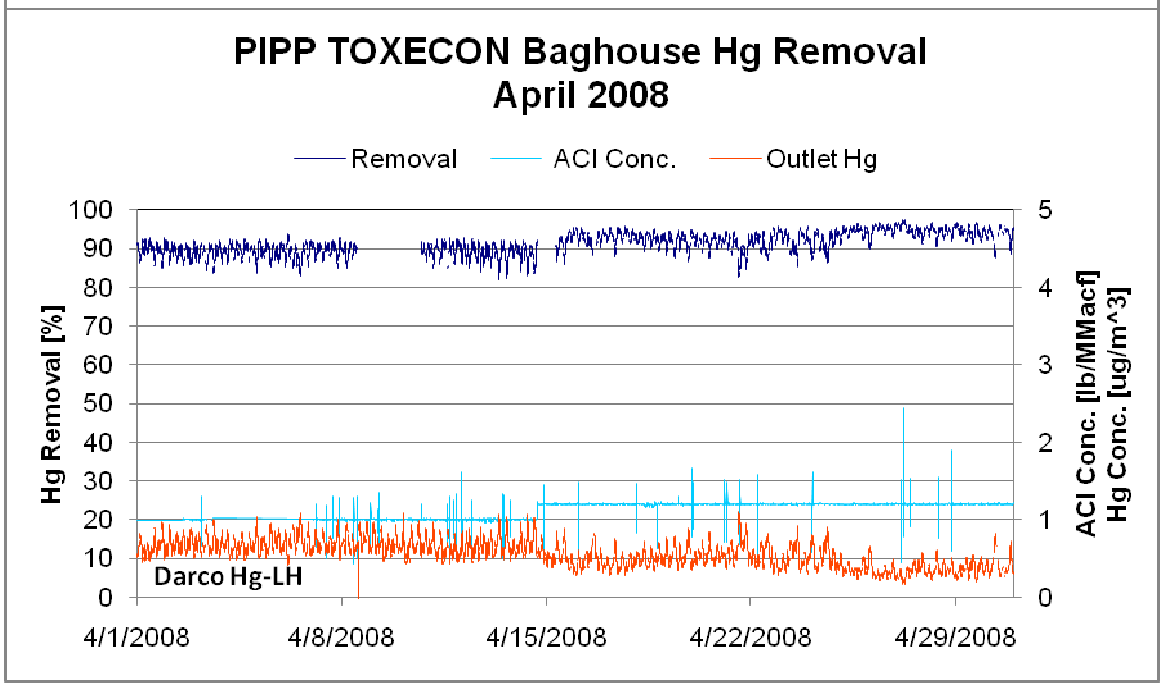

PIPP TOXECON Baghouse Hg Removal
November 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
11/1/2007
11/8/2007
11/15/2007
11/22/2007
11/29/2007

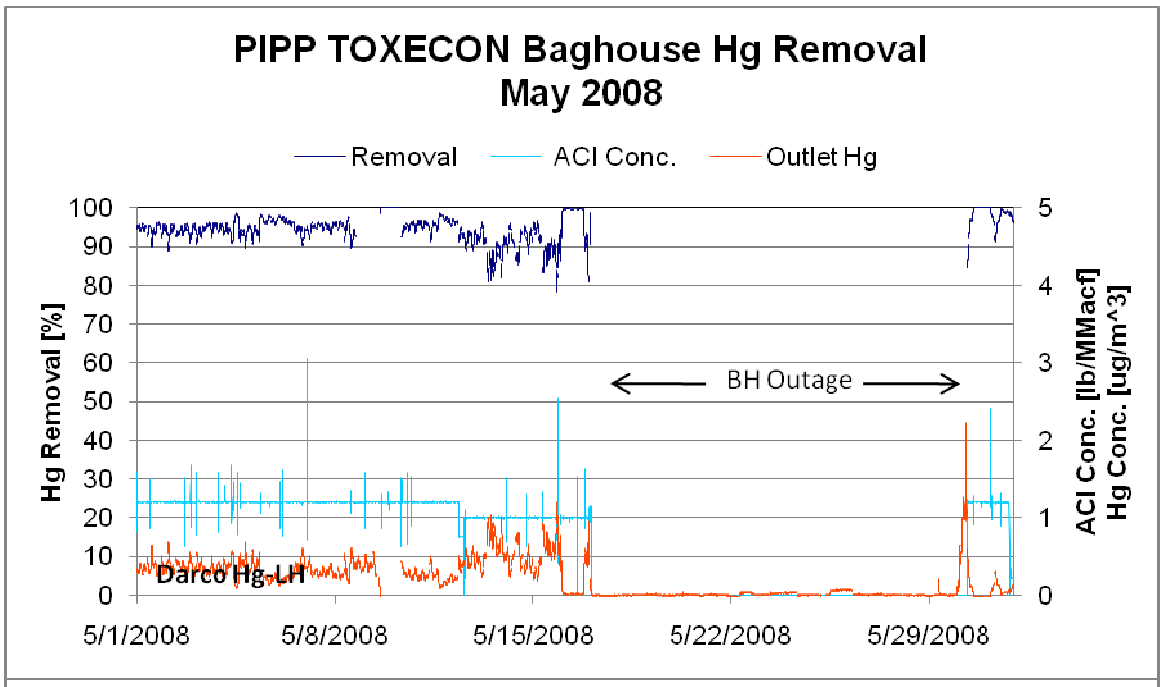

PIPP TOXECON Baghouse Hg Removal
December 2007
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
12/1/2007
12/8/2007
12/15/2007
12/22/2007
12/29/2007

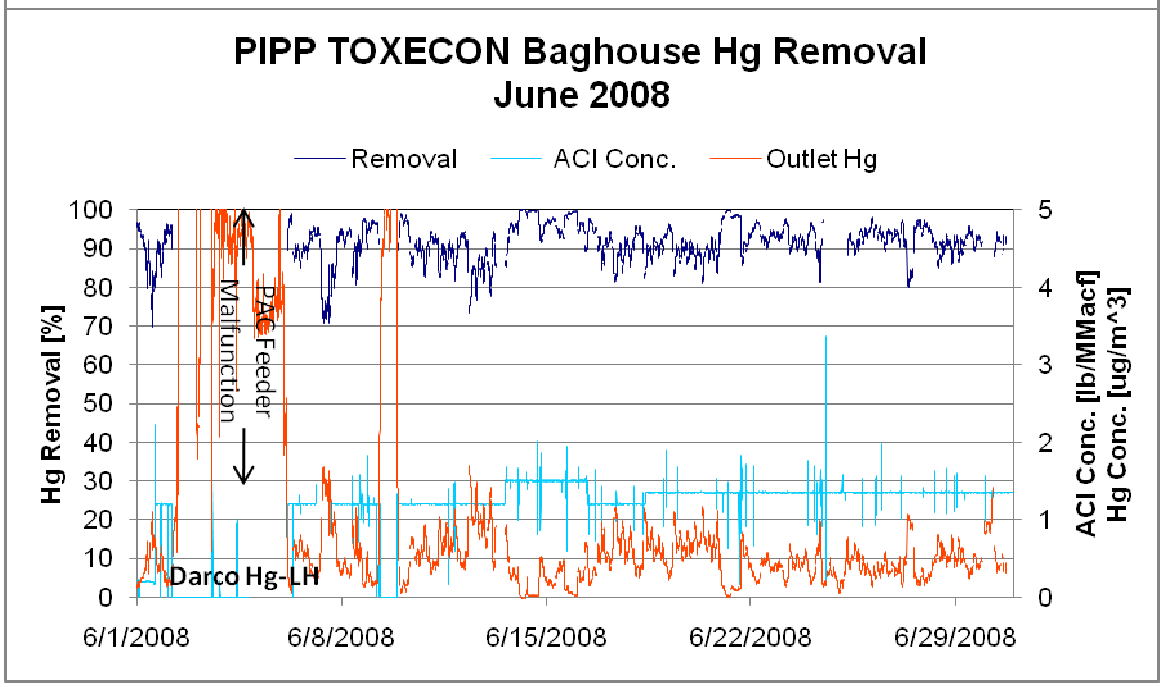

PIPP TOXECON Baghouse Hg Removal
January 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg
Darco Hg-LH
1/1/2008
1/8/2008
1/15/2008
1/22/2008
1/29/2008

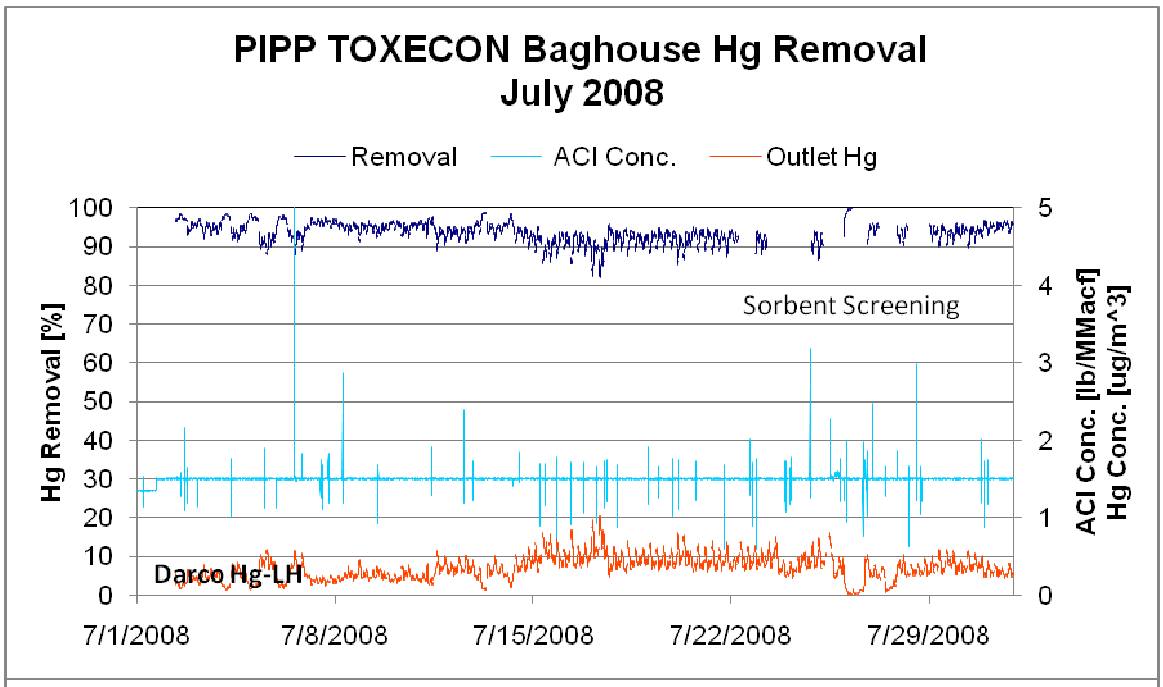

PIPP TOXECON Baghouse Hg Removal
February 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Alternative PAC
2/1/2008
2/8/2008
2/15/2008
2/22/2008
2/29/2008

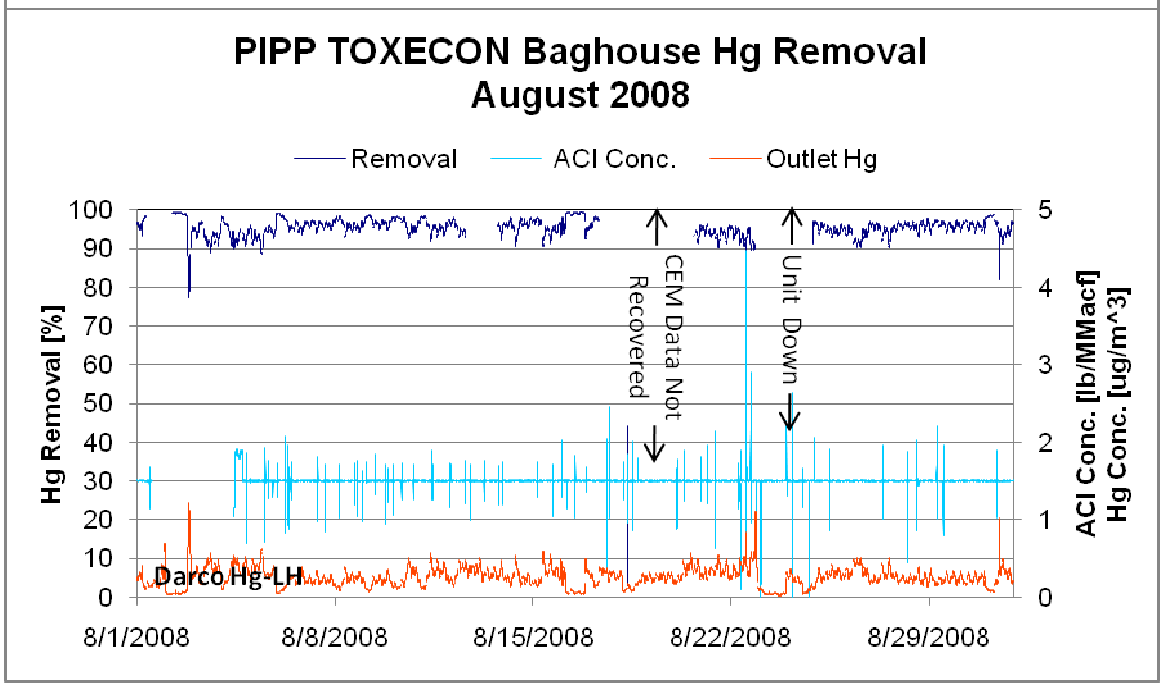

PIPP TOXECON Baghouse Hg Removal
March 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Alternative PAC
Darco Hg-LH
3/1/2008
3/8/2008
3/15/2008
3/22/2008
3/29/2008

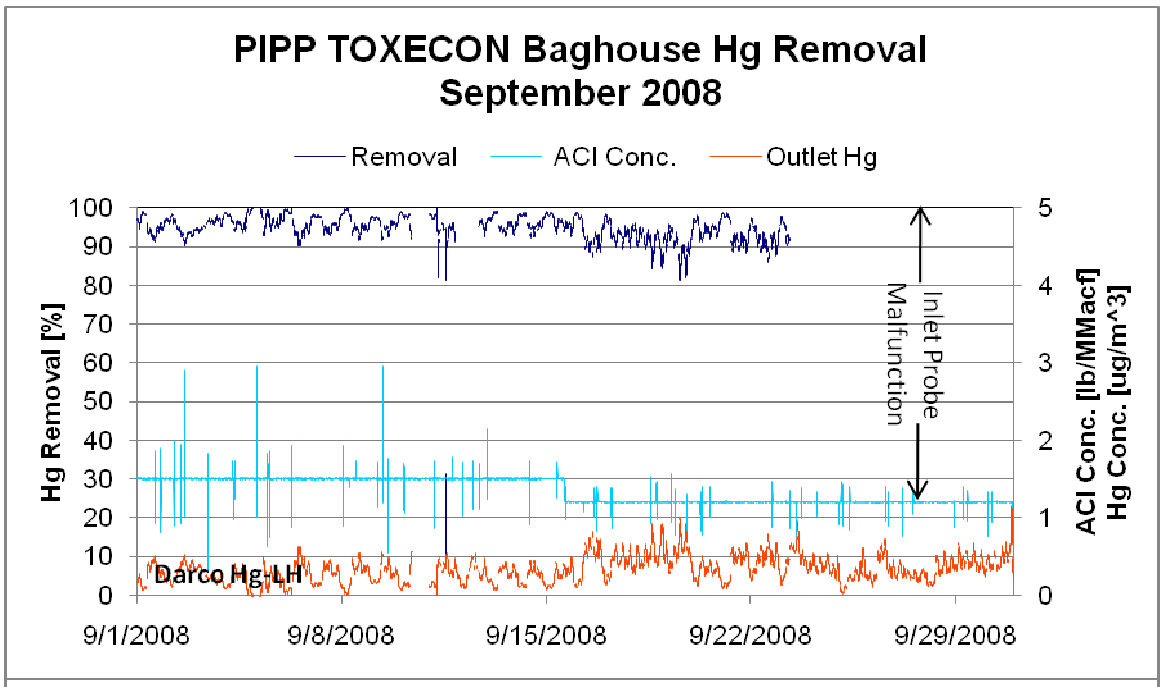

PIPP TOXECON Baghouse Hg Removal
April 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
4/1/2008
4/8/2008
4/15/2008
4/22/2008
4/29/2008

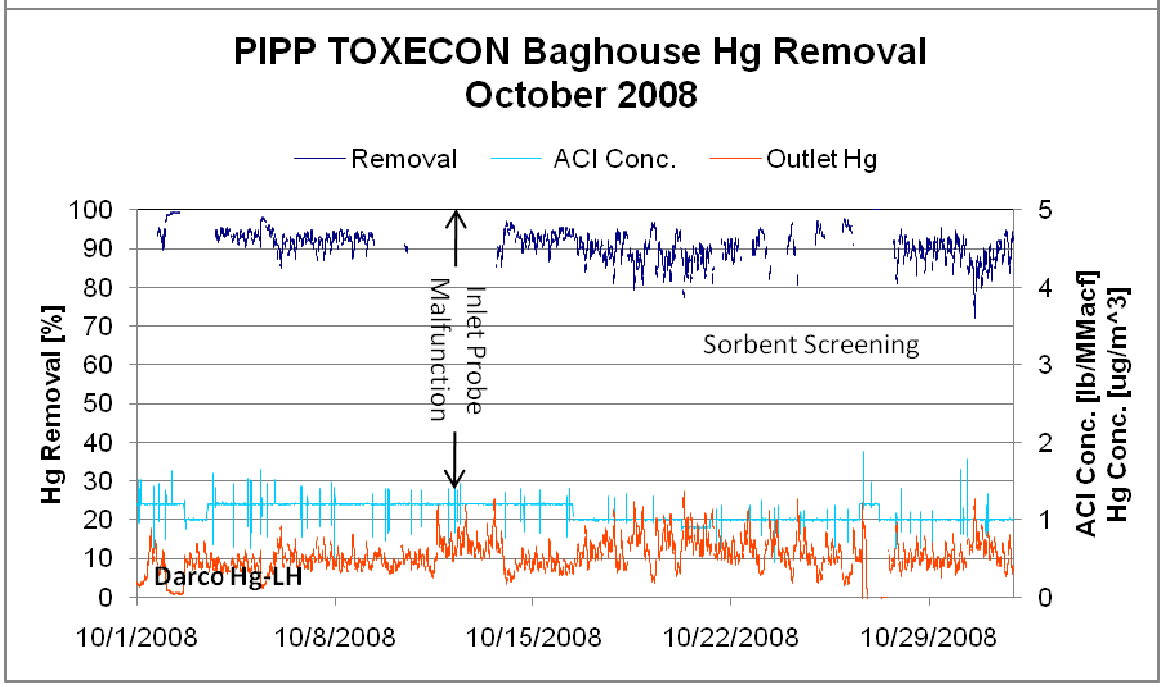

PIPP TOXECON Baghouse Hg Removal
May 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
BH Outage
Darco Hg-LH
5/1/2008
5/8/2008
5/15/2008
5/22/2008
5/29/2008

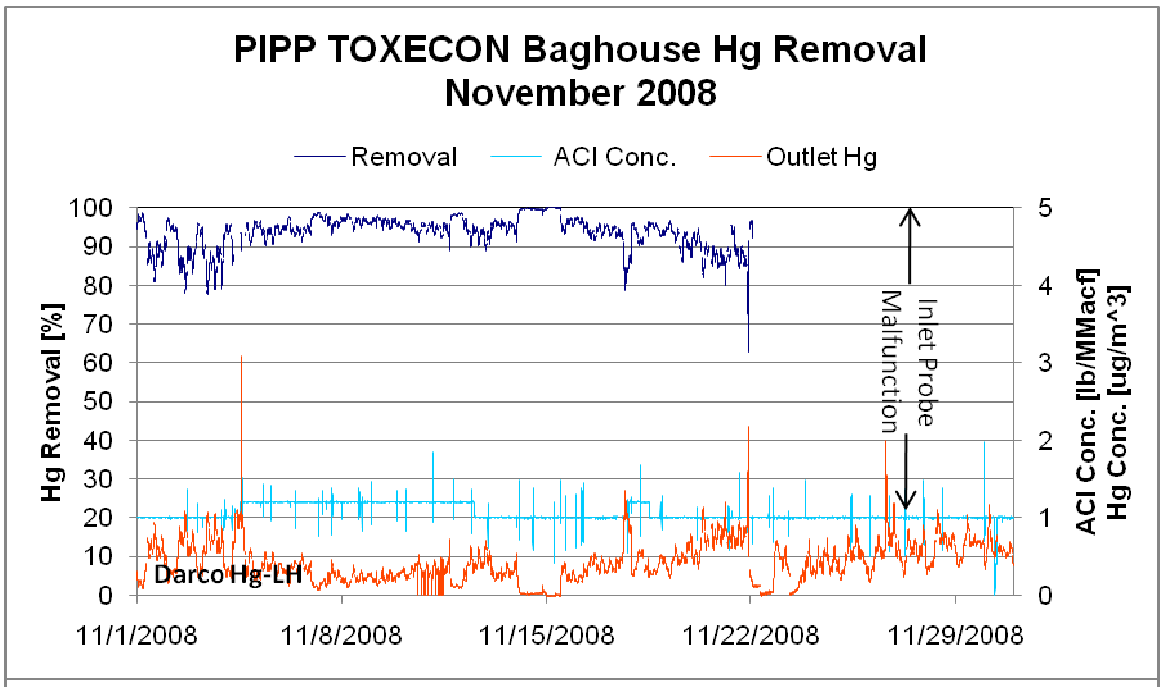

PIPP TOXECON Baghouse Hg Removal
June 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Malfunction
PAC Feeder
Darco Hg-LH
6/1/2008
6/8/2008
6/15/2008
6/22/2008
6/29/2008

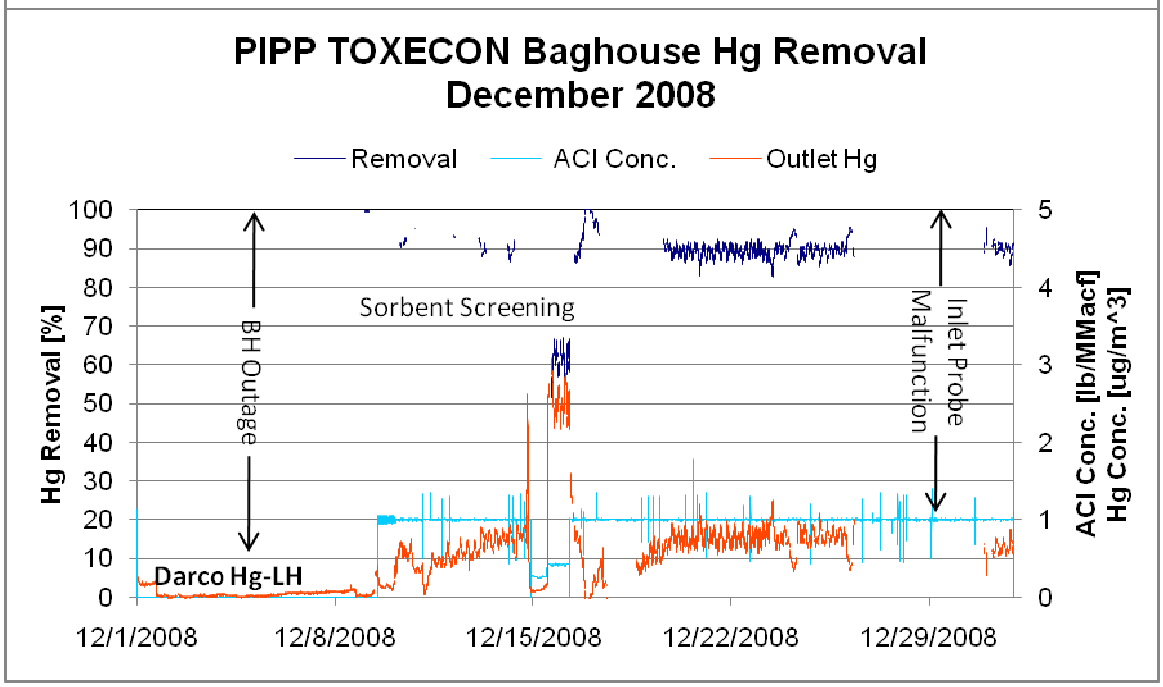

PIPP TOXECON Baghouse Hg Removal
July 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Sorbent Screening
Darco Hg-LH
7/1/2008
7/8/2008
7/15/2008
7/22/2008
7/29/2008

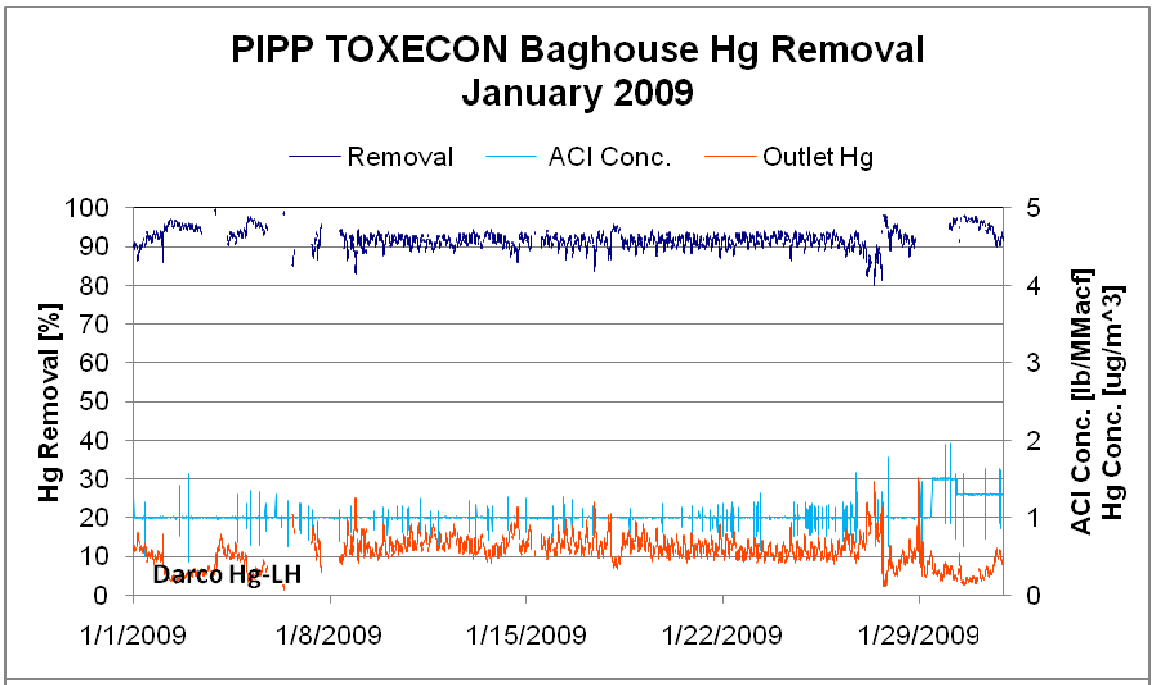

PIPP TOXECON Baghouse Hg Removal
August 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
CEM Data Not Recovered
Unit Down
Darco Hg-LH
8/1/2008
8/8/2008
8/15/2008
8/22/2008
8/29/2008

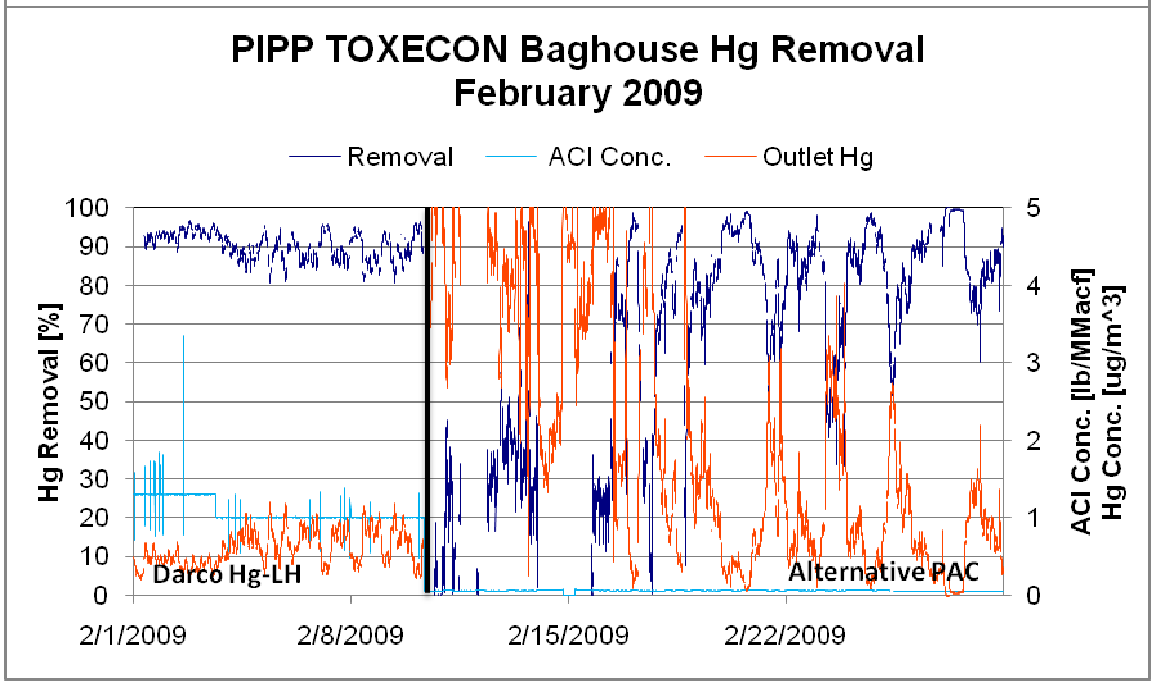

PIPP TOXECON Baghouse Hg Removal
September 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Inlet Probe Malfunction
Darco Hg-LH
9/1/2008
9/8/2008
9/15/2008
9/22/2008
9/29/2008

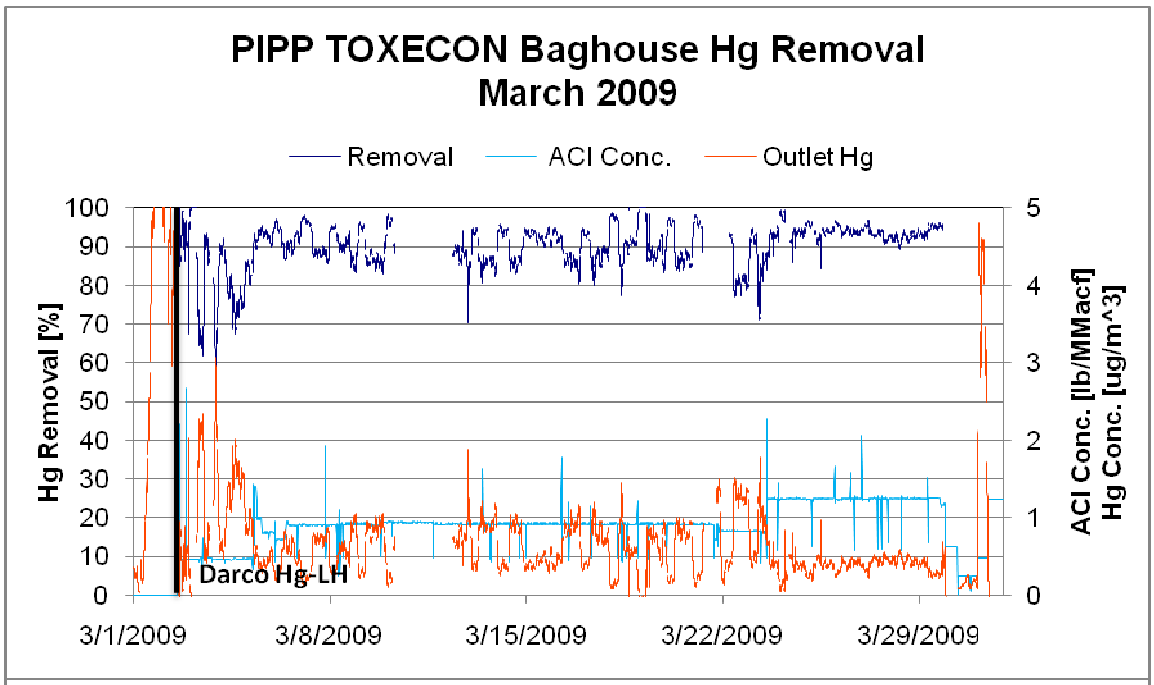

PIPP TOXECON Baghouse Hg Removal
October 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Inlet Probe Malfunction
Sorbent Screening
Darco Hg-LH
10/1/2008
10/8/2008
10/15/2008
10/22/2008
10/29/2008

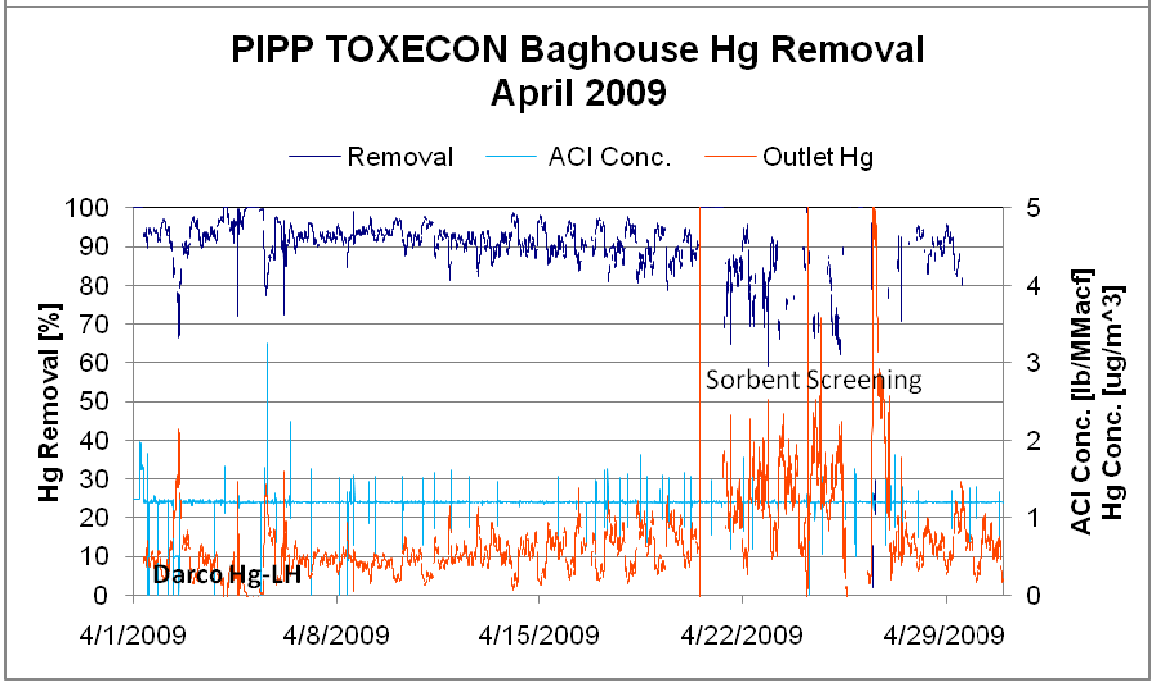

PIPP TOXECON Baghouse Hg Removal
November 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Inlet Probe Malfunction
Darco Hg-LH
11/1/2008
11/8/2008
11/15/2008
11/22/2008
11/29/2008

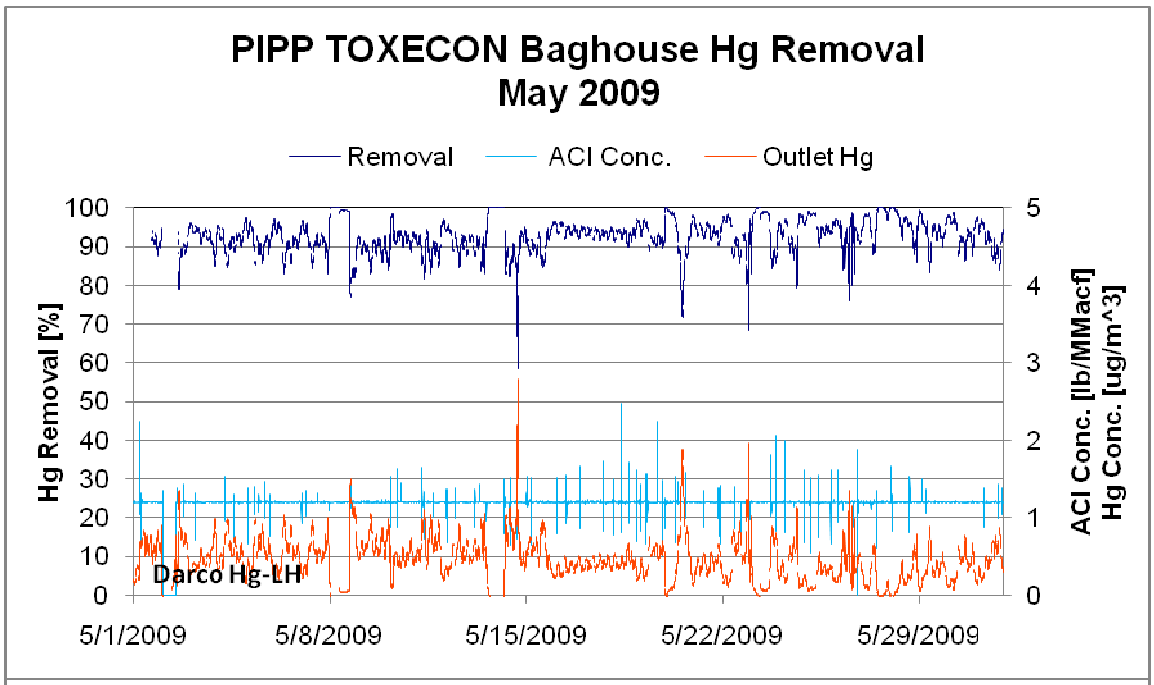

PIPP TOXECON Baghouse Hg Removal
December 2008
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
BH Outage
Sorbent Screening
Inlet Probe Malfunction
Darco Hg-LH
12/1/2008
12/8/2008
12/15/2008
12/22/2008
12/29/2008

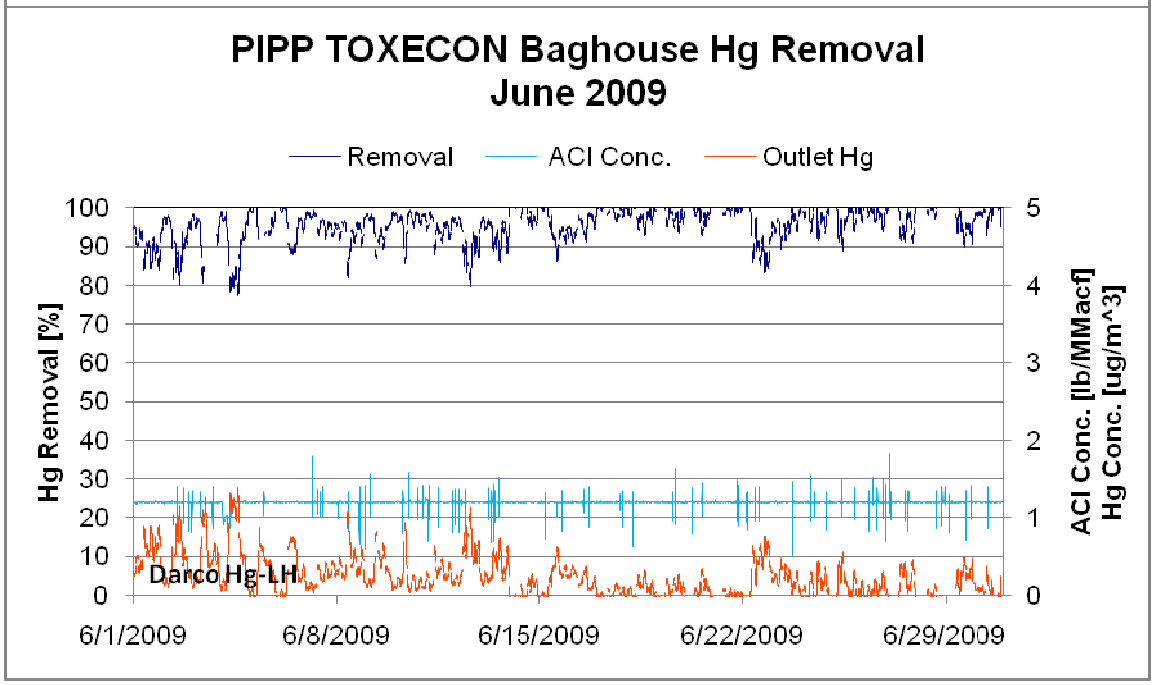

PIPP TOXECON Baghouse Hg Removal
January 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
1/1/2009
1/8/2009
1/15/2009
1/22/2009
1/29/2009

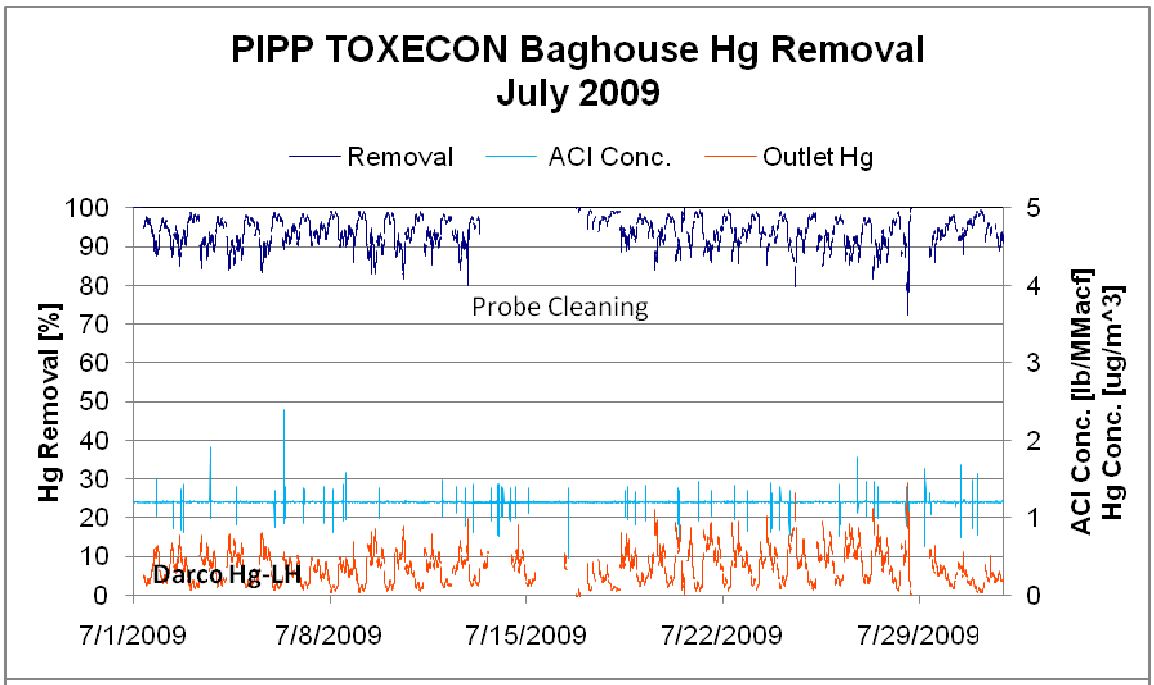

PIPP TOXECON Baghouse Hg Removal
February 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
Alternative PAC
2/1/2009
2/8/2009
2/15/2009
2/22/2009

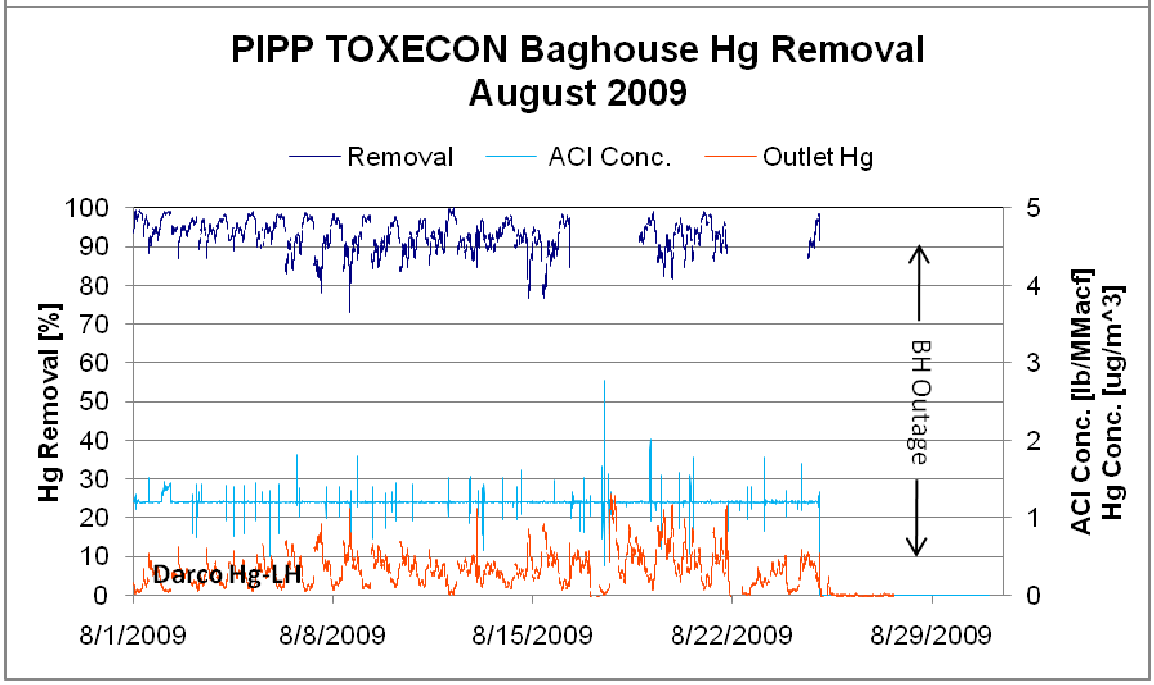

PIPP TOXECON Baghouse Hg Removal
March 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
3/1/2009
3/8/2009
3/15/2009
3/22/2009
3/29/2009

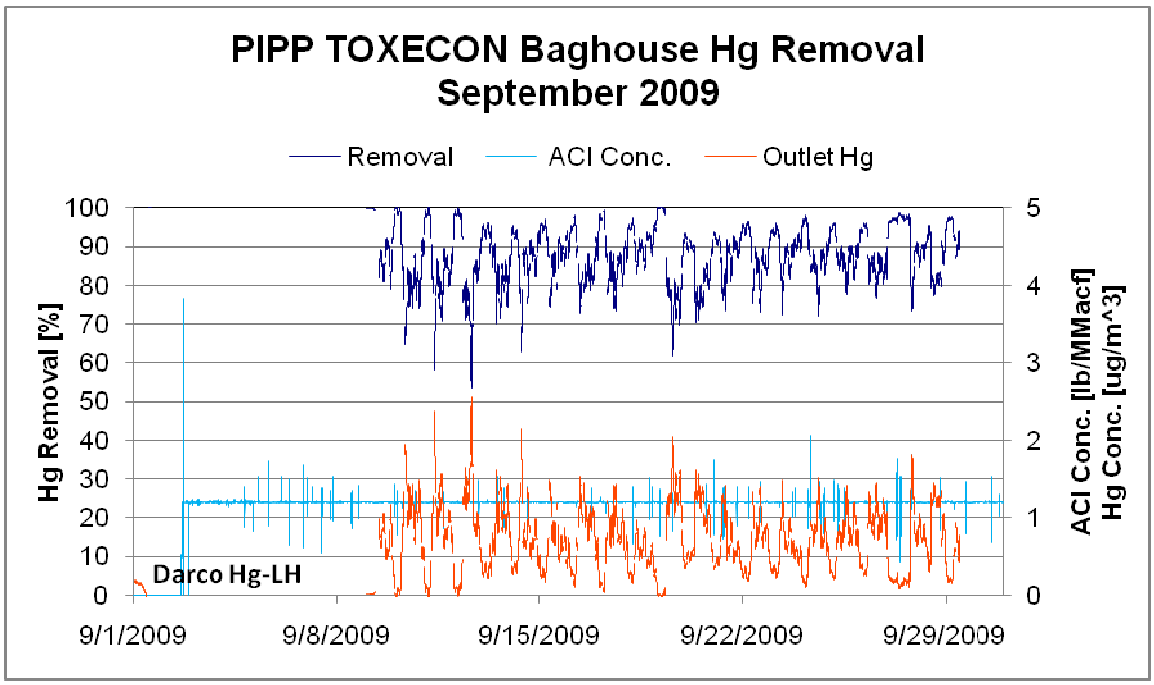

PIPP TOXECON Baghouse Hg Removal
April 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Sorbent Screening
Darco Hg-LH
4/1/2009
4/8/2009
4/15/2009
4/22/2009
4/29/2009


PIPP TOXECON Baghouse Hg Removal
May 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
5/1/2009
5/8/2009
5/15/2009
5/22/2009
5/29/2009


PIPP TOXECON Baghouse Hg Removal
June 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Darco Hg-LH
6/1/2009
6/8/2009
6/15/2009
6/22/2009
6/29/2009


PIPP TOXECON Baghouse Hg Removal
July 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
Probe Cleaning
Darco Hg-LH
7/1/2009
7/8/2009
7/15/2009
7/22/2009
7/29/2009


PIPP TOXECON Baghouse Hg Removal
August 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
BH Outage
Darco Hg-LH
8/1/2009
8/8/2009
8/15/2009
8/22/2009
8/29/2009


PIPP TOXECON Baghouse Hg Removal
September 2009
Removal
ACI Conc.
Outlet Hg
Hg Removal [%]
ACI Conc. [lb/MMacf]
Hg Conc. [ug/m^3]
100
90
80
70
60
50
40
30
20
10
0
5
4
3
2
1
0
Darco Hg-LH
9/1/2009
9/8/2009
9/15/2009
9/22/2009
9/29/2009

Appendix J. Alternative PAC Testing 2009

TOXECON™ Retrofit for Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers

Test Report for Alternative Carbon Injection - Presque Isle Power Plant

Prepared for:
We Energies
DOE/NETL

Prepared by:
ADA Environmental Solutions

8100 SouthPark Way, Unit B
Littleton, CO 80120
(303) 734-1727

April 9, 2009

Table of Contents

1. Introduction 4
2. Test Program Description 4
   2.1. Alternative Sorbent Injection Equipment Description 4
   2.2. Baseline Testing 8
   2.3. Parametric Testing 9
3. Testing Information and Conventions 11
   3.1. Sorbent Description 11
   3.2. Sorbent Injection Calculation Basis 11
4. Mercury Control Results and Discussion 12
   4.1. Baseline 12
   4.2. PAC #2 14
   4.3. PAC #1 17
   4.4. PAC #3 19
   4.5. PAC #6 21
   4.6. PAC #5 23
   4.7. PAC #4 25
   4.8. Mercury Removal Profiles 26
5. Conclusions 30

List of Figures

Figure 1. Picture of Portable Injection Equipment Inside Boiler House 6
Figure 2. Injection Port (similar for each duct)..... 7
Figure 3. TOXECON™ Hg Injection/Monitor System Schematic 8
Figure 4. Alternative PAC Injection Test Matrix 10
Figure 5. Baseline Mercury and Plant Data 13
Figure 6. Mercury and Plant Data During PAC #2 Parametric Tests 15
Figure 7. PAC #2 Mercury Removal Versus Temperature Correlations 16
Figure 8. Mercury and Plant Data During PAC #1 Parametric Tests 17
Figure 9. PAC #1 Mercury Removal Versus Temperature Correlations 18
Figure 10. Mercury and Plant Data During PAC #3 Parametric Tests 19
Figure 11. PAC #3 Mercury Removal Versus Temperature Correlations 20
Figure 12. Mercury and Plant Data During PAC #6 Parametric Tests 21
Figure 13. PAC #6 Mercury Removal Versus Temperature Correlations 22
Figure 14. Mercury and Plant Data During PAC #5 Parametric Tests 23
Figure 15. PAC #5 Mercury Removal Versus Temperature Correlations 24
Figure 16. Mercury and Plant Data During PAC #4 Parametric Tests 25
Figure 17. PAC #4 Mercury Removal Versus Temperature Correlations 26
Figure 18. Sorbent Performance Curves, Normalized to 330°F 27
Figure 19. Sorbent Performance Curves, Normalized to 340°F 27
Figure 20. DARCO Hg-LH® Performance Curves, Normalized to 330°F 28
Figure 21. DARCO Hg-LH® Performance Curves, Normalized to 340°F 28

List of Tables

Table 1. Approximate Sorbent Injection Rates/Concentrations 11
Table 2. Parametric Injection Times, Concentrations, and Removals 29

1. Introduction

In February 2009 as part of the Clean Coal Power Initiative project at We Energies' Presque Isle Power Plant a test of alternative sorbents for mercury control was performed. The alternative sorbent test program was designed to support the overall objectives of the TOXECON™ retrofit at Presque Isle as well as to further the technical understanding of the TOXECON™ technology for both We Energies and the greater industry. Sorbent injection tests were conducted to assess the capability of alternative sorbents injected in the TOXECON™ system to control mercury. Temporary injection equipment was installed specifically for these tests. The Thermo Scientific Mercury Freedom Systems currently installed upstream of PAC injection and downstream of the TOXECON™ baghouse were used to measure the inlet and outlet mercury concentrations.

Specifically, the following test program objectives were pursued:

1. Quantify the mercury removal versus sorbent injection rate while injecting alternative sorbents using temporary injection equipment.
2. Using data from previous testing periods to compare the mercury removal obtained by a commercially available sorbent against removals obtained by the alternative sorbents.
3. Record baghouse performance over the test period, showing how pressure drop, cleaning frequency and mercury removal change.
4. Evaluate the technical performances of tested sorbents.

The alternative sorbent injection tests for mercury control were conducted in a parametric testing format over a period of two weeks in February 2009. Initially, ADA-ES planned to inject NORIT Americas DARCO® Hg-LH using the temporary injection equipment along with the alternative carbons, but due to time constraints this was not possible. The purpose of injecting DARCO® Hg-LH was to have a direct comparison between a commercially available sorbent and the alternative sorbents while using the temporary injection system. Since a direct comparison was not available data from previous parametric testing with DARCO® Hg-LH was used for the comparison. A total of six alternative carbons provided by ADA-ES were tested.

2. Test Program Description

2.1. Alternative Sorbent Injection Equipment Description

The temporary sorbent injection equipment consisted of a portable sorbent injection module capable of delivering a sufficient feed rate of activated carbon to develop performance curves for the different sorbents. The injection module was comprised of sorbent storage and handling, a metering and feed delivery system, transport hose, a sorbent distribution system, and 3 injection lances.

Figure 1 shows the portable injection equipment installed at the Presque Isle Power Plant. The unit was approximately 16 feet high (two 8-ft sections), with an 8 ft x 8 ft footprint and an empty weight of three (3) tons. The loading capacity of the injection equipment was one super sack of sorbent (~1,000 lbs). Placement of the temporary injection equipment for this test program was inside the boiler house on the ground floor between Units 8 & 9.

The sorbent was metered by a variable speed screw feeder into a pneumatic eductor that provided the motive force to transport the sorbent to the injection points. A regenerative blower provided the conveying air. During the parametric injection testing ADA personnel manually adjusted the feed rate in proportion to the varying Unit load.

For parametric injection testing, sorbent was delivered to the site in 1,000 pound super sacks. The super sacks were off-loaded from the delivery truck by plant personnel to the lay down area near the injection equipment. ADA personnel loaded the super sacks into the portable injection silo as needed throughout the test.

Figure 1. Picture of Portable Injection Equipment Inside Boiler House

The sorbent was conveyed to three injection lances which were located downstream of the ID fan discharges, but upstream of the point where the ducts combine. Each lance discharged sorbent into the center of its duct, where turbulent flow provided gas/sorbent mixing. The lances were located underneath the permanent PAC injection lances. This location was also downstream of the NO_x analyzer probe used for boiler feedback. These are the same ports used during previous alternative carbon tests (**Figure 2**).

Figure 2. Injection Port (similar for each duct)

A schematic of the system is shown in **Figure 3**. At location "C" in the schematic, mercury monitoring with the current Mercury CEM units continued unchanged. At the PAC Injection locations the alternative PACs were injected using the ports (one per unit) shown in **Figure 2**. The permanently installed ACI system was not operating during the period of alternative PAC testing.

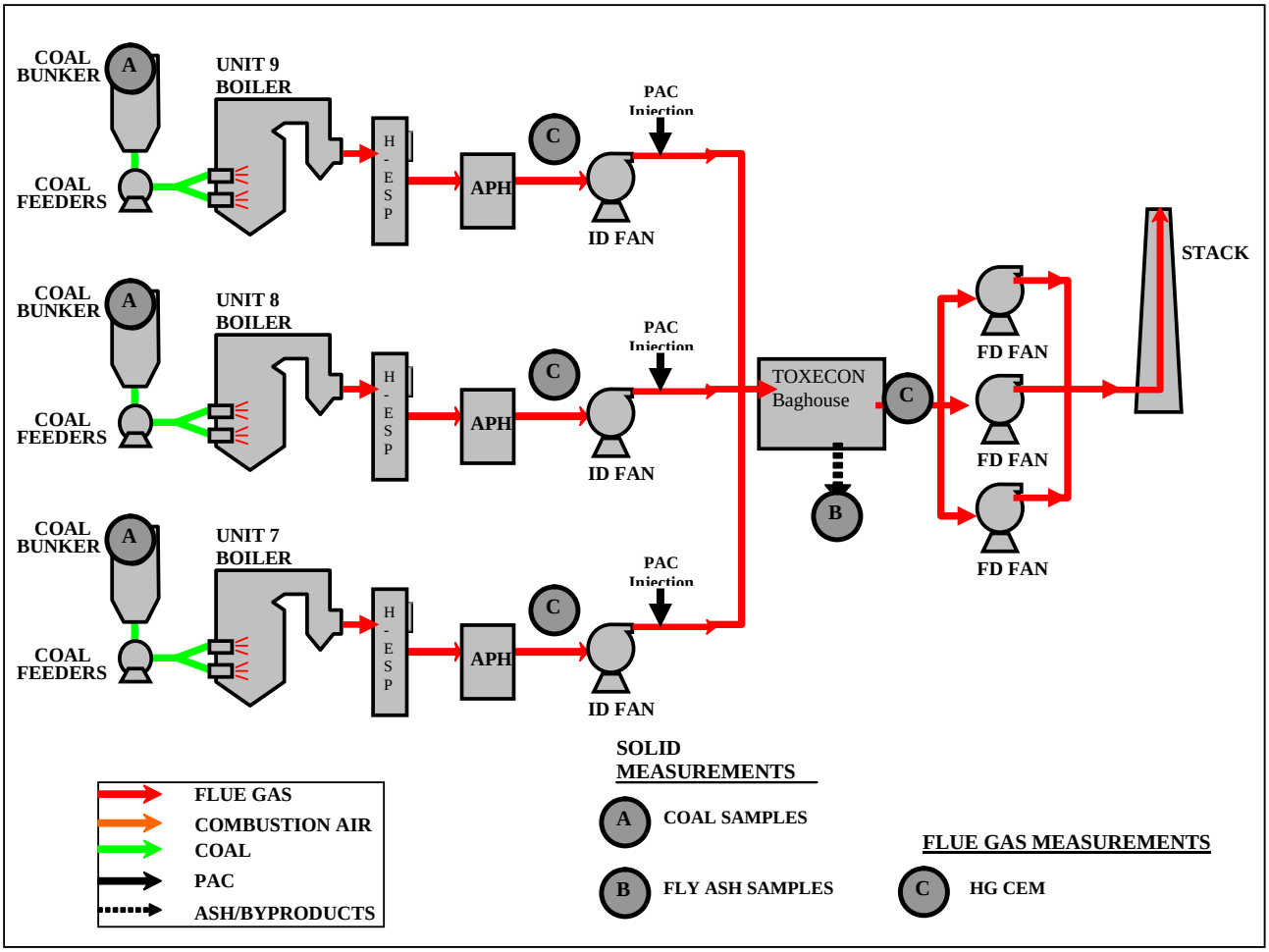


Figure 3. TOXECON™ Hg Injection/Monitor System Schematic

2.2. Baseline Testing

Baseline measurements were taken over a six day period during the week prior to injection testing. PAC injection from the permanent activated carbon injection (ACI) system was stopped on Tuesday, February 10th and alternative sorbent injection testing started on Monday, February 16th. Unit 8 had an unscheduled outage from February 13th and came back to full load on the morning of the 16th. During this baseline period without PAC injection, mercury levels increased until a new, higher baseline condition was established.

This period was used to determine the native mercury removal without injection as well as ensure that the baghouse had enough time to clear out as much PAC as possible from the previously on-going injection. Mercury was continuously measured at the inlet and outlet locations. The inlet measurement was made using the Unit 8 probe.

2.3. Parametric Testing

Parametric tests were performed with six alternative PACs over a two week period from February 16th through the 28th. Each alternative PAC was injected using the temporary injection equipment at nominal concentrations ranging from 0.5 lb/MMacf to 1.5 lb/MMacf. Each parametric test was run for 6 to 12 hours depending on the amount of PAC available and operating conditions with the intent to capture enough stable mercury and baghouse data to produce an average mercury control point. The series of parametric tests were used to develop sorbent performance curves relating the injection concentration to mercury removal efficiency for each alternative PAC. **Figure 4** shows the parametric test matrix and schedule.

The alternative PAC injection tests were performed 24 hours a day throughout the entire test period. This made it possible to get the six alternative PACs tested; however, there was not enough time to inject the DARCO® Hg-LH as planned. It was requested that the plant hold full, steady load for the duration of the test, but this was not possible due to power demand and the Unit 8's planned outage starting earlier than expected. Each night between about midnight and 6:00am the load on all three units was lowered to mid-load levels due to power demand. The last alternative PAC, PAC #4, was tested with only 2 Units online because of Unit 8's early outage. Since load and flue gas flow varied during testing the injection rates (lb/hr) were manually adjusted to maintain consistent injection concentrations (lb/MMacf).

All baghouse operational setpoints were unchanged during the two week period of testing except when a full clean of the baghouse was initiated when switching to a different carbon to remove residual PAC from the bags. This was performed by manually pulsing all the bags twice.

Coal samples were taken on the Monday, Wednesday, and Friday of the two weeks of parametric testing from the A1 coal feeders on each Unit. Ash samples were taken on the second day of testing of each alternative PAC from baghouse hoppers 1, 5, 6, and 10. These four ash samples were then composited at the ADA-ES laboratory. Coal and ash analysis was not part of the test plan, however, analysis of the samples could be done if it was determined that the data was needed.

	Normal Operations					Active Testing Program													Return to Normal O	
Test Day	**M1**	**M2**	**M3**	**M4**	**M5**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**M4**	**M5**
Testing Date	**2/11**	**2/12**	**2/13**	**2/14**	**2/15**	**2/16**	**2/17**	**2/18**	**2/19**	**2/20**	**2/21**	**2/22**	**2/23**	**2/24**	**2/25**	**2/26**	**2/27**	**2/28**	**3/1**	**3/2**
Day or the Week	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Mon**
Test Sequence Day	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Test Phase/Period	Mobilization/Baseline					Parametric Tests													Decommissioning	
Mobilization																				
Mobilization/Safety Training	X																			
Injection Equipment Set-up		X	X																	
Stabilize Test Equipment for Standby				X	X															
Decommissioning - balance of test equipment																			X	X
Vacate Site (NLT)																				X
Sorbent Tests																				
Baseline (no PAC injection)	X	X	X	X	X															
Rebasline/Recovery								X		X		X		X		X			X	X
Parametric Tests: Altenative PAC #2						#2	#2	#2												
Parametric Tests: Altenative PAC #1								#1	#1	#1										
Parametric Tests: Altenative PAC #3										#3	#3	#3								
Parametric Tests: Altenative PAC #6													#6	#6						
Parametric Tests: Altenative PAC #5														#5	#5	#5				
Parametric Tests: Altenative PAC #4																#4	#4	#4	#4	
Analytical Methods																				
Flue Gas Mercury [ThermoCEM System - UPSTREAM of ACI, INLET]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Flue Gas Mercury [ThermoCEM System - BH OUTLET]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CEM Systems QA/OA - remote/site monitoring	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Solid Sampling																				
Coal Samples, every Monday, Wednesday, Friday						3		3		3			3		3		3			
Fly Ash Samples, last day of each PAC								4		4		4		4		4		4		

Figure 4. Alternative PAC Injection Test Matrix

3. Testing Information and Conventions

The following sections present information relevant to this mercury control test program.

3.1. Sorbent Description

This test program evaluated the performance of six different alternative PACs. Each PAC was chemically enhanced with bromine. All PACs were treated and prepared by ADA-ES domestically.

3.2. Sorbent Injection Calculation Basis

The sorbent injection concentration refers to the amount of sorbent injected into the duct per million actual cubic foot of flue gas or lb/MMacf. The actual mass flow rate of sorbent is therefore dependent on the total volumetric flow of flue gas at the point of injection. The mass flow rate is determined by the following calculation:

$$\dot{m}_{sorbent} = \frac{\dot{Q}_{fluegas}}{10^6} \times Concentration * 60$$

where,

$\dot{m}_{sorbent}$	lb/hr	mass feed rate of sorbent
$\dot{Q}_{fluegas}$	acfm	volumetric flow rate of flue gas
Concentration	lb/MMacf	sorbent injection concentration
60	min/hr	conversion factor

Table 1 summarizes the nominal sorbent feed rates for the injection concentrations evaluated during this demonstration. The flue gas volumetric flow rates were taken from the plant's EDS system which measures the flow rates at the stack of each Unit. The total flow rate was then calculated by adding together each online Unit's flow. The injection rates were adjusted according to the varying flow rates to keep consistent injection concentrations.

Table 1. Approximate Sorbent Injection Rates/Concentrations

Units 7-9 TOXECON Alternative PAC Injection Rates			
lb/Mmacf	**lb/hr, 3 Units full-load**	**lb/hr, 3 Units mid-load**	**lb/hr, 2 Units full-load**
0.25	16.5	14.25	11.0
0.50	33.0	28.5	22.0
0.75	49.5	42.75	33.0
1.00	66.0	57.0	44.0
1.25	82.5	71.25	55.0
1.50	99.0	85.5	66.0

4. Mercury Control Results and Discussion

The following section presents the results from the baseline period and the six alternative PAC parametric test periods. General evaluations yielded from the overall program are also discussed. The data is presented in the order that the PACs were tested (#2, #1, #3, #6, #5, #4).

4.1. Baseline

Baseline measurements were taken over a six day period during the week prior to injection testing. PAC injection from the permanent activated carbon injection (ACI) system was stopped on Tuesday, February 10th and alternative sorbent injection testing started on Monday, February 16th. Unit 8 had an unscheduled outage from February 13th and came back to full load on the morning of the 16th. Over this baseline period we were able to obtain data showing mercury concentration recovery as well as steady state operation. **Figure 5** shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the baseline period.

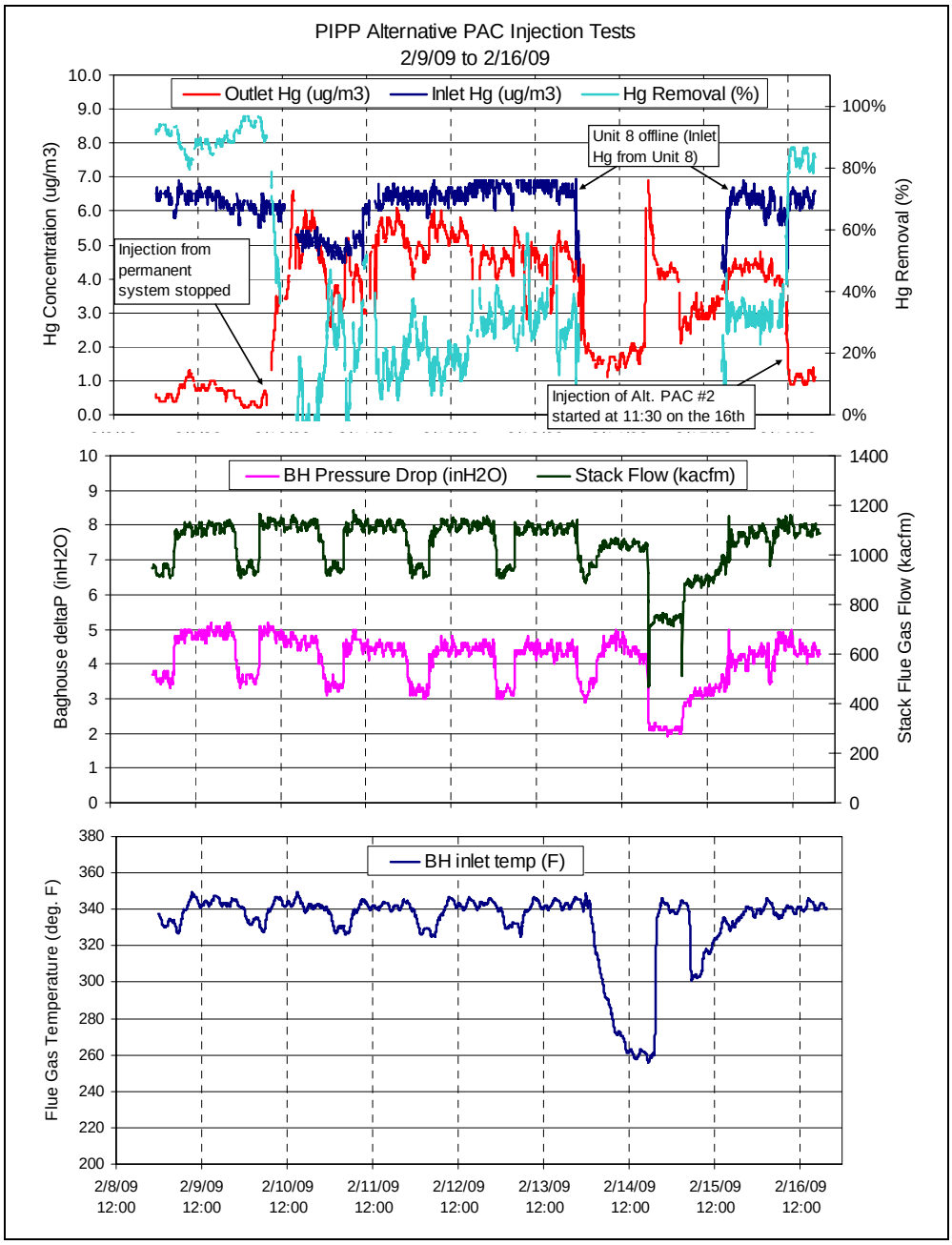


Figure 5. Baseline Mercury and Plant Data

4.2. PAC #2

Alternative PAC #2 was the first sorbent tested. The initial injection plan was to test target injection concentrations of 0.5, 1.0 and 1.5 lb/MMacf. However, at the injection concentration of 1.0 lb/MMacf the mercury removal percentages were between 95% – 100%. Since the mid-range injection concentration was able to produce such high mercury removal it was decided to test lower injection concentrations. The lower injection concentrations tested were 0.5 and 0.75 lb/MMacf. The injection concentration of 0.5 lb/MMacf was tested for the second time to determine if the results were repeatable and 0.75 lb/MMacf was tested to fill out the sorbent performance curve. **Figure 6** shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the PAC #2 tests. As expected, baghouse pressure drop varied with flue gas flow rate and was minimally affected by PAC injection rate.

The grey bars on the graphs in **Figure 6** and subsequent figures represent the periods of PAC injection while the blue bars represent the periods of data used for the sorbent performance curves. The data used for the performance curves was taken from periods when it was determined that the conditions had stabilized.

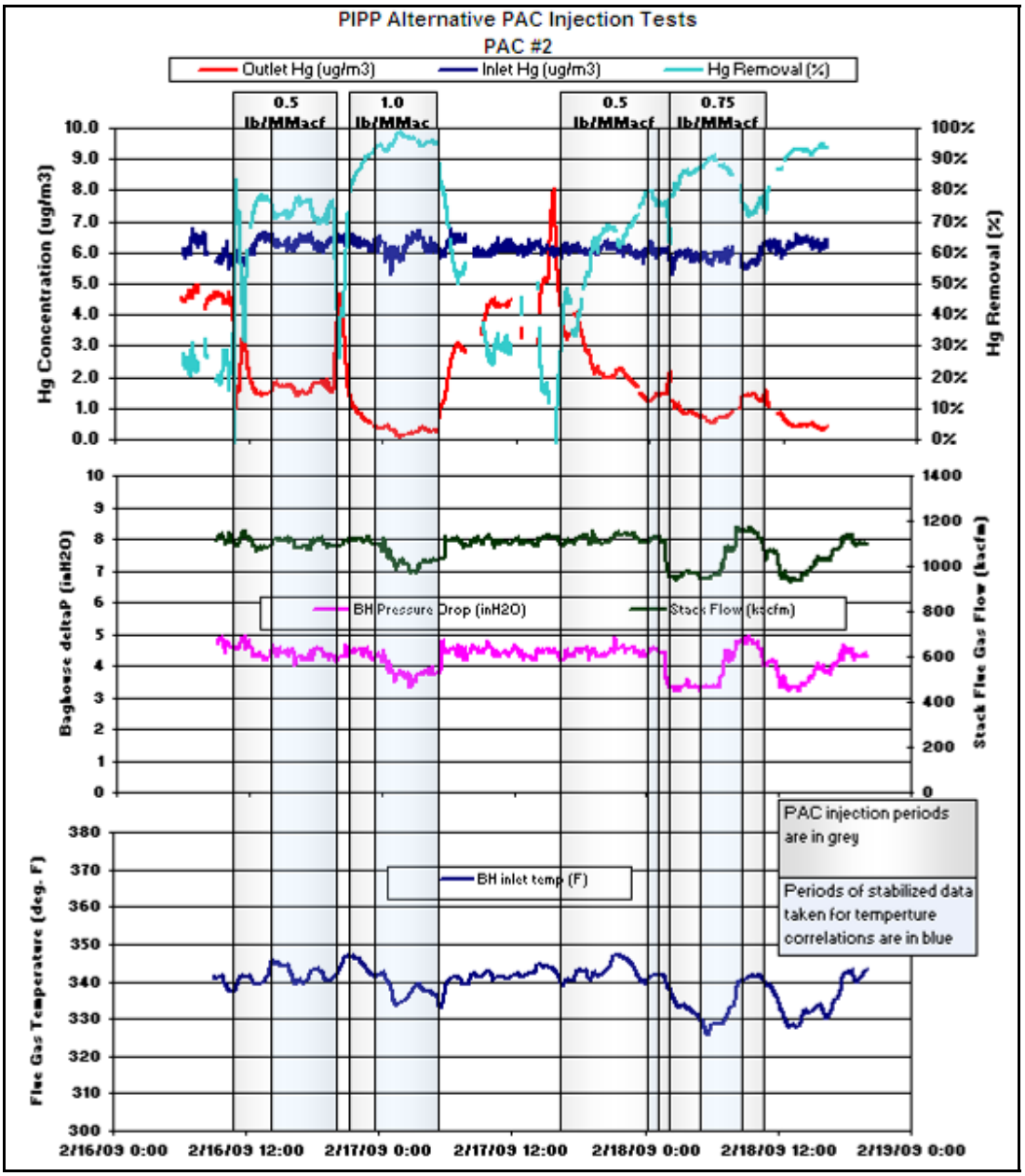


Figure 6. Mercury and Plant Data During PAC #2 Parametric Tests

Figure 7 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested. The data used for the correlations is taken from the periods shown in **Figure 6** in the light blue bar areas. The correlations are linear as the baghouse temperature increases the mercury removal percentage decreases. A removal percentage at a given temperature can be determined by inserting the given temperature into the linear regression formula. **Figure 7** also shows the two periods of an injection concentration of 0.5 lb/MMacf (shown by pink triangles and blue squares) which confirms that the mercury removal for PAC #2 at this injection concentration is repeatable.

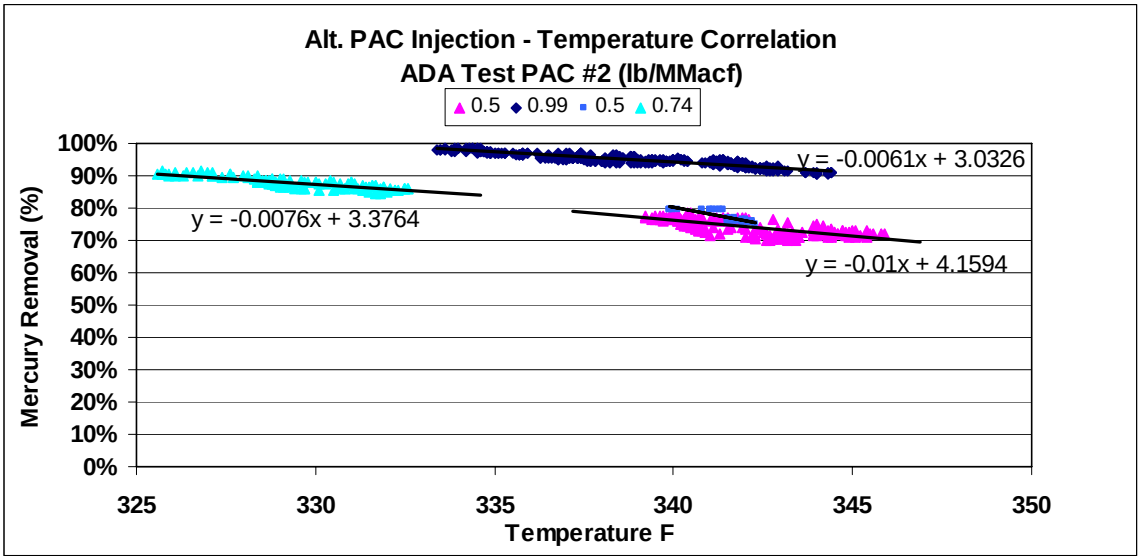


Figure 7. PAC #2 Mercury Removal Versus Temperature Correlations

4.3. PAC #1

Alternative PAC #1 was the second sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. **Figure 8** shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the PAC #1 tests. After testing the four injection concentrations, the injection rate was increased to the equipment's highest feed rate to run out the remainder of the sorbent. This explains why the mercury removal percentages remained high after the 1.5 lb/MMacf tests was finished.

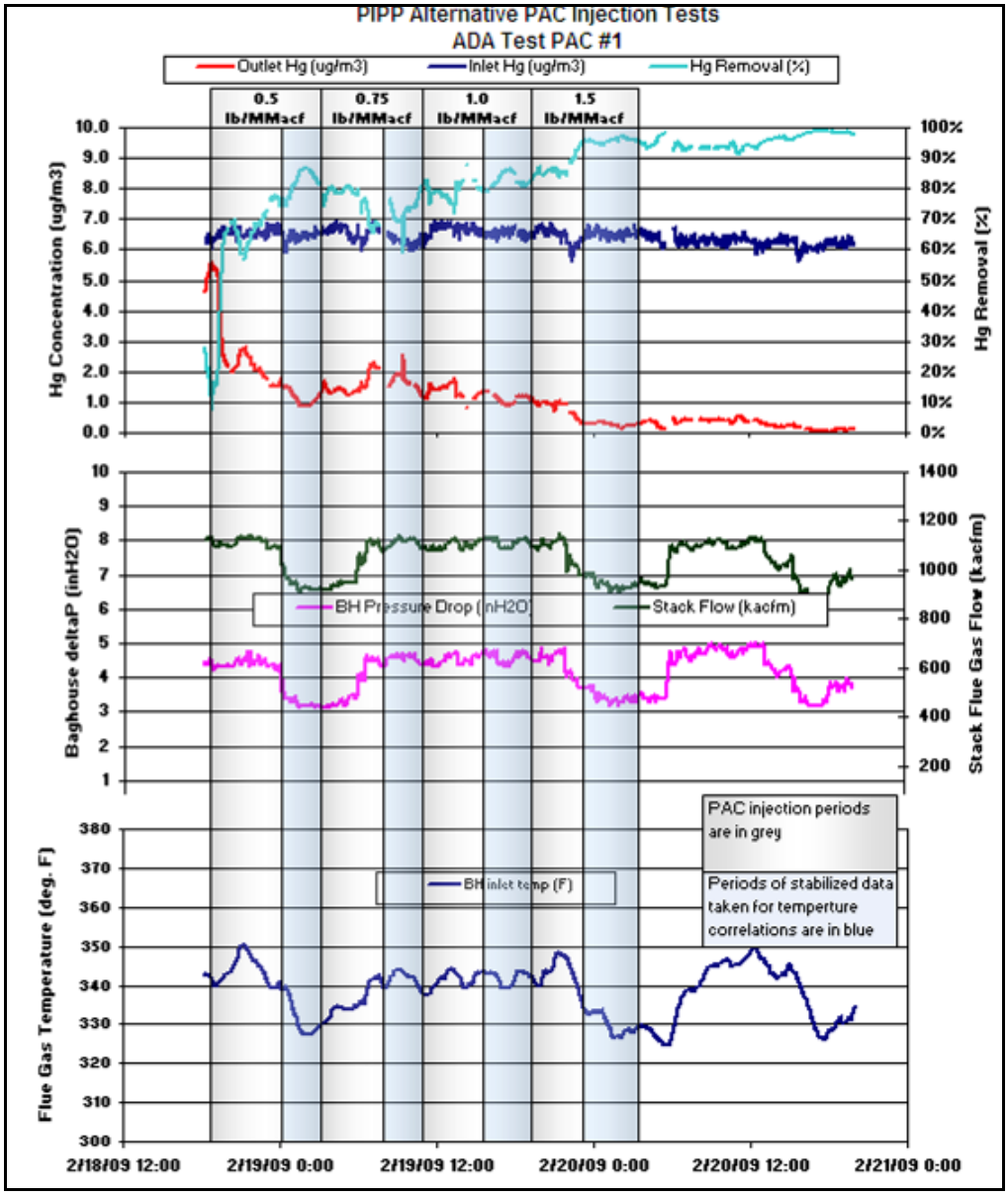


Figure 8. Mercury and Plant Data During PAC #1 Parametric Tests

Figure 9 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested. The data used for the correlations is taken from the periods shown in **Figure 8** in the light blue bar areas.

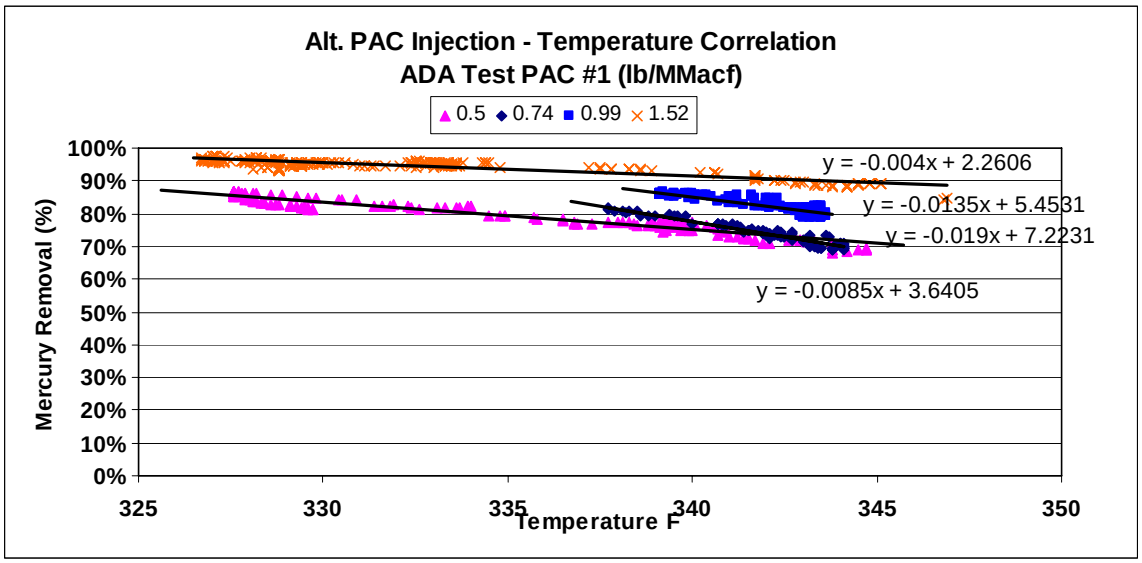


Figure 9. PAC #1 Mercury Removal Versus Temperature Correlations

4.4. PAC #3

Alternative PAC #3 was the third sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. **Figure 10** shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the PAC #3 tests.

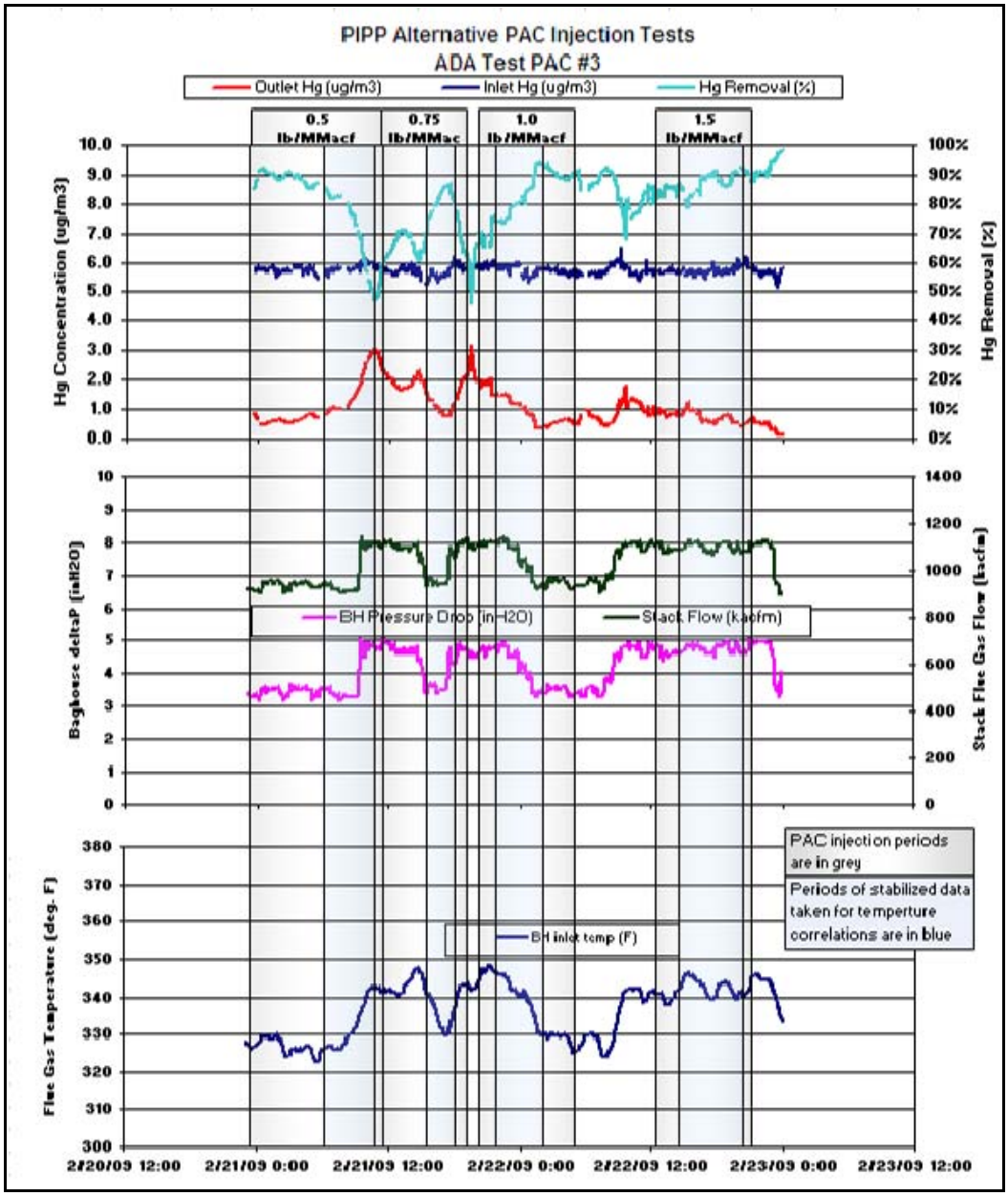


Figure 10. Mercury and Plant Data During PAC #3 Parametric Tests

Figure 11 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested. The data used for the correlations is taken from the periods shown in **Figure 10** in the light blue bar areas.

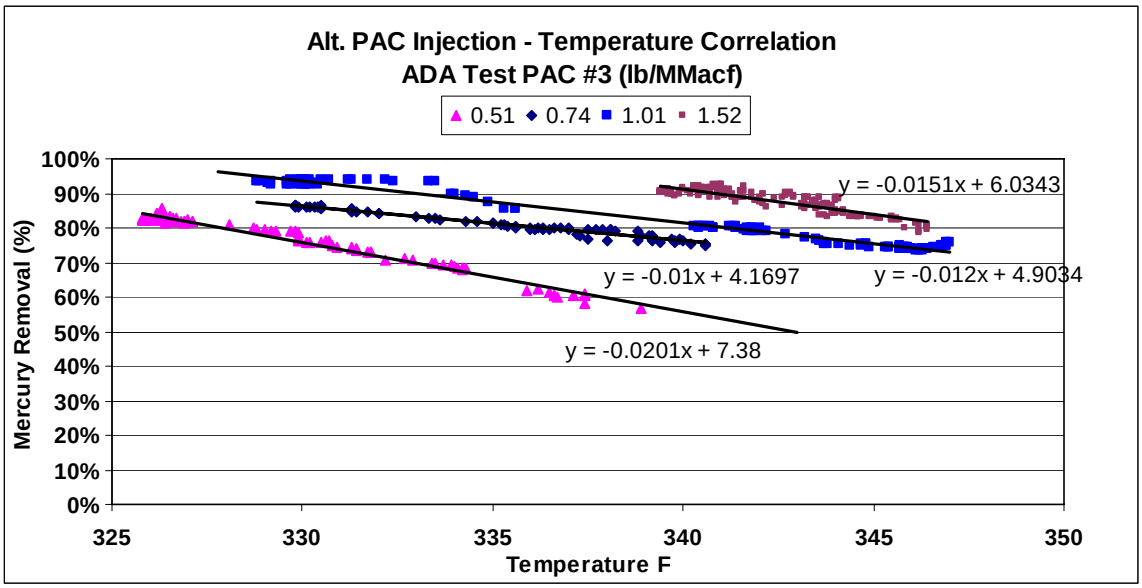


Figure 11. PAC #3 Mercury Removal Versus Temperature Correlations

4.5. PAC #6

Alternative PAC #6 was the fourth sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/ MMacf. **Figure 12** shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the PAC #6 tests.

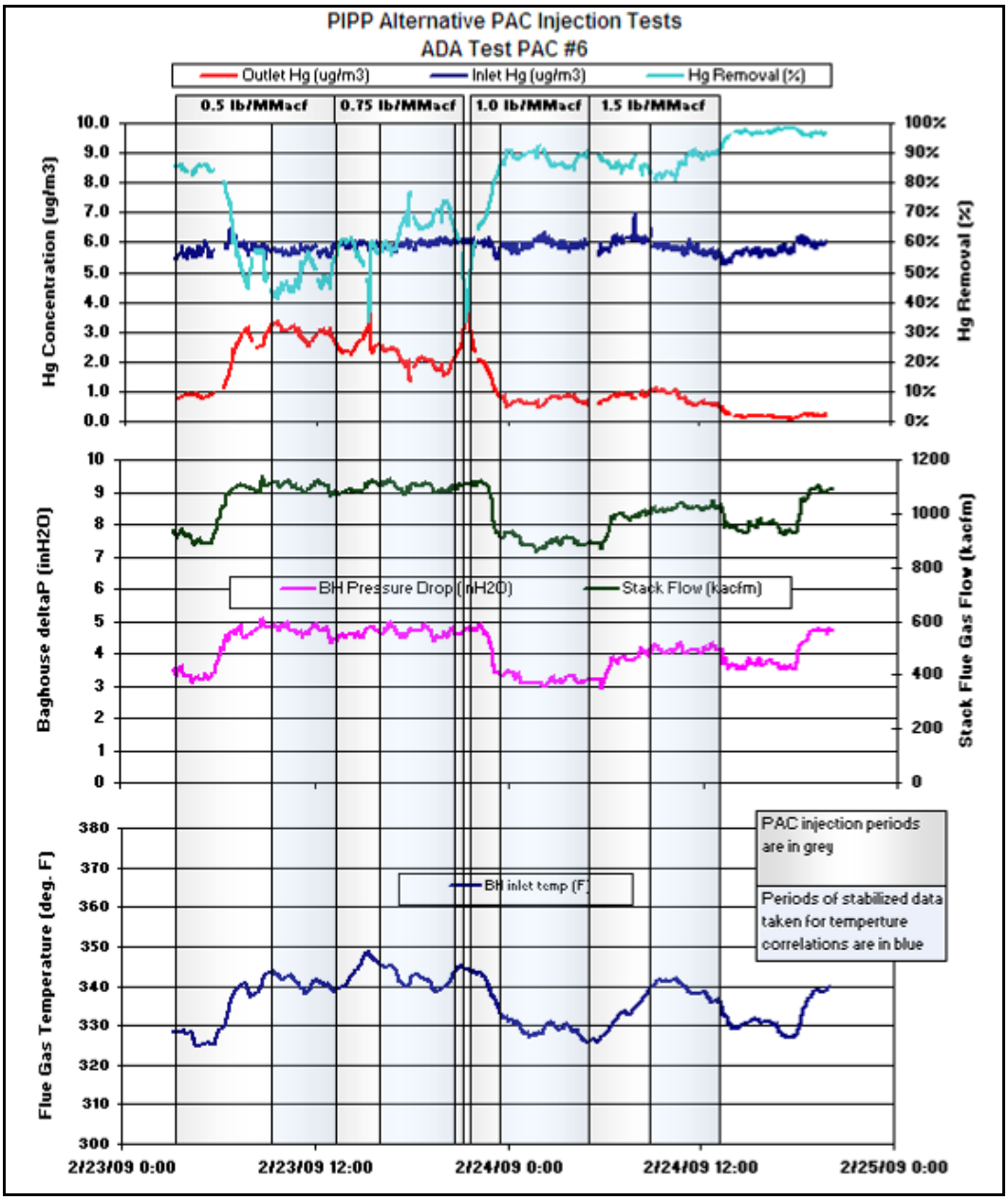


Figure 12. Mercury and Plant Data During PAC #6 Parametric Tests

Figure 13 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested. The data used for the correlations is taken from the periods shown in **Figure 12** in the light blue bar areas.

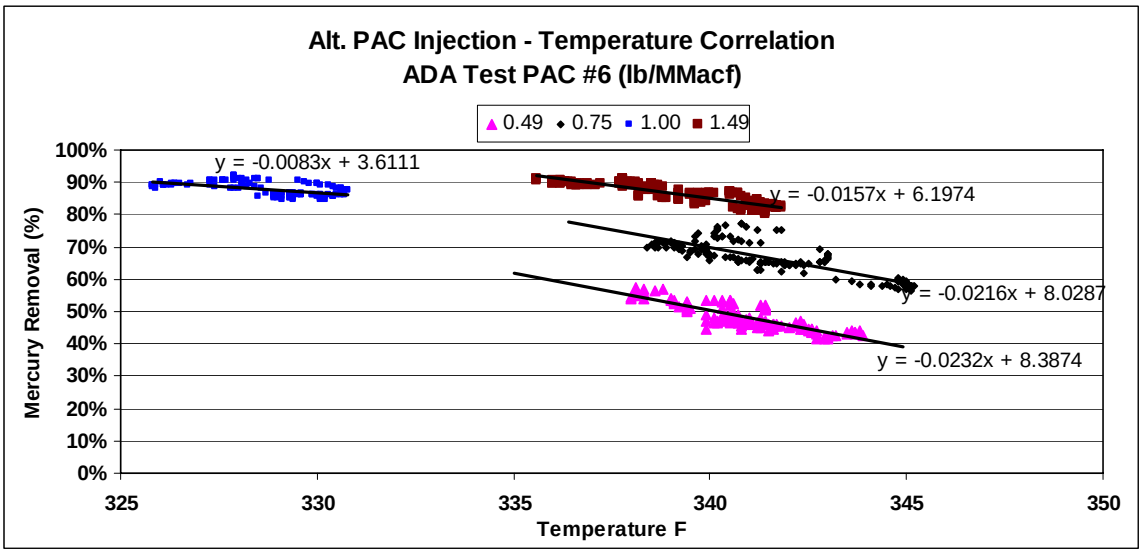


Figure 13. PAC #6 Mercury Removal Versus Temperature Correlations

4.6. PAC #5

Alternative PAC #5 was the fifth sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. **Figure 14** shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the PAC #5 tests.

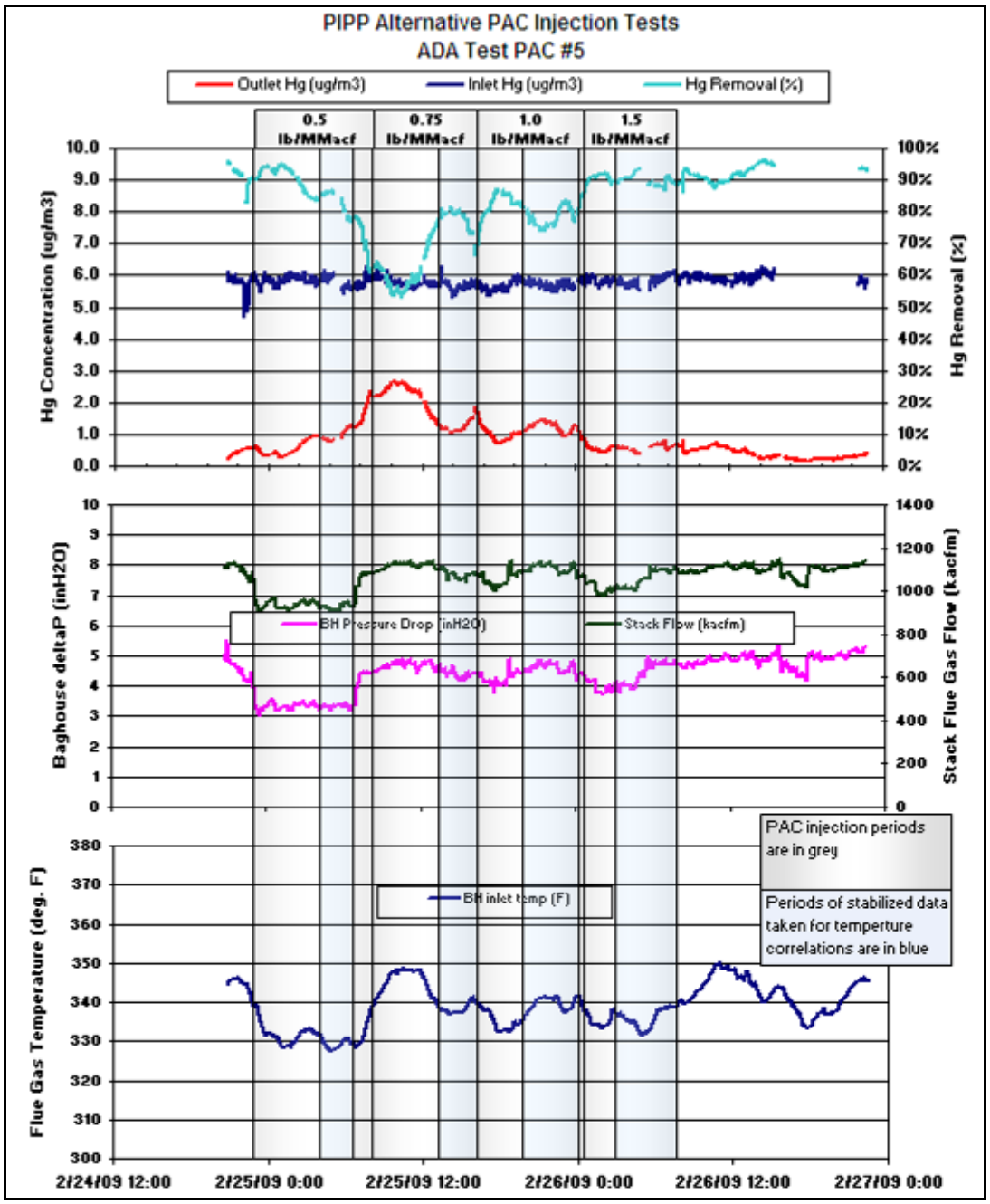


Figure 14. Mercury and Plant Data During PAC #5 Parametric Tests

Figure 15 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested. The data used for the correlations is taken from the periods shown in **Figure 14** in the light blue bar areas.

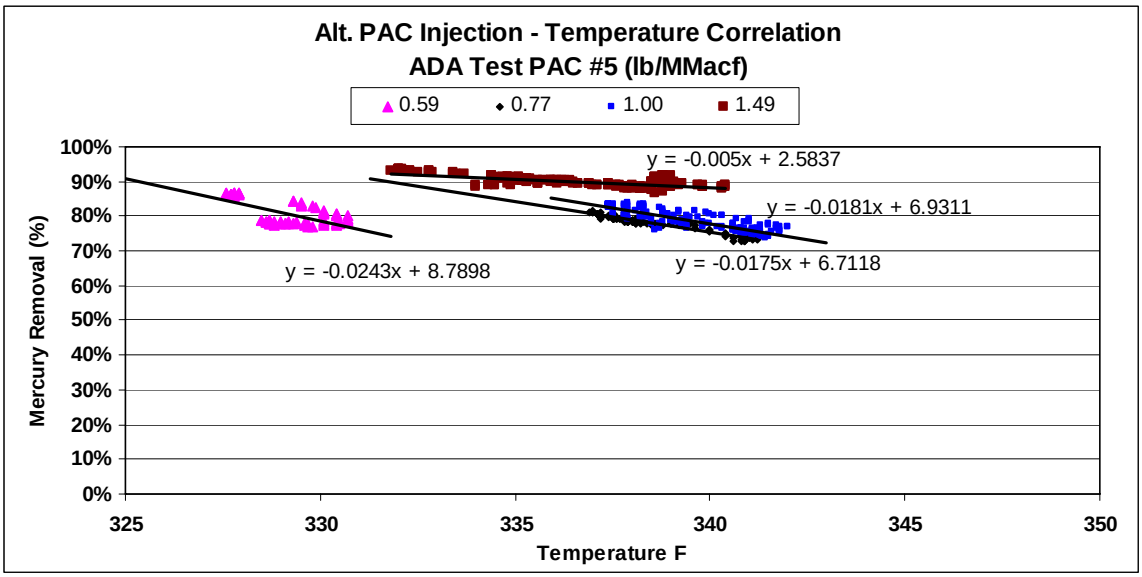


Figure 15. PAC #5 Mercury Removal Versus Temperature Correlations

4.7. PAC #4

Alternative PAC #4 was the last sorbent tested. The injection concentrations tested were 0.5, 0.75, 1.0, and 1.5 lb/MMacf. **Figure 16** shows the mercury inlet, outlet, and removal, the stack flue gas flow, baghouse temperature and pressure drop for the PAC #4 tests. Prior to starting injection of PAC #4 Unit 8 went into its scheduled outage. The injection to the Unit 8 duct was secured and the injection rate to the other two ducts was adjusted to account for the reduced flue gas flow rate.

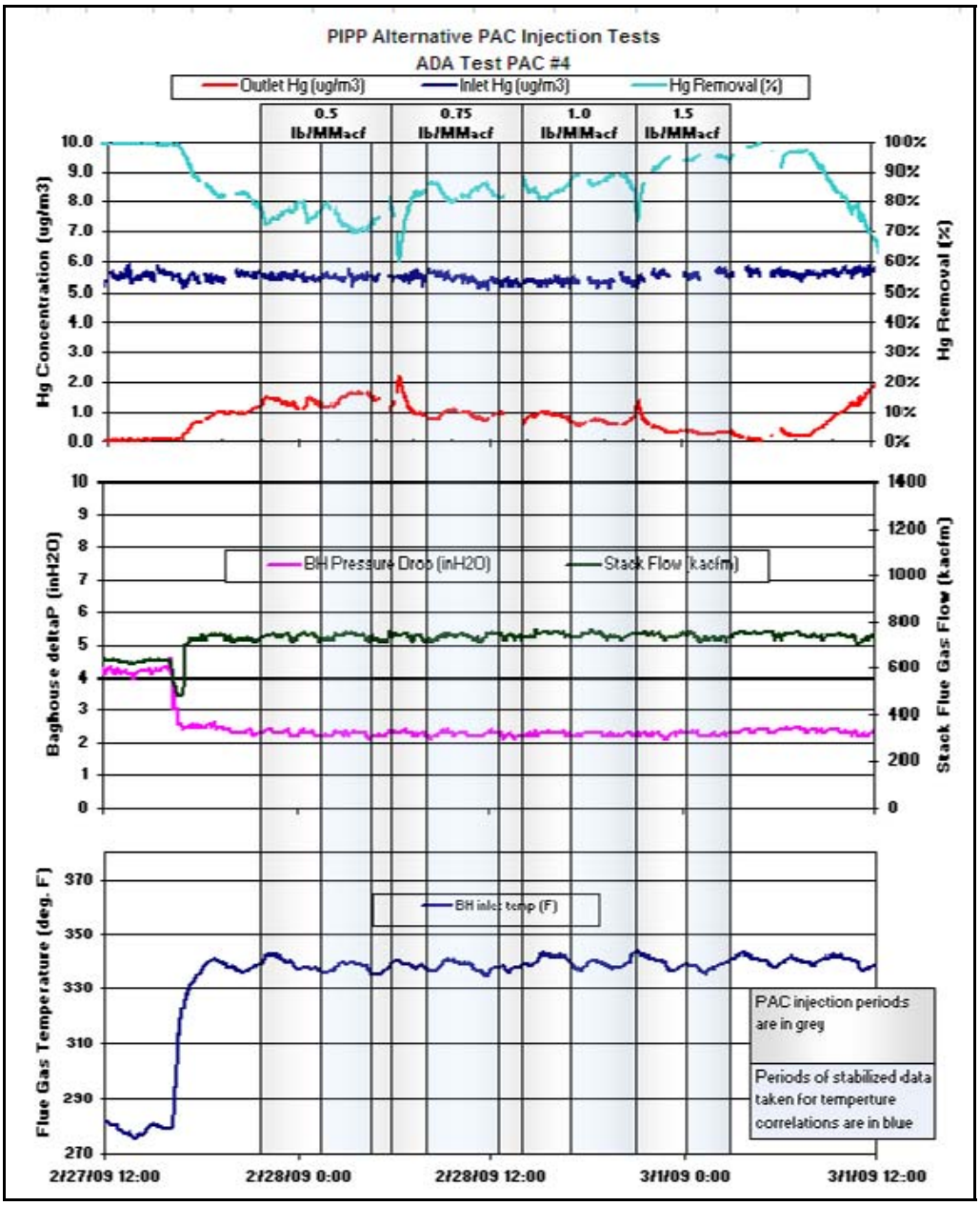


Figure 16. Mercury and Plant Data During PAC #4 Parametric Tests

Figure 17 shows the correlation between mercury removal percentage and the baghouse temperature for each injection concentration tested. The data used for the correlations is taken from the periods shown in **Figure 16** in the light blue bar areas.

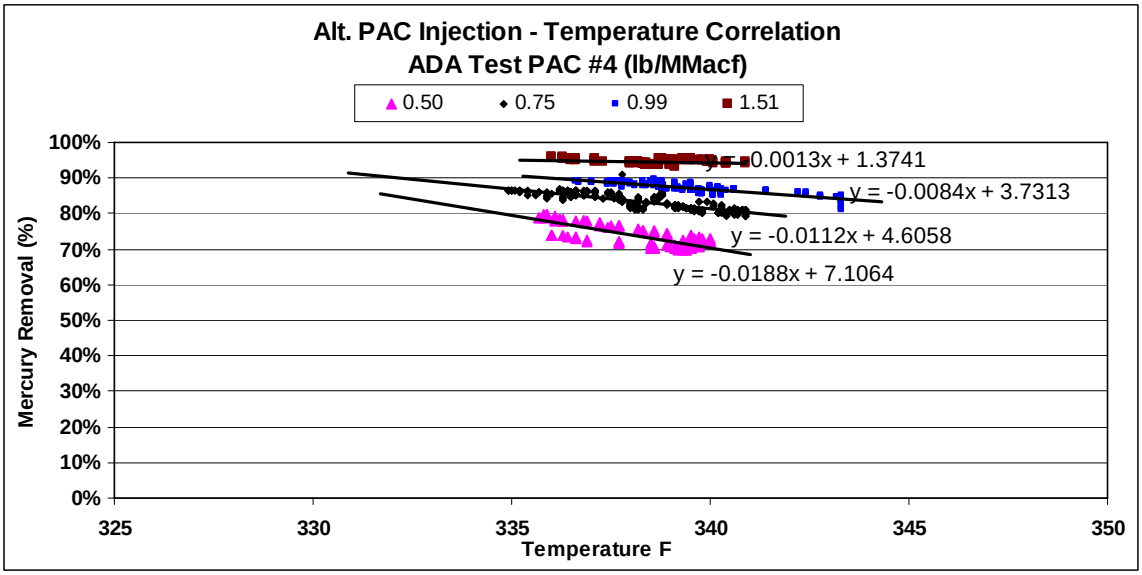


Figure 17. PAC #4 Mercury Removal Versus Temperature Correlations

4.8. Mercury Removal Profiles

The mercury removal at baghouse temperatures of 330°F and 340°F are shown in **Figure 18** and **Figure 19**, respectively. **Table 2** displays the injection times, concentrations, and mercury removals that correspond to the data in **Figure 18** and **Figure 19**. Each removal point was calculated using the linear regression equations produced by the Hg removal versus baghouse temperature correlations. Note: There is an inherent variability in this method of extrapolation. Even though removal has been shown to have a linear relationship with baghouse temperature, any error in this method can be exaggerated by data collected over a limited temperature range and variable plant operating conditions. Long term injection over a wide temperature range would be preferable to characterize each sorbent's performance at a specific temperature.

The data in **Figure 18**, **Figure 19**, and **Table 2**, also displays removal data from DARCO Hg-LH® injection tests performed in 1st Quarter 2008 injection tests. The removals were determined by the same linear regression method as the alternative PACs.

Taking into account the variability of determining mercury removals at specific temperatures, the alternative PACs performed as well or perhaps better than the DARCO Hg-LH® did in the previous tests. PACs #1 and #2 seemed to perform

slightly better than the others, while PACs #3, #6 were on the lower end of the removals.

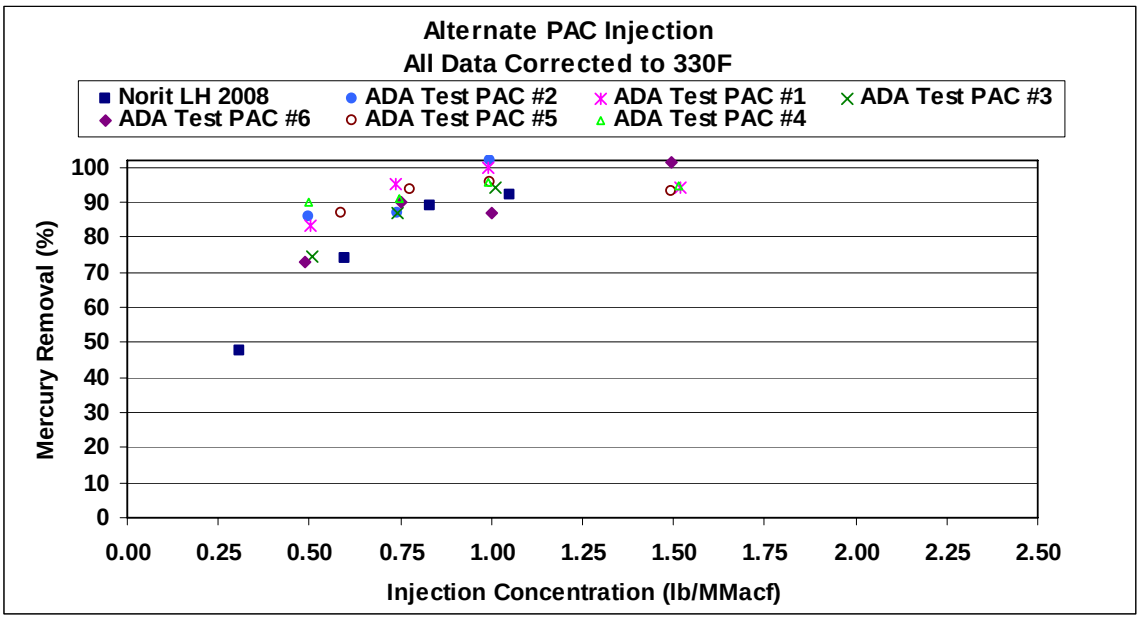


Figure 18. Sorbent Performance Curves, Normalized to 330°F

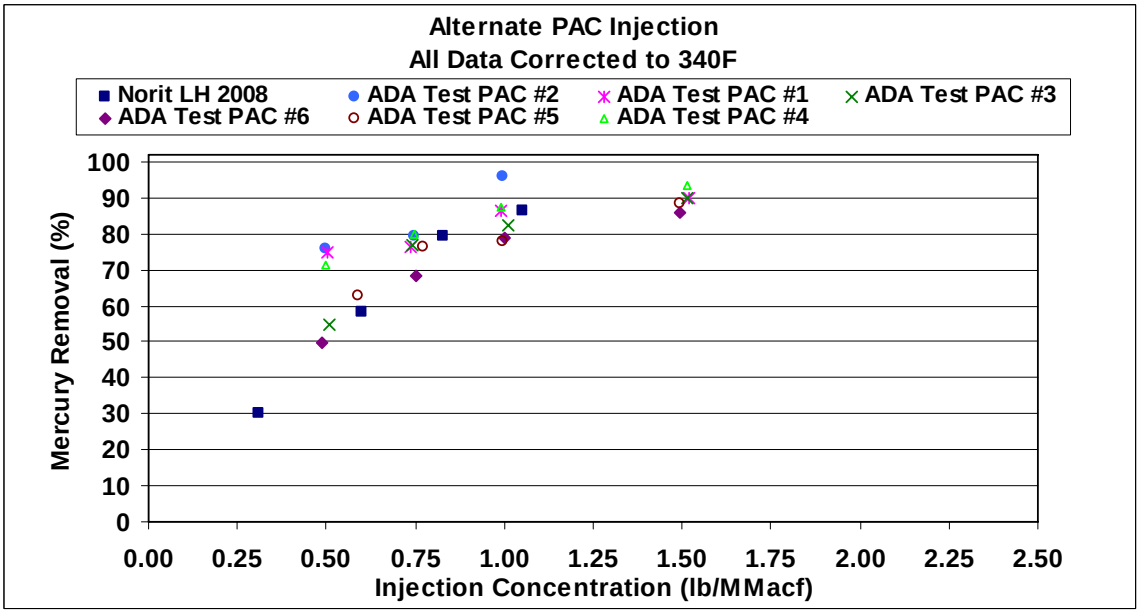


Figure 19. Sorbent Performance Curves, Normalized to 340°F

PAC #4 performed well at the lower injection concentrations and even though this PAC was tested with only 2 out of 3 Units online it is possible to make a performance comparison with the other tests. Historically, PAC injection with the Presque Isle TOXECON™ system produces similar mercury control at the same injection concentration if there are 2 or 3 Units are online. Evidence of the similarity can be

seen in **Figure 20** and **Figure 21** which display DARCO Hg-LH performance curves from periods with 2 Units online, 3 Units online, and from the 2008 tests using temporary injection equipment.

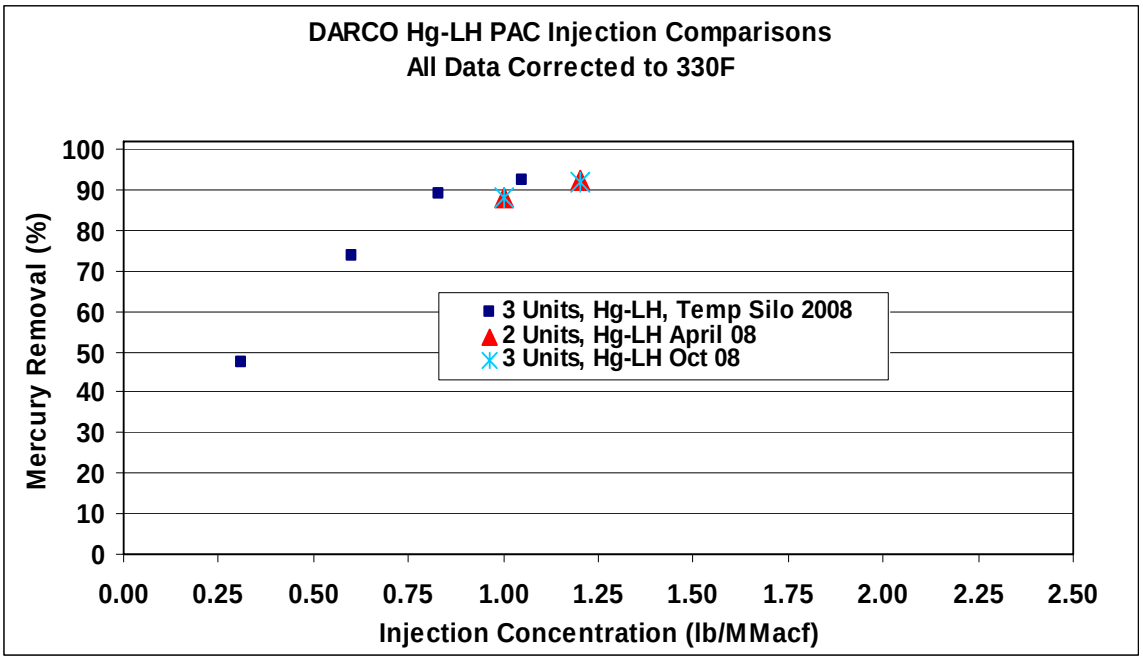


Figure 20. DARCO Hg-LH® Performance Curves, Normalized to 330°F

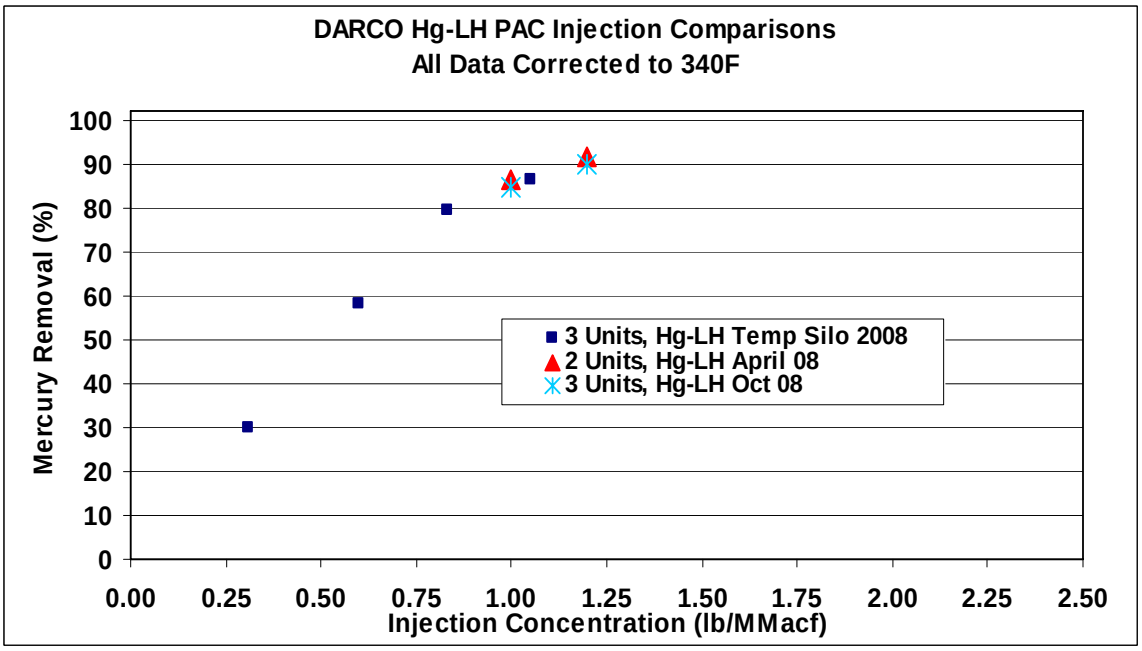


Figure 21. DARCO Hg-LH® Performance Curves, Normalized to 340°F

Table 2. Parametric Injection Times, Concentrations, and Removals

Start Date	End Date	Injection Start Time	Injection End Time	PAC Injection Concentration (lb/MMacf)	Calc. Hg Removal at 330F	Calc. Hg Removal at 340F
DARCO Hg LH Un-Milled Round 2 from Mini Silo 2008						
3/11/2008	3/12/2008	18:15	18:15	0.31	47.51	30.04
3/12/2008	3/13/2008	18:15	12:00	0.60	73.85	58.30
3/13/2008	3/13/2008	12:00	21:00	0.83	89.30	79.26
3/13/2008	3/14/2008	21:00	6:00	1.05	92.25	86.30
PAC #2						
2/16/2009	2/16/2009	11:30	19:30	0.50	85.94	75.94
2/18/2009	2/18/2009	1:50	9:50	0.74	86.84	79.24
2/16/2009	2/17/2009	20:30	5:30	0.99	101.96	95.86
PAC #1						
2/18/2009	2/19/2009	19:05	3:10	0.50	83.55	75.05
2/19/2009	2/19/2009	3:10	11:00	0.74	95.31	76.31
2/19/2009	2/19/2009	11:15	19:20	0.99	99.81	86.31
2/19/2009	2/20/2009	19:40	4:30	1.52	94.06	90.06
PAC #3						
2/20/2009	2/21/2009	23:40	11:00	0.51	74.70	54.60
2/21/2009	2/21/2009	11:10	19:20	0.74	86.97	76.97
2/21/2009	2/22/2009	19:30	5:00	1.01	94.34	82.34
2/22/2009	2/22/2009	13:20	21:00	1.52	105.13	90.03
PAC #6						
2/23/2009	2/23/2009	2:50	13:00	0.49	73.14	49.94
2/23/2009	2/23/2009	13:00	21:00	0.75	90.07	68.47
2/23/2009	2/24/2009	21:20	5:00	1.00	87.21	78.91
2/24/2009	2/24/2009	5:20	13:20	1.49	101.64	85.94
PAC #5						
2/24/2009	2/25/2009	22:50	8:00	0.59	86.98	62.98
2/25/2009	2/25/2009	8:00	16:00	0.77	93.68	76.18
2/25/2009	2/26/2009	16:09	0:00	1.00	95.81	77.71
2/26/2009	2/26/2009	0:00	8:25	1.49	93.37	88.37
PAC #4						
2/27/2009	2/28/2009	22:00	6:00	0.50	90.24	71.44
2/28/2009	2/28/2009	6:15	14:30	0.75	90.98	79.78
2/28/2009	2/28/2009	14:30	21:10	0.99	95.93	87.53
2/28/2009	3/1/2009	21:10	3:00	1.51	94.51	93.21

5. Conclusions

- All six ADA-ES alternative sorbents performed as well as the commercially available sorbent DARCO Hg-LH® in the TOXECON™ baghouse at Presque Isle.

- Mercury removal varied linearly with baghouse temperature. As temperature increased mercury removal decreased. This is a well-documented correlation in the TOXECON™ baghouse.

- PAC injection using these six alternative carbons showed minimal effect on baghouse pressure drop or other performance parameters. Cleaning frequency was unchanged during these tests.

Appendix K. Inlet CEMS Daily Average Mercury Concentrations

We Energies Presque Isle Unit 7–9 Baghouse Inlet

Mercury CEMS Average Daily Mercury Concentrations, 2006-2009.

Date	Elemental Channel	Unit 8 Total Mercury
01/01/06	—	-0.25
01/02/06	—	-0.25
01/03/06	—	-0.28
01/04/06	—	-0.25
01/05/06	—	-0.28
01/06/06	—	3.39
01/07/06	—	6.49
01/08/06	—	6.71
01/09/06	—	6.80
01/10/06	—	6.60
01/11/06	—	6.49
01/12/06	—	6.55
01/13/06	—	6.20
01/14/06	—	5.86
01/15/06	—	5.71
01/16/06	—	6.86
01/17/06	—	6.25
01/18/06	—	6.41
01/19/06	—	6.87
01/20/06	—	6.64
01/21/06	—	5.97
01/22/06	—	5.82
01/23/06	—	5.03
01/24/06	—	5.54
01/25/06	—	5.72
01/26/06	—	#N/A
01/27/06	—	5.26
01/28/06	—	5.78
01/29/06	—	6.23
01/30/06	—	5.70

Date	Elemental Channel	Unit 8 Total Mercury
01/31/06	—	5.22
02/01/06	—	5.61
02/02/06	—	5.23
02/03/06	—	5.49
02/04/06	—	5.44
02/05/06	—	5.28
02/06/06	—	5.03
02/07/06	—	4.88
02/08/06	—	4.96
02/09/06	—	4.93
02/10/06	—	4.88
02/11/06	—	5.10
02/12/06	—	5.19
02/13/06	—	5.00
02/14/06	—	5.00
02/15/06	—	5.14
02/16/06	—	5.00
02/17/06	—	4.87
02/18/06	—	4.52
02/19/06	—	5.25
02/20/06	—	5.32
02/21/06	—	5.18
02/22/06	—	4.77
02/23/06	—	4.85
02/24/06	—	4.83
02/25/06	—	5.06
02/26/06	—	4.94
02/27/06	—	5.16
02/28/06	—	5.16
03/01/06	—	5.21

Date	Elemental Channel	Unit 8 Total Mercury
03/02/06	—	5.22
03/03/06	—	5.14
03/04/06	—	5.09
03/05/06	—	5.17
03/06/06	—	5.25
03/07/06	—	5.02
03/08/06	—	1.21
03/09/06	—	#N/A
03/10/06	—	3.74
03/11/06	—	4.36
03/12/06	—	4.76
03/13/06	—	4.51
03/14/06	—	3.98
03/15/06	—	4.78
03/16/06	—	4.70
03/17/06	—	4.78
03/18/06	—	4.79
03/19/06	—	5.04
03/20/06	—	5.06
03/21/06	—	0.33
03/22/06	—	0.03
03/23/06	—	-0.04
03/24/06	—	2.95
03/25/06	—	4.17
03/26/06	—	4.47
03/27/06	—	4.60
03/28/06	—	-0.11
03/29/06	—	-0.05
03/30/06	—	0.64
03/31/06	—	5.15
04/01/06	—	4.98
04/02/06	—	4.99
04/03/06	—	5.13

Date	Elemental Channel	Unit 8 Total Mercury
04/04/06	—	5.12
04/05/06	—	5.05
04/06/06	—	5.00
04/07/06	—	4.85
04/08/06	—	4.88
04/09/06	—	4.87
04/10/06	—	5.02
04/11/06	—	5.09
04/12/06	—	5.22
04/13/06	—	4.98
04/14/06	—	5.04
04/15/06	—	4.96
04/16/06	—	4.91
04/17/06	—	5.06
04/18/06	—	5.01
04/19/06	—	4.97
04/20/06	—	5.63
04/21/06	—	6.75
04/22/06	—	6.52
04/23/06	—	5.29
04/24/06	—	4.53
04/25/06	—	3.98
04/26/06	—	3.89
04/27/06	—	3.66
04/28/06	—	3.54
04/29/06	—	3.62
04/30/06	—	3.66
05/01/06	—	3.63
05/02/06	—	3.56
05/03/06	—	3.62
05/04/06	—	3.74
05/05/06	—	3.60
05/06/06	—	-0.06

Date	Elemental Channel	Unit 8 Total Mercury
05/07/06	—	-0.15
05/08/06	—	-0.04
05/09/06	—	1.94
05/10/06	—	3.70
05/11/06	—	3.70
05/12/06	—	3.52
05/13/06	—	3.60
05/14/06	—	3.84
05/15/06	—	4.05
05/16/06	—	4.72
05/17/06	—	4.57
05/18/06	—	4.30
05/19/06	—	4.28
05/20/06	—	4.25
05/21/06	—	4.46
05/22/06	—	4.72
05/23/06	—	4.95
05/24/06	—	0.05
05/25/06	—	-0.08
05/26/06	—	-0.06
05/27/06	—	-0.02
05/28/06	—	-0.11
05/29/06	—	-0.16
05/30/06	—	-0.14
05/31/06	—	-0.15
06/01/06	—	-0.07
06/02/06	—	0.00
06/03/06	—	-0.03
06/04/06	—	-0.07
06/05/06	—	-0.13
06/06/06	—	-0.11
06/07/06	—	-0.16
06/08/06	—	-0.14

Date	Elemental Channel	Unit 8 Total Mercury
06/09/06	—	-0.22
06/10/06	—	-0.32
06/11/06	—	-0.30
06/12/06	—	-0.27
06/13/06	—	-0.24
06/14/06	—	-0.23
06/15/06	—	-0.22
06/16/06	—	-0.03
06/17/06	—	-0.04
06/18/06	—	-0.02
06/19/06	—	-0.06
06/20/06	—	-0.12
06/21/06	—	0.48
06/22/06	—	5.23
06/23/06	—	5.32
06/24/06	—	5.41
06/25/06	—	5.16
06/26/06	—	5.26
06/27/06	—	5.15
06/28/06	—	4.84
06/29/06	—	4.05
06/30/06	—	4.81
07/01/06	—	4.92
07/02/06	—	4.80
07/03/06	—	4.89
07/04/06	—	4.79
07/05/06	—	4.72
07/06/06	—	4.97
07/07/06	—	4.98
07/08/06	—	5.07
07/09/06	—	5.13
07/10/06	—	4.94
07/11/06	—	4.96

Date	Elemental Channel	Unit 8 Total Mercury
07/12/06	—	4.63
07/13/06	—	4.44
07/14/06	—	4.40
07/15/06	—	4.42
07/16/06	—	4.34
07/17/06	—	4.29
07/18/06	—	4.95
07/19/06	—	5.33
07/20/06	—	6.13
07/21/06	—	5.32
07/22/06	—	149.42
07/23/06	—	7.78
07/24/06	—	3.41
07/25/06	—	4.43
07/26/06	—	3.51
07/27/06	—	3.95
07/28/06	—	#N/A
07/29/06	—	#N/A
07/30/06	—	#N/A
07/31/06	—	6.18
08/01/06	—	6.35
08/02/06	—	28.88
08/03/06	—	7.25
08/04/06	—	7.84
08/05/06	—	7.88
08/06/06	—	7.93
08/07/06	—	8.07
08/08/06	—	8.09
08/09/06	—	7.61
08/10/06	—	7.44
08/11/06	—	6.92
08/12/06	—	7.29

Date	Elemental Channel	Unit 7 Total Mercury
08/12/06	—	28.34
08/13/06	—	3.55
08/14/06	—	5.75
08/15/06	—	6.24
08/16/06	—	6.49
08/17/06	—	6.98
08/18/06	—	6.85
08/19/06	—	6.53
08/20/06	—	6.81
08/21/06	—	6.91
08/22/06	—	6.95
08/23/06	—	6.60
08/24/06	—	5.50
08/25/06	—	5.25

Date	Elemental Channel	Unit 8 Total Mercury
08/25/08	—	6.12
08/26/06	—	6.22
08/27/06	—	5.18
08/28/06	—	5.57

Date	Elemental Channel	Unit 7 Total Mercury
08/28/06	—	6.52
08/29/06	—	5.19
08/30/06	—	5.14
08/31/06	—	5.04
09/01/06	—	6.21
09/02/06	—	9.44
09/03/06	—	9.48
09/04/06	—	9.41
09/05/06	—	7.19
09/06/06	—	5.79
09/07/06	—	6.51

Date	Elemental Channel	Unit 7 Total Mercury
09/08/06	—	6.06
09/09/06	—	5.93
09/10/06	—	5.72
09/11/06	—	5.95
09/12/06	—	6.39
09/13/06	—	6.63
09/14/06	—	6.61
09/15/06	—	1.20

Date	Elemental Channel	Unit 8 Total Mercury
09/15/06	—	7.22
09/16/06	—	7.72
09/17/06	—	7.39
09/18/06	—	7.46
09/19/06	—	7.30
09/20/06	—	7.29
09/21/06	—	7.43
09/22/06	—	6.79
09/23/06	—	6.28
09/24/06	—	5.96
09/25/06	—	5.78
09/26/06	—	5.79
09/27/06	—	5.83
09/28/06	—	5.79

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
09/29/06	—	6.32
09/30/06	—	6.28
10/01/06	—	5.96
10/02/06	—	5.92
10/03/06	—	6.41
10/04/06	—	6.53
10/05/06	—	6.72

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
10/06/06	—	6.60
10/07/06	—	0.60
10/08/06	—	-0.06
10/09/06	—	6.60
10/10/06	—	6.94

Date	Elemental Channel	Unit 8 Total Mercury
10/11/06	—	7.10
10/12/06	—	7.46
10/13/06	—	8.17
10/14/06	—	8.58
10/15/06	—	8.47
10/16/06	—	8.16
10/17/06	—	7.23
10/18/06	—	6.69
10/19/06	—	6.91
10/20/06	—	6.86
10/21/06	—	7.26
10/22/06	—	7.59
10/23/06	—	7.84
10/24/06	—	7.76
10/25/06	—	7.12
10/26/06	—	7.22
10/27/06	—	7.11
10/28/06	—	7.09
10/29/06	—	7.02
10/30/06	—	6.85
10/31/06	—	5.71

Date	Elemental Channel	Unit 7 Total Mercury
10/31/06	—	5.40
11/01/06	—	5.36
11/02/06	—	5.40

Date	Elemental Channel	Unit 7 Total Mercury
11/03/06	—	5.62
11/04/06	—	5.67
11/05/06	—	5.69
11/06/06	—	5.47
11/07/06	—	5.48

Date	Elemental Channel	Unit 8 Total Mercury
11/07/06	—	5.45
11/08/06	—	5.66
11/09/06	—	5.85
11/10/06	—	4.98
11/11/06	—	1.56
11/12/06	—	1.06
11/13/06	—	3.74
11/14/06	—	6.10
11/15/06	—	6.31
11/16/06	—	6.16
11/17/06	—	6.00
11/18/06	—	6.43
11/19/06	—	6.60
11/20/06	—	6.51
11/21/06	—	6.48
11/22/06	—	6.35
11/23/06	—	6.19
11/24/06	—	7.07
11/25/06	—	7.53
11/26/06	—	7.76
11/27/06	—	8.00
11/28/06	—	7.78
11/29/06	—	6.87
11/30/06	—	6.76
12/01/06	—	6.65
12/02/06	—	6.97

Date	Elemental Channel	Unit 8 Total Mercury
12/03/06	—	7.14
12/04/06	—	6.78
12/05/06	—	7.29
12/06/06	—	7.57
12/07/06	—	7.99
12/08/06	—	7.83
12/09/06	—	7.89
12/10/06	—	8.03
12/11/06	—	8.34
12/12/06	—	8.29
12/13/06	—	7.67
12/14/06	—	6.93
12/15/06	—	7.50
12/16/06	—	7.55
12/17/06	—	7.62
12/18/06	—	7.63
12/19/06	—	7.27
12/20/06	—	7.50
12/21/06	—	7.84
12/22/06	—	6.91
12/23/06	—	6.41
12/24/06	—	6.89
12/25/06	—	7.37
12/26/06	—	7.75
12/27/06	—	8.05
12/28/06	—	0.58
12/29/06	—	6.60
12/30/06	—	0.22
12/31/06	—	0.37
01/01/07	—	1.99
01/02/07	—	0.14
01/03/07	—	0.05
01/04/07	—	3.80

Date	Elemental Channel	Unit 8 Total Mercury
01/05/07	—	7.53
01/06/07	—	7.68
01/07/07	—	7.68
01/08/07	—	7.33
01/09/07	—	6.77
01/10/07	—	7.04
01/11/07	—	6.66
01/12/07	—	0.29
01/13/07	—	0.37
01/14/07	—	3.30
01/15/07	—	4.23
01/16/07	—	6.17
01/17/07	—	6.10
01/18/07	—	6.06
01/19/07	—	6.14
01/20/07	—	6.07
01/21/07	—	5.87
01/22/07	—	5.89
01/23/07	—	6.07
01/24/07	—	5.30
01/25/07	—	5.41

Date	Elemental Channel	Unit 9 Total Mercury
01/30/07	—	6.82
01/31/07	—	5.75
02/01/07	—	4.20

Date	Elemental Channel	Unit 8 Total Mercury
02/01/07	—	5.62
02/02/07	—	6.59
02/03/07	—	7.80
02/04/07	—	7.62
02/05/07	—	7.60

Date	Elemental Channel	Unit 8 Total Mercury
02/06/07	—	7.20
02/07/07	—	6.97
02/08/07	—	7.13
02/09/07	—	7.34
02/10/07	—	7.95
02/11/07	—	7.52
02/12/07	—	5.93
02/13/07	—	3.72
02/14/07	—	6.56
02/15/07	—	6.97
02/16/07	—	7.63
02/17/07	—	7.62
02/18/07	—	7.99
02/19/07	—	7.82
02/20/07	—	7.97
02/21/07	—	7.86
02/22/07	—	7.67
02/23/07	—	7.95
02/24/07	—	4.66
02/25/07	—	1.47

Date	Elemental Channel	Unit 7 Total Mercury
02/25/07	—	5.86
02/26/07	—	5.01
02/27/07	—	5.94
02/28/07	—	8.68

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
03/22/07	7.23	5.26
03/23/07	7.86	8.04
03/24/07	7.49	7.35
03/25/07	5.93	5.40
03/26/07	6.19	5.73

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
03/27/07	7.57	7.95
03/28/07	8.02	8.11
03/29/07	8.64	8.97
03/30/07	8.05	7.99
03/31/07	7.35	7.00
04/01/07	7.54	6.91
04/02/07	7.47	6.94
04/03/07	5.86	5.97
04/04/07	5.55	6.83
04/05/07	6.11	7.64
04/06/07	7.21	7.75
04/07/07	7.41	7.57
04/08/07	7.54	7.91
04/09/07	7.34	7.74
04/10/07	6.45	6.59
04/11/07	6.75	6.66
04/12/07	6.16	6.11
04/13/07	5.96	6.18
04/14/07	3.90	6.90
04/15/07	0.85	7.63
04/16/07	3.91	7.04
04/17/07	5.63	6.05
04/18/07	5.23	5.54
04/19/07	-0.14	6.39
04/20/07	3.26	6.56
04/21/07	5.13	5.37
04/22/07	3.88	3.88
04/23/07	4.36	4.32
04/24/07	6.66	7.02
04/25/07	6.39	6.76
04/26/07	5.35	5.78
04/27/07	5.35	5.80
04/28/07	5.97	6.78

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
04/29/07	6.27	7.17
04/30/07	5.78	6.41
05/01/07	5.14	5.28
05/02/07	5.77	6.24
05/03/07	2.23	6.86
05/04/07	6.07	6.46
05/05/07	4.39	5.11
05/06/07	5.13	5.33
05/07/07	5.89	5.96
05/08/07	5.33	4.89
05/09/07	5.28	4.77
05/10/07	5.15	4.74
05/11/07	5.96	5.97
05/12/07	7.28	7.70
05/13/07	7.42	8.01
05/14/07	6.79	6.86
05/15/07	7.16	7.14
05/16/07	7.70	8.34
05/17/07	7.53	8.54
05/18/07	7.01	7.99
05/19/07	-0.02	6.91
05/20/07	0.75	7.76
05/21/07	0.34	7.29
05/22/07	-0.53	5.91
05/23/07	-0.43	6.17
05/24/07	-0.22	6.45
05/25/07	0.30	6.43
05/26/07	1.30	2.74
05/27/07	1.44	8.75
05/28/07	1.61	9.32
05/29/07	0.55	7.52
05/30/07	-0.73	6.24
05/31/07	-0.15	7.68

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
06/01/07	0.13	8.24
06/02/07	0.05	7.78
06/03/07	0.04	7.59
06/04/07	0.26	8.07
06/05/07	0.55	8.39
06/06/07	0.26	7.47
06/07/07	-0.24	6.62
06/08/07	0.31	7.70
06/09/07	0.98	8.61
06/10/07	6.11	8.00
06/11/07	5.90	7.45
06/12/07	6.86	7.70
06/13/07	6.65	8.31
06/14/07	6.54	7.86
06/15/07	5.70	6.89
06/16/07	7.48	8.96
06/17/07	7.23	8.41
06/18/07	6.07	6.78
06/19/07	4.96	5.37
06/20/07	5.61	6.56
06/21/07	5.92	6.86
06/22/07	6.32	7.37
06/23/07	6.01	6.47
06/24/07	6.19	6.31
06/25/07	6.26	6.61
06/26/07	6.25	6.42
06/27/07	7.86	8.07
06/28/07	6.20	6.28
06/29/07	5.89	6.38
06/30/07	5.45	5.73
07/01/07	5.06	5.48
07/02/07	5.56	5.82
07/03/07	6.19	6.34

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
07/04/07	6.14	6.18
07/05/07	6.23	6.71
07/06/07	6.81	7.42
07/07/07	6.88	0.56
07/08/07	6.61	4.08
07/09/07	6.57	7.18
07/10/07	6.39	6.69
07/11/07	6.32	-0.74

Date	Unit 7 Total Mercury	Unit 8 Total Mercury
07/11/07	6.32	8.11
07/12/07	6.35	6.77
07/13/07	6.05	6.58
07/14/07	5.85	6.41
07/15/07	5.95	6.53
07/16/07	6.11	6.51

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
07/20/07	7.98	9.20
07/21/07	8.02	8.16
07/22/07	7.51	7.71
07/23/07	7.10	7.32
07/24/07	7.57	7.88
07/25/07	7.15	7.53
07/26/07	7.51	7.75
07/27/07	8.20	8.23
07/28/07	9.07	9.06
07/29/07	9.01	9.02
07/30/07	8.21	8.30
07/31/07	8.22	8.60
08/01/07	6.14	6.49
08/02/07	6.30	6.59
08/03/07	7.69	8.05

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
08/04/07	7.36	7.38
08/05/07	6.58	7.01
08/06/07	6.71	7.48
08/07/07	6.82	7.60
08/08/07	7.58	8.20
08/09/07	7.54	7.88
08/10/07	7.66	8.24
08/11/07	6.78	7.69
08/12/07	7.14	8.04
08/13/07	7.28	7.95
08/14/07	6.62	6.90
08/15/07	7.47	7.66
08/16/07	7.83	7.98
08/17/07	8.11	8.32
08/18/07	8.10	8.42
08/19/07	2.83	3.17
08/20/07	7.11	7.61
08/21/07	7.49	7.86
08/22/07	7.89	8.22
08/23/07	8.28	8.48
08/24/07	8.27	8.33
08/25/07	8.53	8.54
08/26/07	8.34	8.38
08/27/07	7.35	7.62
08/28/07	3.76	4.17
08/29/07	7.28	7.55
08/30/07	7.62	7.57
08/31/07	7.49	7.81
09/01/07	7.09	7.84
09/02/07	7.02	7.71
09/03/07	7.10	7.75
09/04/07	6.32	6.52
09/05/07	4.63	4.59

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
09/06/07	6.36	6.60
09/07/07	7.66	7.82
09/08/07	6.64	6.73
09/09/07	7.29	7.39
09/10/07	6.66	7.10
09/11/07	-0.60	-0.49
09/12/07	-0.39	0.00
09/13/07	-0.17	-0.24
09/14/07	1.81	1.90
09/15/07	6.32	6.56
09/16/07	5.29	6.63
09/17/07	6.35	6.59
09/18/07	5.67	5.64
09/19/07	6.74	6.65
09/20/07	4.64	6.65

Date	Elemental Channel	Unit 9 Total Mercury
09/20/07	—	6.34
09/21/07	—	6.55
09/22/07	—	8.38
09/23/07	—	8.56
09/24/07	—	7.18
09/25/07	—	7.24
09/26/07	—	7.30
09/27/07	—	7.49
09/28/07	—	7.41
09/29/07	—	6.60
09/30/07	—	6.35
10/01/07	—	6.87
10/02/07	—	6.75
10/03/07	—	7.74
10/04/07	—	7.77
10/05/07	—	7.51

Date	Elemental Channel	Unit 9 Total Mercury
10/06/07	—	7.59
10/07/07	—	7.41
10/08/07	—	17.49
10/09/07	—	10.16
10/10/07	—	7.19
10/11/07	—	6.99
10/12/07	—	7.14
10/13/07	—	7.05
10/14/07	—	7.25

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
10/15/07	6.41	6.75
10/16/07	6.42	6.70
10/17/07	6.15	6.41
10/18/07	5.97	6.20
10/19/07	5.89	6.15
10/20/07	6.07	6.42
10/21/07	6.36	6.69
10/22/07	6.82	7.20
10/23/07	6.87	7.27
10/24/07	2.37	2.45
10/25/07	3.55	3.67
10/26/07	6.74	7.09
10/27/07	6.67	7.04
10/28/07	6.96	7.34
10/29/07	6.96	7.32
10/30/07	6.86	7.22
10/31/07	6.83	7.25

Date	Elemental Channel	Unit 9 Total Mercury
11/01/07	—	6.57
11/02/07	—	6.62
11/03/07	—	6.85

Date	Elemental Channel	Unit 9 Total Mercury
11/04/07	—	6.70
11/05/07	—	6.94

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
11/07/07	7.03	7.55
11/08/07	6.77	7.30
11/09/07	7.00	7.42
11/10/07	7.06	7.54
11/11/07	6.94	7.52
11/12/07	6.86	7.42
11/13/07	6.96	7.44
11/14/07	6.85	7.24
11/15/07	6.75	7.22
11/16/07	7.13	7.57
11/17/07	7.38	7.78
11/18/07	7.12	7.56
11/19/07	7.36	7.83
11/20/07	6.70	7.13
11/21/07	6.44	6.83
11/22/07	6.89	7.34
11/23/07	7.09	7.64
11/24/07	7.11	7.64
11/25/07	7.08	7.56
11/26/07	7.03	7.50
11/27/07	6.97	7.45
11/28/07	7.05	7.57
11/29/07	6.78	7.29
11/30/07	6.81	7.37
12/01/07	7.02	7.57
12/02/07	7.03	7.53
12/03/07	7.28	7.74
12/04/07	7.34	7.81
12/05/07	6.84	7.36

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
12/06/07	6.88	7.38
12/07/07	6.83	7.32
12/08/07	7.04	7.48
12/09/07	8.08	8.53
12/10/07	8.63	9.14
12/11/07	8.47	8.94

Date	Unit 7 Total Mercury	Unit 8 Total Mercury
12/17/07	6.24	6.59
12/18/07	6.36	6.99
12/19/07	6.46	7.07
12/20/07	6.31	6.96
12/21/07	4.85	6.71
12/22/07	3.12	6.47
12/23/07	2.31	6.56
12/24/07	2.21	6.83
12/25/07	2.13	6.98
12/26/07	2.00	6.89
12/27/07	1.96	6.66
12/28/07	1.23	6.34
12/29/07	0.01	6.41
12/30/07	-0.02	6.41
12/31/07	-0.03	6.51
01/01/08	-0.02	6.52
01/02/08	0.16	6.40
01/03/08	4.68	6.10
01/04/08	5.31	6.33
01/05/08	5.35	0.21
01/06/08	3.71	-0.07
01/07/08	3.62	-0.12
12/17/07	6.24	6.59
12/18/07	6.36	6.99
12/19/07	6.46	7.07

Date	Unit 7 Total Mercury	Unit 8 Total Mercury
12/20/07	6.31	6.96
12/21/07	4.85	6.71
12/22/07	3.12	6.47
12/23/07	2.31	6.56
12/24/07	2.21	6.83
12/25/07	2.13	6.98
12/26/07	2.00	6.89
12/27/07	1.96	6.66
12/28/07	1.23	6.34
12/29/07	0.01	6.41
12/30/07	-0.02	6.41
12/31/07	-0.03	6.51
01/01/08	-0.02	6.52
01/02/08	0.16	6.40
01/03/08	4.68	6.10
01/04/08	5.31	6.33
01/05/08	5.35	0.21
01/06/08	3.71	-0.07
01/07/08	3.62	-0.12

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
01/07/08	3.62	5.51
01/08/08	2.76	5.56
01/09/08	1.99	5.68
01/10/08	1.67	5.51
01/11/08	0.00	5.94
01/12/08	0.01	5.80
01/13/08	0.01	5.77
01/14/08	0.02	5.86
01/15/08	0.00	5.99
01/16/08	0.03	5.86
01/17/08	0.03	5.98
01/18/08	0.02	6.26

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
01/19/08	0.05	6.57
01/20/08	4.16	6.69
01/21/08	5.86	6.56
01/22/08	6.06	6.52
01/23/08	6.15	6.61
01/24/08	5.92	6.37
01/25/08	5.76	6.13
01/26/08	4.78	6.06
01/27/08	3.53	6.17
01/28/08	2.96	6.05
01/29/08	3.79	6.10
01/30/08	3.85	6.30
01/31/08	1.67	6.68
02/01/08	2.29	6.31
02/02/08	2.43	6.25
02/03/08	1.43	5.97
02/04/08	1.17	5.96
02/05/08	1.37	6.05
02/06/08	2.40	5.96
02/07/08	2.42	6.00
02/08/08	1.91	6.13
02/09/08	3.06	6.36
02/10/08	2.32	6.33
02/11/08	2.12	6.42
02/12/08	2.39	6.20
02/13/08	1.98	6.07
02/14/08	1.63	6.16
02/15/08	1.87	6.18
02/16/08	1.76	6.06
02/17/08	1.51	6.38

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
02/19/08	6.43	6.69

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
02/20/08	6.46	6.69
02/21/08	6.39	6.64
02/22/08	6.13	6.29
02/23/08	6.10	6.17
02/24/08	6.26	6.27
02/25/08	6.27	6.40
02/26/08	6.10	6.58
02/27/08	5.97	6.49
02/28/08	5.63	6.01
02/29/08	6.13	6.41
03/01/08	6.41	6.63
03/02/08	6.32	6.57
03/03/08	6.22	6.51
03/04/08	6.39	6.72
03/05/08	6.40	6.68
03/06/08	6.25	6.48
03/07/08	6.28	6.73
03/08/08	6.49	6.95
03/09/08	6.40	6.91
03/10/08	6.19	6.60
03/11/08	6.13	6.42
03/12/08	5.92	6.31
03/13/08	5.96	6.41
03/14/08	5.94	6.33
03/15/08	5.85	6.22
03/16/08	5.91	6.33
03/17/08	5.86	6.27
03/18/08	5.72	6.08
03/19/08	5.42	5.83
03/20/08	5.24	5.67
03/21/08	4.71	5.25
03/22/08	0.09	0.09
03/23/08	0.11	0.11

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
03/24/08	0.08	0.12

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
03/30/08	5.39	6.83
03/31/08	5.40	6.82
04/01/08	5.33	6.80
04/02/08	5.36	6.90
04/03/08	5.43	6.91
04/04/08	5.53	6.95
04/05/08	5.68	7.12
04/06/08	5.69	7.16
04/07/08	5.76	7.20
04/08/08	4.34	7.00
04/09/08	—	—
04/10/08	—	—
04/11/08	5.02	6.52
04/12/08	3.98	5.32
04/13/08	4.06	5.45
04/14/08	4.48	5.67
04/15/08	5.44	6.23
04/16/08	5.99	6.44
04/17/08	6.22	6.59
04/18/08	6.27	6.70
04/19/08	6.44	6.83
04/20/08	6.36	6.77
04/21/08	6.20	6.59
04/22/08	5.95	6.32
04/23/08	6.06	6.45
04/24/08	5.97	6.42
04/25/08	5.92	6.36
04/26/08	5.85	6.28
04/27/08	5.99	6.52
04/28/08	5.88	6.43

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
04/29/08	5.89	6.37
04/30/08	6.01	6.46
05/01/08	5.97	6.46
05/02/08	5.56	6.06
05/03/08	5.70	6.16
05/04/08	5.81	6.27
05/05/08	5.88	6.28
05/06/08	5.99	6.42
05/07/08	5.87	6.25
05/08/08	5.66	5.98
05/09/08	5.23	5.46
05/10/08	5.16	5.56
05/11/08	—	—
05/12/08	—	—
05/13/08	—	—
05/14/08	5.43	5.93
05/15/08	5.26	5.57
05/16/08	5.22	5.64
05/17/08	0.08	0.08
05/18/08	0.05	0.01
05/19/08	0.03	0.01
05/20/08	0.02	0.05
04/11/08	5.02	6.52
04/12/08	3.98	5.32
04/13/08	4.06	5.45
04/14/08	4.48	5.67
04/15/08	5.44	6.23
04/16/08	5.99	6.44
04/17/08	6.22	6.59
04/18/08	6.27	6.70
04/19/08	6.44	6.83
04/20/08	6.36	6.77
04/21/08	6.20	6.59

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
04/22/08	5.95	6.32
04/23/08	6.06	6.45
04/24/08	5.97	6.42
04/25/08	5.92	6.36
04/26/08	5.85	6.28
04/27/08	5.99	6.52
04/28/08	5.88	6.43
04/29/08	5.89	6.37
04/30/08	6.01	6.46
05/01/08	5.97	6.46
05/02/08	5.56	6.06
05/03/08	5.70	6.16
05/04/08	5.81	6.27
05/05/08	5.88	6.28
05/06/08	5.99	6.42
05/07/08	5.87	6.25
05/08/08	5.66	5.98
05/09/08	5.23	5.46
05/10/08	5.16	5.56
05/11/08	—	—
05/12/08	—	—
05/13/08	—	—
05/14/08	5.43	5.93
05/15/08	5.26	5.57
05/16/08	5.22	5.64
05/17/08	0.08	0.08
05/18/08	0.05	0.01
05/19/08	0.03	0.01
05/20/08	0.02	0.05
04/11/08	5.02	6.52
04/12/08	3.98	5.32
04/13/08	4.06	5.45
04/14/08	4.48	5.67

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
04/15/08	5.44	6.23
04/16/08	5.99	6.44
04/17/08	6.22	6.59
04/18/08	6.27	6.70
04/19/08	6.44	6.83
04/20/08	6.36	6.77
04/21/08	6.20	6.59
04/22/08	5.95	6.32
04/23/08	6.06	6.45
04/24/08	5.97	6.42
04/25/08	5.92	6.36
04/26/08	5.85	6.28
04/27/08	5.99	6.52
04/28/08	5.88	6.43
04/29/08	5.89	6.37
04/30/08	6.01	6.46
05/01/08	5.97	6.46
05/02/08	5.56	6.06
05/03/08	5.70	6.16
05/04/08	5.81	6.27
05/05/08	5.88	6.28
05/06/08	5.99	6.42
05/07/08	5.87	6.25
05/08/08	5.66	5.98
05/09/08	5.23	5.46
05/10/08	5.16	5.56
05/11/08	#N/A	#N/A
05/12/08	#N/A	#N/A
05/13/08	#N/A	#N/A
05/14/08	5.43	5.93
05/15/08	5.26	5.57
05/16/08	5.22	5.64
05/17/08	0.08	0.08

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
05/18/08	0.05	0.01
05/19/08	0.03	0.01
05/20/08	0.02	0.05

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
05/20/08	0.92	3.55
05/21/08	0.81	3.55
05/22/08	1.32	3.26
05/23/08	1.42	3.38
05/24/08	1.43	3.24
05/25/08	1.38	3.11
05/26/08	0.50	1.51
05/27/08	-0.30	-0.28
05/28/08	-0.23	-0.22
05/29/08	-0.28	-0.27
05/30/08	0.89	2.45
05/31/08	1.02	2.89
06/01/08	1.20	2.93
06/02/08	1.23	2.96
06/03/08	3.57	4.59
06/04/08	4.96	5.20
06/05/08	4.98	5.30
06/06/08	4.95	5.52
06/07/08	4.84	5.46
06/08/08	4.92	5.72
06/09/08	4.90	5.67
06/10/08	4.78	5.55
06/11/08	5.21	5.97
06/12/08	5.65	6.32
06/13/08	5.80	6.36
06/14/08	5.70	6.39
06/15/08	5.52	6.32
06/16/08	5.58	6.33

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
06/17/08	5.62	6.27
06/18/08	5.74	6.40
06/19/08	5.59	6.27
06/20/08	5.64	6.24
06/21/08	5.43	6.13
06/22/08	5.20	5.95
06/23/08	4.73	5.39
06/24/08	4.36	5.03
06/25/08	5.22	5.79
06/26/08	5.12	5.78
06/27/08	4.91	5.54
06/28/08	5.08	5.66
06/29/08	4.99	5.57
06/30/08	4.67	5.34
07/01/08	4.57	5.15
07/02/08	4.60	5.15
07/03/08	4.56	5.08
07/04/08	4.30	4.91
07/05/08	4.30	4.93
07/06/08	4.41	4.97
07/07/08	4.48	4.98
07/08/08	4.39	4.93
07/09/08	4.34	4.93
07/10/08	4.39	4.97
07/11/08	4.66	5.24
07/12/08	5.00	5.57
07/13/08	5.16	5.74
07/14/08	5.24	5.85
07/15/08	5.21	5.81
07/16/08	5.18	5.69
07/17/08	5.16	5.63
07/18/08	5.12	5.64
07/19/08	5.28	5.84

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
07/20/08	5.28	5.86
07/21/08	5.10	5.64
07/22/08	4.85	5.46

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
07/28/08	0.00	4.93
07/29/08	0.00	6.16
07/30/08	0.00	6.20
07/31/08	0.00	6.39
08/01/08	0.00	3.80

Date	Elemental Channel	Unit 9 Total Mercury
08/01/08	—	4.33
08/02/08	—	5.35
08/03/08	—	5.35
08/04/08	—	5.42
08/05/08	—	5.53
08/06/08	—	5.60
08/07/08	—	5.72
08/08/08	—	5.59
08/09/08	—	6.06
08/10/08	—	6.65
08/11/08	—	6.84
08/12/08	—	6.70

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
08/13/08	4.11	4.72
08/14/08	5.55	6.37
08/15/08	5.67	6.53
08/16/08	5.52	6.47
08/17/08	1.79	2.12
08/18/08	0.01	-0.05
08/19/08	0.03	0.02

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
08/20/08	-0.01	-0.01

Date	Elemental Channel	Unit 9 Total Mercury
08/20/08	—	5.78
08/21/08	—	5.66
08/22/08	—	5.05
08/23/08	—	-0.09
08/24/08	—	0.45
08/25/08	—	5.78
08/26/08	—	5.41
08/27/08	—	5.38
08/28/08	—	5.65
08/29/08	—	5.80
08/30/08	—	5.82
08/31/08	—	5.62
09/01/08	—	5.76
09/02/08	—	5.77
09/03/08	—	6.26
09/04/08	—	6.24
09/05/08	—	6.09
09/06/08	—	6.23
09/07/08	—	6.35
09/08/08	—	6.53
09/09/08	—	6.49
09/10/08	—	6.50
09/11/08	—	6.09

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
09/11/08	1.47	5.30
09/12/08	2.84	3.14
09/13/08	5.87	6.48
09/14/08	6.09	6.76
09/15/08	6.22	6.86

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
09/16/08	6.32	6.92
09/17/08	6.19	6.71
09/18/08	5.90	6.41
09/19/08	5.35	5.83
09/20/08	5.01	5.54
09/21/08	4.99	5.56
09/22/08	4.64	5.94
09/23/08	1.41	2.33
09/24/08	0.05	-0.05
09/25/08	0.22	0.17
09/26/08	0.56	0.55
09/27/08	0.78	0.75
09/28/08	1.22	1.19
09/29/08	1.00	0.98
09/30/08	0.19	0.17
10/01/08	0.20	0.27

Date	Elemental Channel	Unit 9 Total Mercury
10/01/08	—	5.94
10/02/08	—	5.17
10/03/08	—	4.87
10/04/08	—	6.33
10/05/08	—	6.16
10/06/08	—	6.02
10/07/08	—	6.23
10/08/08	—	6.23
10/09/08	—	6.04

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
10/11/08	0.02	0.01
10/12/08	0.04	0.03
10/13/08	0.03	0.04

Date	Elemental Channel	Unit 9 Total Mercury
10/13/08	0.00	5.84
10/14/08	0.00	5.84
10/15/08	0.00	5.86
10/16/08	0.00	6.09
10/17/08	0.00	6.04
10/18/08	0.00	6.11
10/19/08	0.00	5.86
10/20/08	0.00	5.88
10/21/08	0.00	6.03

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
10/27/08	4.16	5.02
10/28/08	4.39	4.95
10/29/08	4.38	4.90
10/30/08	4.63	5.14
10/31/08	4.65	5.14
11/01/08	4.58	5.17
11/02/08	4.62	5.20
11/03/08	4.52	5.06
11/04/08	4.33	5.12

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
11/04/08	5.80	6.37
11/05/08	5.65	5.92
11/06/08	5.71	6.04
11/07/08	5.91	6.26
11/08/08	5.91	6.31
11/09/08	6.00	6.39
11/10/08	6.33	6.58
11/11/08	6.23	6.38
11/12/08	6.21	6.34
11/13/08	6.09	6.25
11/14/08	6.19	6.35

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
11/15/08	6.23	6.48
11/16/08	6.36	6.63
11/17/08	6.17	6.45
11/18/08	6.27	6.49
11/19/08	6.32	6.67
11/20/08	5.84	6.22
11/21/08	5.84	5.99
11/22/08	0.38	0.32
11/23/08	0.08	-0.02
11/24/08	0.23	0.16
11/25/08	0.10	0.08
11/26/08	—	—
11/27/08	—	—
11/28/08	—	—
11/29/08	—	—
11/30/08	—	—
12/01/08	—	—
12/02/08	—	—
12/03/08	0.17	41.82
12/04/08	0.09	10.55
12/05/08	0.00	1.45
12/06/08	0.00	-1.36
12/07/08	0.15	-0.01

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
12/15/08	6.35	6.49
12/16/08	6.13	6.45

Date	Elemental Channel	Unit 8 Total Mercury
12/17/08	—	4.69
12/18/08	—	4.90
12/19/08	—	7.20
12/20/08	—	7.11

Date	Elemental Channel	Unit 8 Total Mercury
12/21/08	—	7.16
12/22/08	—	7.20
12/23/08	—	7.30
12/24/08	—	7.19
12/25/08	—	7.49
12/26/08	—	7.31
12/27/08	—	5.81
12/28/08	—	6.63
12/29/08	—	6.47
12/30/08	—	6.58
12/31/08	—	6.33
01/01/09	—	6.02
01/02/09	—	4.92
01/03/09	—	5.22
01/04/09	—	6.61
01/05/09	—	6.60
01/06/09	—	6.43
01/07/09	—	6.35
01/08/09	—	6.56
01/09/09	—	6.81
01/10/09	—	7.18
01/11/09	—	7.40
01/12/09	—	7.26
01/13/09	—	7.21
01/14/09	—	7.40
01/15/09	—	7.25
01/16/09	—	7.03
01/17/09	—	7.01
01/18/09	—	7.17
01/19/09	—	7.15
01/20/09	—	6.95
01/21/09	—	6.96
01/22/09	—	6.91

Date	Elemental Channel	Unit 8 Total Mercury
01/23/09	—	6.95
01/24/09	—	6.91
01/25/09	—	6.88
01/26/09	—	6.92
01/27/09	—	6.47

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
01/28/09	5.40	5.81

Date	Unit 8 Total Mercury	Unit 9 Total Mercury
01/29/09	5.78	2.67
01/30/09	6.49	2.40

Date	Unit 7 Total Mercury	Unit 8 Total Mercury
01/31/09	4.90	5.97
02/01/09	4.57	6.12
02/02/09	4.62	6.31
02/03/09	4.55	6.34
02/04/09	5.02	6.27
02/05/09	5.29	6.25
02/06/09	5.14	6.37
02/07/09	5.01	6.50
02/08/09	4.58	6.48
02/09/09	4.29	6.35
02/10/09	4.42	6.06

Date	Unit 7 Total Mercury	Unit 8 Total Mercury
02/11/09	5.00	6.34
02/12/09	5.06	6.49
02/13/09	5.23	6.65
02/14/09	0.09	-0.16
02/15/09	1.58	1.87
02/16/09	5.02	6.25

Date	Unit 7 Total Mercury	Unit 8 Total Mercury
02/17/09	5.02	6.32
02/18/09	4.95	6.32
02/19/09	5.21	6.58
02/20/09	4.84	6.38
02/21/09	4.66	6.04
02/22/09	4.55	5.71
02/23/09	4.62	5.83
02/24/09	4.57	5.84
02/25/09	4.52	5.76
02/26/09	4.63	5.77

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
02/26/09	5.58	5.82
02/27/09	5.19	5.67
02/28/09	4.90	5.31
03/01/09	4.96	5.51

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
03/01/09	5.51	6.34
03/02/09	4.96	6.34
03/03/09	3.60	6.24
03/04/09	2.84	6.15
03/05/09	2.72	5.92
03/06/09	2.72	6.03
03/07/09	2.74	6.18
03/08/09	2.87	6.18
03/09/09	2.96	6.26
03/10/09	2.65	6.10
03/11/09	2.96	6.11
03/12/09	2.59	6.27
03/13/09	3.00	6.36
03/14/09	2.57	6.32
03/15/09	2.41	6.16

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
03/16/09	2.38	6.40
03/17/09	2.31	6.15
03/18/09	3.32	6.31
03/19/09	3.59	5.92
03/20/09	2.99	5.90
03/21/09	3.06	6.02
03/22/09	3.35	6.16

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
03/22/09	5.56	3.35
03/23/09	5.30	5.71
03/24/09	5.28	5.94

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
03/24/09	5.94	6.59
03/25/09	6.12	6.48
03/26/09	6.69	6.54
03/27/09	6.41	6.84
03/28/09	5.88	7.13
03/29/09	4.79	7.27
03/30/09	0.00	7.27
03/31/09	0.07	6.68
04/01/09	0.47	6.54
04/02/09	3.73	6.07
04/03/09	5.71	6.13
04/04/09	5.21	5.91
04/05/09	5.17	5.92
04/06/09	5.13	5.84
04/07/09	5.23	5.93
04/08/09	5.38	6.10
04/09/09	5.51	6.20
04/10/09	5.48	6.32
04/11/09	5.00	6.16

Date	Unit 7 Total Mercury	Unit 9 Total Mercury
04/12/09	5.14	6.46
04/13/09	5.33	6.21
04/14/09	5.29	6.08
04/15/09	5.68	6.40
04/16/09	6.04	6.66

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
04/16/09	5.24	6.76
04/17/09	5.52	6.41
04/18/09	5.93	5.96
04/19/09	5.82	5.81
04/20/09	5.89	5.87
04/21/09	5.55	6.41
04/22/09	5.63	6.63

Date	Elemental Channel	Unit 8 Total Mercury
05/01/09	—	6.72
05/02/09	—	3.61
05/03/09	—	6.51
05/04/09	—	6.57
05/05/09	—	6.42
05/06/09	—	6.18
05/07/09	—	6.13
05/08/09	—	6.26
05/09/09	—	6.23
05/10/09	—	6.12
05/11/09	—	6.23
05/12/09	—	5.98
05/13/09	—	5.94
05/14/09	—	6.22
05/15/09	—	6.31
05/16/09	—	6.34
05/17/09	—	6.51

Date	Elemental Channel	Unit 8 Total Mercury
05/18/09	—	6.47
05/19/09	—	6.62
05/20/09	—	6.51
05/21/09	—	6.73
05/22/09	—	6.72

Date	Elemental Channel	Unit 7 Total Mercury
05/22/09	—	5.78
05/23/09	—	5.62
05/24/09	—	5.74
05/25/09	—	5.80
05/26/09	—	5.68
05/27/09	—	5.52
05/28/09	—	5.38
05/29/09	—	5.41
05/30/09	—	5.51
05/31/09	—	5.56
06/01/09	—	5.58
06/02/09	—	5.63

Date	Unit 7 Elem Mercury	Unit 7 Total Mercury
06/02/09	6.63	5.63
06/03/09	6.51	5.68
06/04/09	2.54	2.80
06/05/09	2.94	3.27

Date	Unit 9 Elem Mercury	Unit 9 Total Mercury
06/05/09	5.21	5.53
06/06/09	5.69	6.22
06/07/09	5.26	6.03
06/08/09	5.81	6.31
06/09/09	5.80	6.34
06/10/09	2.86	6.30

Date	Elemental Channel	Unit 7 Total Mercury
06/10/09	—	5.63
06/11/09	—	5.41
06/12/09	—	5.51
06/13/09	—	5.40
06/14/09	—	5.00
06/15/09	—	4.60
06/16/09	—	4.54
06/17/09	—	4.39
06/18/09	—	4.50
06/19/09	—	4.32
06/20/09	—	4.17
06/21/09	—	4.08
06/22/09	—	4.39
06/23/09	—	4.78
06/24/09	—	5.18
06/25/09	—	5.35
06/26/09	—	5.12
06/27/09	—	4.82
06/28/09	—	4.78
06/29/09	—	4.88
06/30/09	—	5.14
07/01/09	—	5.14
07/02/09	—	5.20
07/03/09	—	5.04
07/04/09	—	5.01
07/05/09	—	5.07
07/06/09	—	5.18
07/07/09	—	5.15
07/08/09	—	5.03
07/09/09	—	4.84
07/10/09	—	4.74

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
07/17/09	4.25	6.92
07/18/09	4.28	6.92
07/19/09	4.44	7.08
07/20/09	4.67	6.99
07/21/09	4.95	6.71
07/22/09	5.09	6.78

Date	Elemental Channel	Unit 9 Total Mercury
07/23/09	—	6.61
07/24/09	—	6.52
07/25/09	—	6.47
07/26/09	—	6.62
07/27/09	—	6.15
07/28/09	—	4.99
07/29/09	—	4.64
07/30/09	—	4.72
07/31/09	—	4.56

Date	Elemental Channel	Unit 8 Total Mercury
07/31/09	—	4.44
08/01/09	—	4.35
08/02/09	—	4.46
08/03/09	—	4.04
08/04/09	—	5.00
08/05/09	—	5.12

Date	Elemental Channel	Unit 7 Total Mercury
08/05/09	—	4.53
08/06/09	—	4.23
08/07/09	—	4.41
08/08/09	—	4.39
08/09/09	—	4.26
08/10/09	—	4.15

Date	Elemental Channel	Unit 7 Total Mercury
08/11/09	—	3.84
08/12/09	—	3.70
08/13/09	—	3.88
08/14/09	—	3.88
08/15/09	—	4.09
08/16/09	—	1.05
08/17/09	—	-0.13
08/18/09	—	0.03

Date	Elemental Channel	Unit 9 Total Mercury
08/18/09	—	6.58
08/19/09	—	6.59
08/20/09	—	6.39
08/21/09	—	5.18
08/22/09	—	0.09
08/23/09	—	0.12
08/24/09	—	2.02
08/25/09	—	6.43
08/26/09	—	6.41
08/27/09	—	6.46
08/28/09	—	6.17

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
08/28/09	—	9.41
08/29/09	—	10.98
08/30/09	—	11.44
08/31/09	1.67	8.80
09/01/09	2.62	3.99
09/02/09	4.48	6.06
09/03/09	4.48	5.99
09/04/09	4.48	5.96
09/05/09	4.05	5.60
09/06/09	3.80	5.07

Date	Unit 8 Elem Mercury	Unit 8 Total Mercury
09/07/09	3.96	5.14
09/08/09	4.43	5.65
09/09/09	4.49	5.62
09/10/09	4.59	5.71
09/11/09	4.58	5.65
09/12/09	4.49	5.57
09/13/09	4.50	5.54
09/14/09	4.59	5.63
09/15/09	4.63	5.73
09/16/09	4.73	5.85
09/17/09	4.45	5.53
09/18/09	4.47	5.52
09/19/09	4.34	5.50
09/20/09	4.30	5.48
09/21/09	4.35	5.44
09/22/09	4.42	5.48
09/23/09	4.52	5.64
09/24/09	4.54	5.61
09/25/09	4.87	6.07
09/26/09	4.98	6.36
09/27/09	5.09	6.46
09/28/09	5.49	6.76
09/29/09	5.58	7.11
09/30/09	5.55	7.01

Appendix L. Inlet CEMS Calibration Record

We Energies Presque Isle Unit 7–9 Baghouse Inlet

Mercury CEMS Calibration Check Record, 2006-2009.

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/07/06	00:01	INST	15.0	15	0.00	0.0%	14.26	-4.9%	PASS
01/07/06	00:09	ORIF	15.0	15	-0.13	-0.9%	14.91	-0.6%	PASS
01/08/06	00:01	INST	15.0	15	0.00	0.0%	14.66	-2.3%	PASS
01/08/06	00:09	ORIF	15.0	15	-0.02	-0.1%	14.86	-0.9%	PASS
01/09/06	00:01	INST	15.0	15	0.00	0.0%	14.76	-1.6%	PASS
01/09/06	00:09	ORIF	15.0	15	-0.11	-0.7%	14.88	-0.8%	PASS
01/10/06	No Calibration Check								
01/11/06	No Calibration Check								
01/12/06	00:01	INST	5.0	15	0.00	0.0%	5.33	+2.2%	PASS
01/13/06	00:01	INST	5.0	15	0.01	+0.1%	5.08	+0.5%	PASS
01/13/06	00:09	ORIF	5.0	15	-0.17	-1.1%	4.84	-1.1%	PASS
01/14/06	00:01	INST	15.0	15	0.00	0.0%	14.52	-3.2%	PASS
01/14/06	00:09	ORIF	15.0	15	0.00	0.0%	14.41	-3.9%	PASS
01/14/06	07:39	ORIF	15.0	15	-0.14	-0.9%	14.47	-3.5%	PASS
01/15/06	07:38	ORIF	15.0	15	-0.18	-1.2%	13.80	-8.0%	FAIL
01/16/06	00:01	INST	15.0	15	0.00	0.0%	12.98	-13.5%	FAIL
01/16/06	00:09	ORIF	15.0	15	-0.24	-1.6%	14.83	-1.1%	PASS
01/16/06	07:38	ORIF	15.0	15	0.04	+0.3%	15.09	+0.6%	PASS
01/17/06	00:01	INST	15.0	15	0.01	+0.1%	15.67	+4.5%	PASS
01/17/06	00:09	ORIF	15.0	15	-0.07	-0.5%	14.05	-6.3%	PASS
01/17/06	07:38	ORIF	15.0	15	-0.03	-0.2%	14.55	-3.0%	PASS
01/18/06	00:01	INST	15.0	15	0.44	+2.9%	14.45	-3.7%	PASS
01/18/06	07:38	ORIF	15.0	15	-0.23	-1.5%	14.31	-4.6%	PASS
01/19/06	00:00	INST	15.0	15	0.00	0.0%	14.57	-2.9%	PASS
01/19/06	07:37	ORIF	15.0	15	0.05	+0.3%	14.58	-2.8%	PASS
01/20/06	07:37	ORIF	15.0	15	0.00	0.0%	14.86	-0.9%	PASS
01/21/06	07:37	ORIF	5.0	15	-0.02	-0.1%	4.75	-1.7%	PASS
01/22/06	00:01	INST	5.0	15	0.00	0.0%	4.90	-0.7%	PASS
01/22/06	00:09	ORIF	5.0	15	-0.10	-0.7%	4.82	-1.2%	PASS
01/22/06	07:37	ORIF	5.0	15	-0.04	-0.3%	4.86	-0.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/23/06	00:01	INST	5.0	15	0.01	+0.1%	4.97	-0.2%	PASS
01/23/06	00:09	ORIF	5.0	15	-0.12	-0.8%	4.72	-1.9%	PASS
01/23/06	07:37	ORIF	5.0	15	-0.05	-0.3%	4.83	-1.1%	PASS
01/24/06	00:01	INST	5.0	15	0.00	0.0%	4.83	-1.1%	PASS
01/24/06	00:09	ORIF	5.0	15	-0.17	-1.1%	4.72	-1.9%	PASS
01/24/06	07:37	ORIF	5.0	15	-0.05	-0.3%	4.83	-1.1%	PASS
01/25/06	00:01	INST	5.0	15	0.01	+0.1%	5.05	+0.3%	PASS
01/25/06	00:09	ORIF	5.0	15	-0.08	-0.5%	4.62	-2.5%	PASS
01/26/06	Probe Power Interruption – No Calibration Check								
01/27/06	Probe Converter Heater Failure – No Calibration Check								
01/28/06	06:05	INST	5.0	15	-0.10	-0.7%	5.71	+4.7%	PASS
01/28/06	06:14	ORIF	5.0	15	0.08	+0.5%	8.95	+26.3%	FAIL
01/28/06	07:39	ORIF	5.0	15	-0.35	-2.3%	4.60	-2.7%	PASS
01/28/06	08:52	INST	5.0	15	-0.01	-0.1%	4.99	-0.1%	PASS
01/28/06	08:59	ORIF	5.0	15	-0.06	-0.4%	5.01	+0.1%	PASS
01/28/06	16:05	INST	5.0	15	-0.03	-0.2%	4.96	-0.3%	PASS
01/29/06	No Calibration Check								
01/30/06	07:39	ORIF	Calibrator Error						
01/31/06	07:38	ORIF	Calibrator Error						
02/01/06	00:02	INST	5.0	15	-0.01	-0.1%	6.44	+9.6%	FAIL
02/01/06	07:38	ORIF	5.0	15	0.25	+1.7%	0.27	-31.5%	FAIL
02/02/06	00:02	INST	5.0	15	0.00	0.0%	6.51	+10.1%	FAIL
02/02/06	07:39	ORIF	5.0	15	0.10	+0.7%	0.39	-30.7%	FAIL
02/03/06	00:02	INST	5.0	15	0.00	0.0%	5.92	+6.1%	PASS
02/03/06	07:39	ORIF	5.0	15	0.09	+0.6%	5.70	+4.7%	PASS
02/04/06	07:39	ORIF	12.0	15	-0.12	-0.8%	12.32	2.1%	PASS
02/05/06	07:39	ORIF	12.0	15	-0.08	-0.5%	12.08	+0.5%	PASS
02/06/06	07:39	ORIF	12.0	15	-0.14	-0.9%	11.75	-1.7%	PASS
02/07/06	07:39	ORIF	12.0	15	-0.15	-1.0%	11.69	-2.1%	PASS
02/08/06	07:39	ORIF	12.0	15	-0.19	-1.3%	11.93	-0.5%	PASS
02/09/06	07:39	ORIF	12.0	15	-0.26	-1.7%	11.74	-1.7%	PASS
02/10/06	07:40	ORIF	12.0	15	-0.05	-0.3%	11.59	-2.7%	PASS
02/11/06	07:40	ORIF	12.0	15	0.05	+0.3%	11.87	-0.9%	PASS
02/12/06	07:39	ORIF	12.0	15	-0.03	-0.2%	12.16	+1.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/13/06	07:39	ORIF	12.0	15	-0.14	-0.9%	11.79	-1.4%	PASS
02/14/06	07:39	ORIF	12.0	15	-0.19	-1.3%	11.93	-0.5%	PASS
02/15/06	07:39	ORIF	12.0	15	-0.06	-0.4%	12.03	+0.2%	PASS
02/16/06	07:39	ORIF	12.0	15	-0.08	-0.5%	11.74	-1.7%	PASS
02/17/06	07:39	ORIF	12.0	15	-0.11	-0.7%	12.38	+2.5%	PASS
02/18/06	07:39	ORIF	12.0	15	-0.12	-0.8%	10.55	-9.7%	FAIL
02/19/06	07:39	ORIF	12.0	15	-0.39	-2.6%	11.50	-3.3%	PASS
02/20/06	07:39	ORIF	12.0	15	0.05	+0.3%	12.89	+5.9%	PASS
02/21/06	07:39	ORIF	12.0	15	0.07	+0.5%	13.12	+7.5%	FAIL
02/22/06	07:39	ORIF	12.0	15	0.10	+0.7%	11.0	-6.7%	FAIL
02/23/06	07:38	ORIF	12.0	15	0.01	+0.1%	11.71	-1.9%	PASS
02/24/06	07:38	ORIF	12.0	15	-0.01	-0.1%	12.04	+0.3%	PASS
02/25/06	07:38	ORIF	12.0	15	-0.16	-1.1%	12.22	+1.5%	PASS
02/26/06	07:38	ORIF	12.0	15	-0.19	-1.3%	11.72	-1.9%	PASS
02/27/06	07:38	ORIF	12.0	15	-0.17	-1.1%	11.65	-2.3%	PASS
02/28/06	07:38	ORIF	12.0	15	-0.01	-0.1%	12.21	+1.4%	PASS
03/01/06	07:38	ORIF	12.0	15	0.07	+0.5%	11.48	-3.5%	PASS
03/02/06	07:38	ORIF	12.0	15	0.17	+1.1%	12.74	+4.9%	PASS
03/03/06	07:38	ORIF	12.0	15	-0.19	-1.3%	12.31	+2.1%	PASS
03/04/06	07:38	ORIF	12.0	15	0.02	+0.1%	12.38	+2.5%	PASS
03/05/06	07:37	ORIF	12.0	15	-0.07	-0.5%	11.77	-1.5%	PASS
03/06/06	07:38	ORIF	12.0	15	0.10	+0.7%	12.33	+2.2%	PASS
03/07/06	07:38	ORIF	12.0	15	-0.09	-0.6%	12.31	+2.1%	PASS
03/08/06	07:38	ORIF	12.0	15	-0.20	-1.3%	12.38	+2.5%	PASS
03/09/06	Calibration Data Not Available								
03/10/06	07:38	ORIF	12.0	15	-0.68	-4.5%	11.57	-2.9%	PASS
03/11/06	07:38	ORIF	12.0	15	-0.85	-5.7%	11.06	-6.3%	PASS
03/12/06	07:38	ORIF	12.0	15	0.02	+0.1%	11.90	-0.7%	PASS
03/13/06	07:38	ORIF	12.0	15	0.07	+0.5%	11.63	-2.5%	PASS
03/14/06	07:38	ORIF	12.0	15	-0.20	-1.3%	12.05	+0.3%	PASS
03/15/06	07:38	ORIF	12.0	15	-0.14	-0.9%	11.54	-3.1%	PASS
03/16/06	07:38	ORIF	12.0	15	-0.09	-0.6%	11.86	-0.9%	PASS
03/17/06	07:38	ORIF	12.0	15	0.15	+1.0%	11.42	-3.9%	PASS
03/18/06	07:38	ORIF	12.0	15	0.00	0.0%	12.35	+2.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/19/06	07:38	ORIF	12.0	15	-0.17	-1.1%	11.85	-1.0%	PASS
03/20/06	07:38	ORIF	12.0	15	-0.05	-0.3%	12.35	+2.3%	PASS
03/21/06	07:38	ORIF	12.0	15	0.00	0.0%	12.30	+2.0%	PASS
03/22/06	07:38	ORIF	12.0	15	0.03	+0.2%	12.48	+3.2%	PASS
03/23/06	07:38	ORIF	12.0	15	-0.05	-0.3%	12.83	+5.5%	PASS
03/24/06	07:38	ORIF	12.0	15	-0.15	-1.0%	12.56	+3.7%	PASS
03/25/06	07:38	ORIF	12.0	15	0.20	+1.3%	12.33	+2.2%	PASS
03/26/06	07:37	ORIF	12.0	15	-0.18	-1.2%	11.67	-2.2%	PASS
03/27/06	07:37	ORIF	12.0	15	-0.01	-0.1%	11.49	-3.4%	PASS
03/28/06	07:38	ORIF	12.0	15	-0.15	-1.0%	11.74	-1.7%	PASS
03/29/06	07:38	ORIF	12.0	15	-0.16	-1.1%	11.75	-1.7%	PASS
03/30/06	07:38	ORIF	12.0	15	0.16	+1.1%	12.09	+0.6%	PASS
03/31/06	07:38	ORIF	12.0	15	0.18	+1.2%	11.80	-1.3%	PASS
04/01/06	07:38	ORIF	12.0	15	-0.03	-0.2%	12.06	+0.4%	PASS
04/02/06	07:38	ORIF	12.0	15	-0.41	-2.7%	11.18	-5.5%	PASS
04/03/06	07:38	ORIF	12.0	15	-0.02	-0.1%	12.17	+1.1%	PASS
04/04/06	07:38	ORIF	12.0	15	-0.24	-1.6%	11.46	-3.6%	PASS
04/05/06	07:36	ORIF	12.0	15	-0.02	-0.1%	12.61	+4.1%	PASS
04/06/06	07:36	ORIF	12.0	15	-0.05	-0.3%	11.37	-4.2%	PASS
04/07/06	07:36	ORIF	12.0	15	0.00	0.0%	12.06	+0.4%	PASS
04/08/06	07:36	ORIF	12.0	15	-0.30	-2.0%	11.74	-1.7%	PASS
04/09/06	07:36	ORIF	12.0	15	-0.12	-0.8%	11.64	-2.4%	PASS
04/10/06	07:36	ORIF	12.0	15	0.00	0.0%	11.76	-1.6%	PASS
04/11/06	07:36	ORIF	12.0	15	-0.05	-0.3%	12.38	+2.5%	PASS
04/12/06	07:36	ORIF	12.0	15	0.30	+2.0%	12.88	+5.9%	PASS
04/13/06	07:36	ORIF	12.0	15	0.02	+0.1%	11.83	-1.1%	PASS
04/14/06	07:36	ORIF	12.0	15	-0.14	-0.9%	11.90	-0.7%	PASS
04/15/06	07:36	ORIF	12.0	15	-0.06	-0.4%	11.50	-3.3%	PASS
04/16/06	07:36	ORIF	12.0	15	-0.17	-1.1%	11.68	-2.1%	PASS
04/17/06	07:36	ORIF	12.0	15	-0.11	-0.7%	11.60	-2.7%	PASS
04/18/06	07:36	ORIF	12.0	15	-0.18	-1.2%	11.86	-0.9%	PASS
04/19/06	07:36	ORIF	12.0	15	-0.16	-1.1%	11.92	-0.5%	PASS
04/20/06	07:36	ORIF	12.0	15	-0.15	-1.0%	12.12	+0.8%	PASS
04/21/06	07:41	ORIF	5.0	15	1.99	+13.3%	5.48	+3.2%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
04/22/06	07:40	ORIF	5.0	15	0.95	+6.3%	7.60	+17.3%	FAIL
04/23/06	07:40	ORIF	5.0	15	-0.12	-0.8%	6.41	+9.4%	FAIL
04/24/06	07:41	ORIF	5.0	15	0.04	+0.3%	5.95	+6.3%	PASS
04/25/06	07:41	ORIF	5.0	15	-0.02	-0.1%	5.51	+3.4%	PASS
04/26/06	07:41	ORIF	5.0	15	-0.02	-0.1%	5.73	+4.9%	PASS
04/27/06	07:40	ORIF	5.0	15	0.05	+0.3%	5.43	+2.9%	PASS
04/28/06	07:41	ORIF	5.0	15	0.00	0.0%	5.32	+2.1%	PASS
04/29/06	07:40	ORIF	5.0	15	0.01	+0.1%	5.08	+0.5%	PASS
04/30/06	07:40	ORIF	5.0	15	-0.03	-0.2%	5.19	+1.3%	PASS
05/01/06	07:41	ORIF	5.0	15	0.01	+0.1%	5.59	+3.9%	PASS
05/02/06	07:41	ORIF	5.0	15	0.00	0.0%	5.45	+3.0%	PASS
05/03/06	07:41	ORIF	5.0	15	-0.01	-0.1%	5.97	+6.5%	PASS
05/04/06	07:41	ORIF	5.0	15	0.08	+0.5%	5.09	+0.6%	PASS
05/05/06	07:41	ORIF	5.0	15	0.02	+0.1%	5.64	+4.3%	PASS
05/06/06	07:41	ORIF	5.0	15	-0.06	-0.4%	4.98	-0.1%	PASS
05/07/06	07:41	ORIF	5.0	15	-0.18	-1.2%	4.87	-0.9%	PASS
05/08/06	07:41	ORIF	5.0	15	-0.03	-0.2%	4.81	-1.3%	PASS
05/09/06	07:40	ORIF	5.0	15	-0.02	-0.1%	5.06	+0.4%	PASS
05/10/06	07:41	ORIF	5.0	15	0.03	+0.2%	5.09	+0.6%	PASS
05/11/06	07:40	ORIF	5.0	15	-0.04	-0.3%	5.00	0.0%	PASS
05/12/06	07:40	ORIF	5.0	15	-0.15	-1.0%	5.07	+0.5%	PASS
05/13/06	07:40	ORIF	5.0	15	0.11	+0.7%	5.08	+0.5%	PASS
05/14/06	07:40	ORIF	5.0	15	-0.07	-0.5%	4.93	-0.5%	PASS
05/15/06	07:40	ORIF	5.0	15	0.08	+0.5%	5.02	+0.1%	PASS
05/16/06	07:40	ORIF	5.0	15	-0.02	-0.1%	4.97	-0.2%	PASS
05/17/06	07:41	ORIF	5.0	15	-0.13	-0.9%	6.69	+11.3%	FAIL
05/18/06	Maintenance Activities – No Calibration Check								
05/19/06	07:40	ORIF	12.0	15	-0.35	-2.3%	11.78	-1.5%	PASS
05/20/06	07:41	ORIF	12.0	15	-0.08	-0.5%	11.62	-2.5%	PASS
05/21/06	07:40	ORIF	12.0	15	-0.28	-1.9%	11.56	-2.9%	PASS
05/22/06	07:40	ORIF	12.0	15	-0.22	-1.5%	12.32	+2.1%	PASS
05/23/06	07:40	ORIF	12.0	15	-0.08	-0.5%	12.21	+1.4%	PASS
05/24/06	07:41	ORIF	12.0	15	0.14	+0.9%	12.07	+0.5%	PASS
05/25/06	07:41	ORIF	12.0	15	-0.10	-0.7%	12.41	+2.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/26/06	07:41	ORIF	12.0	15	-0.20	-1.3%	12.19	+1.3%	PASS
05/27/06	07:40	ORIF	12.0	15	-0.21	-1.4%	12.12	+0.8%	PASS
05/28/06	07:41	ORIF	12.0	15	-0.11	-0.7%	11.83	-1.1%	PASS
05/29/06	07:40	ORIF	12.0	15	-0.23	-1.5%	11.86	-0.9%	PASS
05/30/06	07:40	ORIF	12.0	15	-0.11	-0.7%	11.84	-1.1%	PASS
05/31/06	07:40	ORIF	12.0	15	-0.13	-0.9%	12.33	+2.2%	PASS
06/01/06	07:40	ORIF	12.0	15	-0.15	-1.0%	12.18	+1.2%	PASS
06/02/06	07:40	ORIF	12.0	15	-0.08	-0.5%	12.78	+5.2%	PASS
06/03/06	07:40	ORIF	12.0	15	0.01	+0.1%	11.50	-3.3%	PASS
06/04/06	07:40	ORIF	12.0	15	0.06	+0.4%	12.00	0.0%	PASS
06/05/06	07:40	ORIF	12.0	15	-0.03	-0.2%	11.52	-3.2%	PASS
06/06/06	07:40	ORIF	12.0	15	-0.20	-1.3%	11.44	-3.7%	PASS
06/07/06	07:40	ORIF	12.0	15	-0.15	-1.0%	11.89	-0.7%	PASS
06/08/06	07:40	ORIF	12.0	15	-0.33	-2.2%	11.36	-4.3%	PASS
06/09/06	07:40	ORIF	12.0	15	-0.12	-0.8%	11.86	-0.9%	PASS
06/10/06	07:40	ORIF	12.0	15	-0.31	-2.1%	11.72	-1.9%	PASS
06/11/06	07:40	ORIF	12.0	15	-0.27	-1.8%	11.24	-5.1%	PASS
06/12/06	07:40	ORIF	12.0	15	-0.25	-1.7%	11.93	-0.5%	PASS
06/13/06	07:40	ORIF	12.0	15	-0.12	-0.8%	11.62	-2.5%	PASS
06/14/06	07:40	ORIF	12.0	15	-0.23	-1.5%	11.86	-0.9%	PASS
06/15/06	07:40	ORIF	12.0	15	-0.26	-1.7%	12.32	+2.1%	PASS
06/16/06	07:40	ORIF	12.0	15	-0.15	-1.0%	11.44	-3.7%	PASS
06/17/06	07:40	ORIF	12.0	15	-0.04	-0.3%	11.69	-2.1%	PASS
06/18/06	07:40	ORIF	12.0	15	-0.15	-1.0%	11.34	-4.4%	PASS
06/19/06	07:40	ORIF	12.0	15	0.13	+0.9%	11.63	-2.5%	PASS
06/20/06	07:40	ORIF	12.0	15	-0.14	-0.9%	11.64	-2.4%	PASS
06/21/06	07:38	ORIF	12.0	15	-0.07	-0.5%	12.02	+0.1%	PASS
06/22/06	07:38	ORIF	12.0	15	-0.08	-0.5%	11.00	-6.7%	PASS
06/23/06	07:38	ORIF	12.0	15	-0.21	-1.4%	11.94	-0.4%	PASS
06/24/06	07:38	ORIF	12.0	15	-0.18	-1.2%	12.41	+2.7%	PASS
06/25/06	07:38	ORIF	12.0	15	0.05	+0.3%	11.85	-1.0%	PASS
06/26/06	07:38	ORIF	12.0	15	-0.20	-1.3%	11.76	-1.6%	PASS
06/27/06	07:38	ORIF	12.0	15	-0.18	-1.2%	12.11	+0.7%	PASS
06/28/06	07:38	ORIF	12.0	15	-0.22	-1.5%	12.18	+1.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
06/29/06	07:38	ORIF	12.0	15	-0.27	-1.8%	11.80	-1.3%	PASS
06/30/06	07:38	ORIF	12.0	15	-0.16	-1.1%	11.79	-1.4%	PASS
07/01/06	07:38	ORIF	12.0	15	-0.26	-1.7%	12.02	+0.1%	PASS
07/02/06	07:38	ORIF	12.0	15	-0.18	-1.2%	12.10	+0.7%	PASS
07/03/06	07:38	ORIF	12.0	15	-0.19	-1.3%	12.08	+0.5%	PASS
07/04/06	07:38	ORIF	12.0	15	-0.22	-1.5%	12.01	+0.1%	PASS
07/05/06	07:38	ORIF	12.0	15	-0.09	-0.6%	11.80	-1.3%	PASS
07/06/06	07:38	ORIF	12.0	15	-0.08	-0.5%	11.84	-1.1%	PASS
07/07/06	07:38	ORIF	12.0	15	-0.25	-1.7%	11.94	-0.4%	PASS
07/08/06	07:38	ORIF	12.0	15	-0.15	-1.0%	11.78	-1.5%	PASS
07/09/06	07:38	ORIF	12.0	15	-0.34	-2.3%	12.09	+0.6%	PASS
07/10/06	07:38	ORIF	12.0	15	-0.17	-1.1%	11.72	-1.9%	PASS
07/11/06	07:38	ORIF	12.0	15	-0.29	-1.9%	11.90	-0.7%	PASS
07/12/06	07:38	ORIF	12.0	15	-0.19	-1.3%	12.10	+0.7%	PASS
07/13/06	07:38	ORIF	12.0	15	-0.07	-0.5%	12.05	+0.3%	PASS
07/14/06	07:38	ORIF	12.0	15	-0.11	-0.7%	11.70	-2.0%	PASS
07/15/06	07:38	ORIF	12.0	15	-0.07	-0.5%	11.58	-2.8%	PASS
07/16/06	07:38	ORIF	12.0	15	-0.03	-0.2%	11.90	-0.7%	PASS
07/17/06	07:38	ORIF	12.0	15	-0.12	-0.8%	11.54	-3.1%	PASS
07/18/06	Maintenance Activities – No Calibration Check								
07/19/06	07:42	ORIF	5.0	15	1.71	+11.4%	7.80	+18.7%	FAIL
07/20/06	07:43	ORIF	5.0	15	-0.13	-0.9%	8.08	+20.5%	PASS
07/21/06	07:43	ORIF	5.0	15	0.31	+2.1%	7.92	+19.5%	PASS
07/22/06	07:43	ORIF	5.0	15	1055.99	N/A	770.40	N/A	FAIL
07/23/06	15:39	ORIF	5.0	15	-0.26	-1.7%	9.69	+31.3%	PASS
07/24/06	07:43	ORIF	5.0	15	-0.63	-4.2%	4.62	-2.5%	PASS
07/25/06	07:43	ORIF	5.0	15	0.17	+1.1%	5.99	+6.6%	PASS
07/26/06	07:43	ORIF	5.0	15	-0.58	-3.9%	5.28	+1.9%	PASS
07/27/06	07:43	ORIF	5.0	15	-0.66	-4.4%	5.19	+1.3%	PASS
07/28/06	Calibration Data Not Available								
07/29/06	Calibration Data Not Available								
07/30/06	Calibration Data Not Available								
07/31/06	Calibration Data Not Available								
08/01/06	07:43	ORIF	8.0	15	-1.96	-13.1%	10.40	+16.0%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/01/06	12:44	INST	8.0	15	-0.01	-0.1%	2.81	-34.6%	FAIL
08/01/06	13:00	ORIF	8.0	15	-3.05	-20.3%	9.22	+8.1%	FAIL
08/01/06	13:18	SYST	8.0	15	-3.24	-21.6%	7.22	-5.2%	FAIL
08/02/06	07:43	ORIF	8.0	15	-1.49	-9.9%	11.37	+22.5%	FAIL
08/02/06	17:23	INST	8.0	15	0.08	+0.5%	2.57	-36.2%	FAIL
08/03/06	07:43	ORIF	8.0	15	-1.33	-8.9%	9.07	+7.1%	FAIL
08/04/06	07:43	ORIF	8.0	15	0.02	+0.1%	9.19	+7.9%	FAIL
08/05/06	07:43	ORIF	8.0	15	-0.14	-0.9%	9.74	+11.6%	FAIL
08/06/06	07:43	ORIF	8.0	15	-0.95	-6.3%	9.31	+8.7%	FAIL
08/07/06	07:43	ORIF	8.0	15	-0.66	-4.4%	9.32	+8.8%	FAIL
08/08/06	07:43	ORIF	8.0	15	-0.18	-1.2%	9.66	+11.1%	FAIL
08/09/06	07:43	ORIF	8.0	15	-0.60	-4.0%	7.55	-3.0%	PASS
08/10/06	07:43	ORIF	8.0	15	-0.06	-0.4%	9.33	+8.9%	FAIL
08/11/06	07:43	ORIF	8.0	15	-0.68	-4.5%	8.15	+1.0%	PASS
08/12/06	06:51	SYST	8.0	15	-0.63	-4.2%	5.61	-15.9%	FAIL
08/13/06	00:11	ORIF	11.0	20	2.93	+14.7%	9.53	-7.4%	FAIL
08/13/06	03:11	ORIF	11.0	20	1.69	+8.5%	8.51	-12.5%	FAIL
08/13/06	06:11	ORIF	11.0	20	0.62	+3.1%	7.80	-16.0%	FAIL
08/13/06	07:44	ORIF	11.0	20	0.38	+1.9%	7.83	-15.9%	FAIL
08/14/06	Maintenance Activities – No Calibration Check								
08/15/06	Maintenance Activities – No Calibration Check								
08/16/06	Maintenance Activities – No Calibration Check								
08/17/06	07:44	ORIF	11.0	20	6.01	+30.1%	1.36	-48.2%	FAIL
08/18/06	Maintenance Activities – No Calibration Check								
08/19/06	07:35	ORIF	11.0	20	0.65	+3.3%	10.49	-2.6%	PASS
08/20/06	07:35	ORIF	11.0	20	0.61	+3.1%	11.39	+2.0%	PASS
08/21/06	07:35	ORIF	11.0	20	0.56	+2.8%	11.50	+2.5%	PASS
08/22/06	07:35	ORIF	11.0	20	0.68	+3.4%	11.42	+2.1%	PASS
08/23/06	07:35	ORIF	11.0	20	0.68	+3.4%	10.80	-1.0%	PASS
08/24/06	07:28	INST	11.0	20	-0.01	-0.1%	5.06	-29.7%	FAIL
08/25/06	07:36	ORIF	11.0	20	0.40	+2.0%	11.51	+2.6%	PASS
08/26/06	07:36	ORIF	11.0	20	-0.22	-1.1%	15.66	+23.3%	FAIL
08/27/06	07:36	ORIF	11.0	20	-1.03	-5.2%	10.03	-4.9%	FAIL
08/28/06	07:36	ORIF	11.0	20	0.05	+0.3%	11.22	+1.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/29/06	07:36	ORIF	11.0	20	0.53	+2.7%	11.60	+3.0%	PASS
08/30/06	07:36	ORIF	11.0	20	0.30	+1.5%	11.10	+0.5%	PASS
08/31/06	07:36	ORIF	11.0	20	0.20	+1.0%	11.31	+1.6%	PASS
09/01/06	07:36	ORIF	11.0	20	0.29	+1.5%	11.39	+2.0%	PASS
09/02/06	07:36	ORIF	11.0	20	0.20	+1.0%	20.17	+45.9%	FAIL
09/03/06	07:36	ORIF	11.0	20	0.37	+1.9%	19.84	+44.2%	FAIL
09/04/06	07:36	ORIF	11.0	20	0.27	+1.4%	19.58	+42.9%	FAIL
09/05/06	07:36	ORIF	11.0	20	0.22	+1.1%	19.95	+44.8%	FAIL
09/06/06	07:36	ORIF	11.0	20	0.19	+1.0%	10.67	-1.7%	PASS
09/07/06	Maintenance Activities – No Calibration Check								
09/08/06	07:36	SYST	11.0	20	-0.25	-1.3%	11.73	+3.7%	PASS
09/09/06	07:36	SYST	11.0	20	-0.14	-0.7%	9.63	-6.9%	FAIL
09/10/06	07:36	SYST	11.0	20	-0.06	-0.3%	9.76	-6.2%	FAIL
09/11/06	07:36	SYST	11.0	20	0.17	+0.9%	9.29	-8.6%	FAIL
09/12/06	07:36	SYST	11.0	20	-0.08	-0.4%	10.99	-0.0%	PASS
09/13/06	07:36	SYST	11.0	20	-0.08	-0.4%	10.76	-1.2%	PASS
09/14/06	07:36	SYST	11.0	20	0.06	+0.3%	11.34	+1.7%	PASS
09/15/06	07:36	SYST	11.0	20	-0.25	-1.3%	11.61	+3.1%	PASS
09/16/06	07:36	SYST	11.0	20	-0.05	-0.3%	11.19	+0.9%	PASS
09/17/06	07:36	SYST	11.0	20	-0.07	-0.4%	10.96	-0.2%	PASS
09/18/06	07:36	SYST	11.0	20	0.36	+1.8%	10.79	-1.1%	PASS
09/19/06	07:36	SYST	11.0	20	0.03	+0.2%	10.30	-3.5%	PASS
09/20/06	07:36	SYST	11.0	20	0.02	+0.1%	10.51	-2.5%	PASS
09/21/06	07:36	SYST	11.0	20	0.31	+1.6%	10.39	-3.1%	PASS
09/22/06	System Span Mode – No Calibration Check								
09/23/06	07:36	SYST	11.0	20	-0.32	-1.6%	11.01	+0.0%	PASS
09/24/06	07:36	SYST	11.0	20	0.65	+3.3%	10.68	-1.6%	PASS
09/25/06	07:36	SYST	11.0	20	0.01	+0.1%	10.80	-1.0%	PASS
09/26/06	07:36	SYST	11.0	20	0.18	+0.9%	10.94	-0.3%	PASS
09/27/06	07:36	SYST	11.0	20	-0.46	-2.3%	10.30	-3.5%	PASS
09/28/06	07:36	SYST	11.0	20	0.28	+1.4%	10.37	-3.2%	PASS
09/29/06	07:36	SYST	11.0	20	-0.35	-1.8%	11.34	+1.7%	PASS
09/30/06	07:36	SYST	11.0	20	-0.51	-2.6%	11.03	+0.1%	PASS
10/01/06	07:36	SYST	11.0	20	-0.18	-0.9%	11.47	+2.4%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
10/02/06	07:36	SYST	11.0	20	-0.45	-2.3%	10.15	-4.3%	PASS
10/03/06	07:36	SYST	11.0	20	0.36	+1.8%	10.80	-1.0%	PASS
10/04/06	07:36	SYST	11.0	20	-0.20	-1.0%	11.09	+0.4%	PASS
10/05/06	07:36	SYST	11.0	20	-0.49	-2.5%	11.73	+3.7%	PASS
10/06/06	07:36	SYST	11.0	20	-0.24	-1.2%	11.45	+2.3%	PASS
10/07/06	07:36	SYST	11.0	20	0.07	+0.4%	10.69	-1.6%	PASS
10/08/06	07:36	SYST	11.0	20	-0.15	-0.8%	0.80	-51.0%	FAIL
10/09/06	07:36	SYST	11.0	20	-0.18	-0.9%	12.17	+5.9%	FAIL
10/10/06	07:36	SYST	11.0	20	-0.56	-2.8%	12.43	+7.2%	FAIL
10/11/06	07:36	SYST	11.0	20	-0.23	-1.2%	11.04	+0.2%	PASS
10/12/06	07:36	SYST	11.0	20	0.11	+0.6%	11.28	+1.4%	PASS
10/13/06	07:36	SYST	11.0	20	0.39	+2.0%	12.00	+5.0%	PASS
10/14/06	07:36	SYST	11.0	20	0.58	+2.9%	12.29	+6.5%	FAIL
10/15/06	07:36	SYST	11.0	20	0.45	+2.3%	11.85	+4.3%	PASS
10/16/06	07:36	SYST	11.0	20	0.26	+1.3%	12.53	+7.7%	FAIL
10/17/06	07:36	SYST	11.0	20	0.51	+2.6%	12.73	+8.7%	FAIL
10/18/06	07:36	SYST	11.0	20	0.32	+1.6%	10.32	-3.4%	PASS
10/19/06	07:36	SYST	11.0	20	0.09	+0.5%	10.09	-4.6%	PASS
10/20/06	07:36	SYST	11.0	20	0.67	+3.4%	10.02	-4.9%	PASS
10/21/06	07:36	SYST	11.0	20	0.41	+2.1%	10.76	-1.2%	PASS
10/22/06	07:36	SYST	11.0	20	0.53	+2.7%	11.19	+0.9%	PASS
10/23/06	07:36	SYST	11.0	20	1.04	+5.2%	11.71	+3.6%	FAIL
10/24/06	07:36	SYST	11.0	20	0.73	+3.7%	11.76	+3.8%	PASS
10/25/06	07:36	SYST	11.0	20	0.64	+3.2%	10.23	-3.9%	PASS
10/26/06	07:36	SYST	11.0	20	0.18	+0.9%	10.11	-4.5%	PASS
10/27/06	07:36	SYST	11.0	20	0.63	+3.2%	10.45	-2.8%	PASS
10/28/06	07:36	SYST	11.0	20	0.65	+3.3%	10.50	-2.5%	PASS
10/29/06	07:36	SYST	11.0	20	0.47	+2.4%	10.11	-4.5%	PASS
10/30/06	Calibration Data Not Available								
10/31/06	07:36	SYST	11.0	20	0.52	+2.6%	10.69	-1.6%	PASS
11/01/06	07:36	SYST	11.0	20	0.16	+0.8%	10.74	-1.3%	PASS
11/02/06	07:36	SYST	11.0	20	0.08	+0.4%	11.37	+1.9%	PASS
11/03/06	07:36	SYST	11.0	20	0.27	+1.4%	11.42	+2.1%	PASS
11/04/06	07:36	SYST	11.0	20	0.52	+2.6%	11.31	+1.6%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
11/05/06	07:36	SYST	11.0	20	0.29	+1.5%	11.47	+2.4%	PASS
11/06/06	07:36	SYST	11.0	20	0.09	+0.5%	11.00	0.0%	PASS
11/07/06	07:36	SYST	11.0	20	0.49	+2.5%	10.70	-1.5%	PASS
11/08/06	07:36	SYST	11.0	20	-0.01	-0.1%	10.01	-5.0%	PASS
11/09/06	07:36	SYST	11.0	20	0.26	+1.3%	9.95	-5.3%	FAIL
11/10/06	07:36	SYST	11.0	20	0.52	+2.6%	10.30	-3.5%	PASS
11/11/06	07:36	SYST	11.0	20	-3.46	-17.3%	5.26	-28.7%	FAIL
11/12/06	07:36	SYST	11.0	20	-3.18	-15.9%	5.33	-28.4%	FAIL
11/13/06	07:36	SYST	11.0	20	-3.56	-17.8%	6.87	-20.7%	FAIL
11/14/06	07:36	SYST	11.0	20	0.32	+1.6%	10.47	-2.7%	PASS
11/15/06	07:36	SYST	11.0	20	0.40	+2.0%	11.01	+0.0%	PASS
11/16/06	07:36	SYST	11.0	20	0.01	+0.1%	10.67	-1.7%	PASS
11/17/06	07:36	SYST	11.0	20	-0.22	-1.1%	10.64	-1.8%	PASS
11/18/06	07:36	SYST	11.0	20	0.31	+1.6%	10.99	-0.0%	PASS
11/19/06	07:36	SYST	11.0	20	0.30	+1.5%	10.99	-0.0%	PASS
11/20/06	07:36	SYST	11.0	20	-0.01	-0.1%	10.83	-0.9%	PASS
11/21/06	07:36	SYST	11.0	20	-0.34	-1.7%	10.44	-2.8%	PASS
11/22/06	07:36	SYST	11.0	20	0.36	+1.8%	10.21	-4.0%	PASS
11/23/06	07:36	SYST	11.0	20	0.32	+1.6%	10.00	-5.0%	PASS
11/24/06	07:36	SYST	11.0	20	0.20	+1.0%	10.61	-2.0%	PASS
11/25/06	07:36	SYST	11.0	20	0.24	+1.2%	10.27	-3.7%	PASS
11/26/06	07:36	SYST	11.0	20	0.28	+1.4%	10.59	-2.1%	PASS
11/27/06	07:36	SYST	11.0	20	0.41	+2.1%	10.41	-3.0%	PASS
11/28/06	07:36	SYST	11.0	20	0.64	+3.2%	10.70	-1.5%	PASS
11/29/06	07:36	SYST	11.0	20	-0.17	-0.9%	11.48	+2.4%	PASS
11/30/06	07:36	SYST	11.0	20	-0.08	-0.4%	11.43	+2.2%	PASS
12/01/06	07:36	SYST	11.0	20	-0.01	-0.1%	10.94	-0.3%	PASS
12/02/06	07:36	SYST	11.0	20	-0.49	-2.5%	11.30	+1.5%	PASS
12/03/06	07:36	SYST	11.0	20	0.28	+1.4%	11.48	+2.4%	PASS
12/04/06	07:36	SYST	11.0	20	0.00	0.0%	10.83	-0.9%	PASS
12/05/06	07:36	SYST	11.0	20	0.29	+1.5%	9.87	-5.7%	FAIL
12/06/06	07:36	SYST	11.0	20	-0.40	-2.0%	10.21	-4.0%	PASS
12/07/06	07:36	SYST	11.0	20	0.41	+2.1%	10.80	-1.0%	PASS
12/08/06	07:36	SYST	11.0	20	0.23	+1.2%	10.54	-2.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
12/09/06	07:36	SYST	11.0	20	-0.50	-2.5%	10.76	-1.2%	PASS
12/10/06	07:36	SYST	11.0	20	0.16	+0.8%	10.98	-0.1%	PASS
12/11/06	07:36	SYST	11.0	20	-0.27	-1.4%	12.08	+5.4%	FAIL
12/12/06	07:36	SYST	11.0	20	-0.38	-1.9%	11.78	+3.9%	PASS
12/13/06	07:36	SYST	11.0	20	-0.06	-0.3%	12.49	+7.5%	FAIL
12/14/06	07:36	SYST	11.0	20	-0.18	-0.9%	9.81	-6.0%	FAIL
12/15/06	07:36	SYST	11.0	20	0.28	+1.4%	10.10	-4.5%	PASS
12/16/06	07:36	SYST	11.0	20	-0.13	-0.7%	10.89	-0.5%	PASS
12/17/06	07:36	SYST	11.0	20	-0.18	-0.9%	10.25	-3.8%	PASS
12/18/06	07:36	SYST	11.0	20	0.08	+0.4%	10.26	-3.7%	PASS
12/19/06	07:36	SYST	11.0	20	0.19	+1.0%	9.84	-5.8%	FAIL
12/20/06	07:36	SYST	11.0	20	-0.10	-0.5%	9.59	-7.1%	FAIL
12/21/06	07:36	SYST	11.0	20	-0.55	-2.8%	11.82	+4.1%	PASS
12/22/06	07:36	SYST	11.0	20	-0.13	-0.7%	11.19	+0.9%	PASS
12/23/06	07:36	SYST	11.0	20	-0.86	-4.3%	11.21	+1.1%	PASS
12/24/06	07:36	SYST	11.0	20	-0.78	-3.9%	10.87	-0.7%	PASS
12/25/06	07:36	SYST	11.0	20	0.35	+1.8%	12.05	+5.3%	FAIL
12/26/06	07:36	SYST	11.0	20	0.42	+2.0%	12.16	+5.8%	FAIL
12/27/06	07:36	SYST	11.0	20	-0.91	-4.6%	11.50	+2.5%	PASS
12/28/06	07:36	SYST	11.0	20	-0.31	-1.5%	11.08	+0.4%	PASS
12/29/06	07:36	SYST	11.0	20	0.28	+1.4%	8.95	-10.3%	FAIL
12/30/06	07:36	SYST	11.0	20	0.33	+1.6%	9.76	-6.2%	FAIL
12/31/06	07:36	SYST	11.0	20	-0.45	-2.2%	0.53	-52.3%	FAIL
01/01/07	07:36	SYST	11.0	20	-0.29	-1.5&	12.35	+6.8%	FAIL
01/02/07	07:36	SYST	11.0	20	0.25	+1.3%	0.51	-52.5%	FAIL
01/03/07	07:36	SYST	11.0	20	0.49	+2.4%	2.14	-44.3%	FAIL
01/04/07	07:36	SYST	11.0	20	0.34	+1.7%	12.25	+6.3%	FAIL
01/05/07	07:36	SYST	11.0	20	-0.22	-1.1%	12.58	+7.9%	FAIL
01/06/07	07:36	SYST	11.0	20	0.33	+1.6%	13.12	+10.6%	FAIL
01/07/07	07:36	SYST	11.0	20	-0.06	-0.3%	12.64	+8.2%	FAIL
01/08/07	07:36	SYST	11.0	20	0.04	+0.2%	12.53	+7.7%	FAIL
01/09/07	07:36	SYST	11.0	20	0.29	+1.5%	11.03	+0.1%	PASS
01/10/07	07:36	SYST	11.0	20	0.67	+3.4%	11.52	+2.6%	PASS
01/11/07	07:36	SYST	11.0	20	0.64	+3.2%	11.45	+2.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/12/07	07:36	SYST	11.0	20	0.05	+0.3%	4.97	-30.2%	FAIL
01/13/07	07:36	SYST	11.0	20	-0.33	-1.7%	-0.68	-58.4%	FAIL
01/14/07	07:36	SYST	11.0	20	0.62	+3.1%	10.92	-0.4%	PASS
01/15/07	07:36	SYST	11.0	20	0.66	+3.3%	10.67	-1.7%	PASS
01/16/07	07:36	SYST	11.0	20	-0.29	-1.5%	10.32	-3.4%	PASS
01/17/07	07:36	SYST	11.0	20	-0.09	-0.4%	10.82	-0.9%	PASS
01/18/07	07:36	SYST	11.0	20	-1.53	-7.7%	10.21	-3.9%	FAIL
01/19/07	07:36	SYST	11.0	20	-0.49	-2.4%	11.05	+0.3%	PASS
01/20/07	07:36	SYST	11.0	20	0.08	+0.4%	11.19	+0.9%	PASS
01/21/07	07:36	SYST	11.0	20	-0.60	-3.0%	9.79	-6.0%	FAIL
01/22/07	07:36	SYST	11.0	20	0.10	+0.5%	11.52	+2.6%	PASS
01/23/07	07:36	SYST	11.0	20	-0.39	-2.0%	11.02	+0.1%	PASS
01/24/07	07:36	SYST	11.0	20	-0.52	-2.6%	11.49	+2.4%	PASS
01/25/07	07:43	SYST	10.0	20	-0.50	-2.5%	8.57	-7.2%	FAIL
01/26/07	14:22	SYST	10.0	20	-0.02	-0.1%	11.06	+5.3%	FAIL
01/27/07	07:43	SYST	10.0	20	-0.27	-1.4%	4.02	-29.9%	FAIL
01/27/07	10:28	SYST	10.0	20	-0.02	-0.1%	9.79	-1.1%	PASS
01/28/07	07:43	SYST	10.0	20	-0.36	-1.8%	10.57	+2.9%	PASS
01/29/07	07:43	SYST	10.0	20	-0.10	-0.5%	8.19	-9.1%	FAIL
01/29/07	09:27	SYST	10.0	20	0.40	+2.0%	9.29	-3.6%	PASS
01/30/07	Maintenance Activities – No Calibration Check								
01/31/07	07:43	SYST	10.0	20	-0.28	-1.4%	8.61	-7.0%	FAIL
02/01/07	07:43	SYST	10.0	20	-0.91	-4.6%	8.84	-5.8%	FAIL
02/02/07	07:43	SYST	10.0	20	-1.18	-5.9%	7.99	-10.1%	FAIL
02/03/07	07:43	SYST	11.0	20	0.14	+0.7%	11.56	+2.8%	PASS
02/04/07	07:43	SYST	11.0	20	-0.08	-0.4%	12.12	+5.6%	FAIL
02/05/07	07:43	SYST	11.0	20	1.10	+5.5%	12.76	+8.8%	FAIL
02/06/07	13.11	SYST	11.0	20	-3.75	-18.7%	7.49	-17.5%	FAIL
02/07/07	07:43	SYST	11.0	20	0.35	+1.8%	9.95	-5.3%	FAIL
02/08/07	07:39	SYST	11.0	20	1.03	+5.2%	11.44	+2.2%	FAIL
02/09/07	07:39	SYST	11.0	20	-1.82	-9.1%	11.64	+3.2%	FAIL
02/10/07	07:39	SYST	11.0	20	3.34	+16.7%	10.81	-0.9%	FAIL
02/11/07	07:39	SYST	11.0	20	3.31	+16.6%	10.08	-4.6%	FAIL
02/12/07	07:39	SYST	11.0	20	3.18	+15.9%	10.22	-3.9%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/13/07	07:39	SYST	11.0	20	-2.80	-14.0%	2.59	-42.1%	FAIL
02/13/07	12:25	SYST	11.0	20	0.90	+4.5%	11.29	+1.5%	PASS
02/14/07	07:39	SYST	11.0	20	0.06	+0.3%	9.87	-5.7%	FAIL
02/15/07	07:39	SYST	11.0	20	-1.70	-8.5%	9.12	-9.4%	FAIL
02/16/07	07:39	SYST	11.0	20	2.99	+15.0%	11.38	+1.9%	FAIL
02/17/07	07:39	SYST	11.0	20	1.11	+5.6%	11.60	+3.0%	FAIL
02/18/07	07:39	SYST	11.0	20	1.28	+6.4%	11.48	+2.4%	FAIL
02/19/07	07:39	SYST	11.0	20	0.40	+2.0%	11.35	+1.8%	PASS
02/20/07	07:39	SYST	11.0	20	0.93	+4.7%	11.97	+4.9%	PASS
02/21/07	07:39	SYST	11.0	20	0.05	+0.3%	11.20	+1.0%	PASS
02/22/07	07:39	SYST	11.0	20	0.83	+4.2%	11.99	+5.0%	PASS
02/23/07	07:39	SYST	11.0	20	1.31	+6.6%	11.41	+2.1%	FAIL
02/24/07	07:39	SYST	11.0	20	1.66	+8.3%	12.23	+6.2%	FAIL
02/25/07	07:40	SYST	11.0	20	-1.85	-9.3%	-2.00	-65.0%	FAIL
02/26/07	07:40	SYST	Calibrator Error						
02/27/07	07:40	SYST	Calibrator Error						
02/28/07	07:40	SYST	Calibrator Error						
03/01/07	Software Errors – No Calibration Check								
03/02/07	Software Errors – No Calibration Check								
03/03/07	Software Errors – No Calibration Check								
03/04/07	Software Errors – No Calibration Check								
03/05/07	Software Errors – No Calibration Check								
03/06/07	Software Errors – No Calibration Check								
03/07/07	Software Errors – No Calibration Check								
03/08/07	Software Errors – No Calibration Check								
03/09/07	Software Errors – No Calibration Check								
03/10/07	Software Errors – No Calibration Check								
03/11/07	Software Errors – No Calibration Check								
03/12/07	08:51	SYST	Calibrator Error						
03/13/07	Manual Recalibration – No Calibration Check								
03/14/07	08:36	SYST	11.0	20	0.41	+2.1%	11.73	+3.7%	PASS
03/14/07	11:46	SYST	11.0	20	0.41	+2.1%	1.33	-48.4%	FAIL
03/14/07	15:00	SYST	11.0	20	0.22	+1.1%	12.40	+7.0%	FAIL
03/15/07	08:36	SYST	11.0	20	1.54	+7.7%	13.88	+14.4%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/16/07	08:36	SYST	11.0	20	1.72	+8.6%	14.41	+17.1%	FAIL
03/17/07	08:36	SYST	11.0	20	3.26	+16.3%	15.03	+20.2%	FAIL
03/18/07	08:36	SYST	11.0	20	4.69	+23.5%	17.11	+30.6%	FAIL
03/19/07	08:36	SYST	11.0	20	4.04	+20.2%	15.86	+24.3%	FAIL
03/20/07	08:36	SYST	11.0	20	0.42	+2.1%	11.43	+2.2%	PASS
03/21/07	07:40	SYST	11.0	20	-0.95	-4.8%	10.96	-0.2%	PASS
03/22/07	07:40	SYST	11.0	20	-1.67	-8.4%	9.60	-7.0%	FAIL
03/22/07	16:48	SYST	11.0	20	-0.76	-3.8%	10.54	-2.3%	PASS
03/23/07	07:40	SYST	11.0	20	1.17	+5.9%	10.77	-1.2%	FAIL
03/24/07	07:40	SYST	11.0	20	0.33	+1.7%	11.48	+2.4%	PASS
03/25/07	07:40	SYST	11.0	20	-1.25	-6.3%	9.75	-6.3%	FAIL
03/26/07	07:40	SYST	11.0	20	-2.21	-11.1%	8.72	-11.4%	FAIL
03/27/07	07:40	SYST	11.0	20	1.02	+5.1%	12.47	+7.4%	FAIL
03/28/07	07:40	SYST	11.0	20	0.75	+3.8%	12.14	+5.7%	FAIL
03/29/07	07:40	SYST	11.0	20	1.96	+9.8%	12.82	+9.1%	FAIL
03/30/07	07:40	SYST	11.0	20	1.63	+8.2%	12.02	+5.1%	FAIL
03/31/07	07:40	SYST	11.0	20	-0.23	-1.2%	10.46	-2.7%	PASS
04/01/07	07:40	SYST	11.0	20	0.24	+1.2%	10.74	-1.3%	PASS
04/02/07	07:40	SYST	11.0	20	-0.29	-1.5%	10.91	-0.4%	PASS
04/03/07	07:40	SYST	11.0	20	0.72	+3.6%	11.76	+3.8%	PASS
04/04/07	07:40	SYST	11.0	20	-0.22	-1.1%	1.15	-49.3%	FAIL
04/05/07	07:40	SYST	11.0	20	0.48	+2.4%	11.87	+4.4%	PASS
04/06/07	07:40	SYST	11.0	20	0.49	+2.5%	11.61	+3.1%	PASS
04/07/07	07:40	SYST	11.0	20	0.49	+2.5%	11.02	+0.1%	PASS
04/08/07	07:40	SYST	11.0	20	0.38	+1.9%	11.20	+1.0%	PASS
04/09/07	07:40	SYST	11.0	20	2.09	+10.5%	13.19	+11.0%	FAIL
04/10/07	07:40	SYST	11.0	20	-0.34	-1.7%	10.25	-3.8%	PASS
04/11/07	07:40	SYST	11.0	20	-0.26	-1.3%	9.94	-5.3%	FAIL
04/12/07	07:40	SYST	11.0	20	-0.09	-0.5%	10.55	-2.3%	PASS
04/13/07	07:40	SYST	11.0	20	0.15	+0.8%	10.89	-0.5%	PASS
04/14/07	07:40	SYST	11.0	20	0.42	+2.1%	11.02	+0.1%	PASS
04/15/07	07:40	SYST	11.0	20	1.42	+7.1%	12.34	+6.7%	FAIL
04/16/07	07:40	SYST	11.0	20	1.29	+6.5%	12.98	+9.9%	FAIL
04/17/07	07:40	SYST	11.0	20	0.49	+2.5%	12.10	+5.5%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
04/18/07	07:40	SYST	11.0	20	-0.64	-3.2%	10.13	-4.4%	PASS
04/19/07	07:40	SYST	11.0	20	-0.02	-0.1%	11.36	+1.8%	PASS
04/20/07	07:40	SYST	11.0	20	0.33	+1.7%	11.47	+2.4%	PASS
04/21/07	07:40	SYST	11.0	20	-0.36	-1.8%	10.65	-1.8%	PASS
04/22/07	07:40	SYST	11.0	20	-1.58	-7.9%	8.97	-10.2%	FAIL
04/23/07	07:40	SYST	11.0	20	-2.08	-10.4%	7.62	-16.9%	FAIL
04/24/07	07:40	SYST	11.0	20	0.83	+4.2%	11.98	+4.9%	PASS
04/25/07	07:40	SYST	11.0	20	2.26	+11.3%	13.88	+14.4%	FAIL
04/26/07	07:40	SYST	11.0	20	-0.63	-3.2%	10.51	-2.5%	PASS
04/27/07	07:40	SYST	11.0	20	-0.86	-4.3%	9.98	-5.1%	FAIL
04/28/07	07:40	SYST	11.0	20	0.04	+0.2%	11.08	+0.4%	PASS
04/29/07	07:40	SYST	11.0	20	1.00	+5.0%	12.46	+7.3%	FAIL
04/30/07	07:40	SYST	11.0	20	1.63	+8.2%	13.82	+14.1%	FAIL
05/01/07	07:40	SYST	11.0	20	-0.71	-3.6%	10.18	-4.1%	PASS
05/01/07	15:27	INST	5.0	20	0.14	+0.7%	5.21	+1.1%	PASS
05/02/07	07:40	SYST	11.0	20	0.02	+0.1%	11.05	+0.3%	PASS
05/03/07	07:40	SYST	11.0	20	0.88	+4.4%	11.40	+2.0%	PASS
05/04/07	07:40	SYST	11.0	20	1.65	+8.3%	12.06	+5.3%	FAIL
05/05/07	07:40	SYST	11.0	20	-0.27	-1.4%	10.35	-3.3%	PASS
05/06/07	07:40	SYST	11.0	20	-1.10	-5.5%	9.84	-5.8%	FAIL
05/07/07	07:40	SYST	11.0	20	0.35	+1.8%	11.54	+2.7%	PASS
05/07/07	19:03	INST	5.0	20	0.14	+0.7%	4.66	-1.7%	PASS
05/07/07	22:03	INST	5.0	20	0.12	+0.6%	4.63	-1.9%	PASS
05/08/07	01:03	INST	5.0	20	0.12	+0.6%	4.65	-1.8%	PASS
05/08/07	04:03	INST	5.0	20	0.11	+0.6%	4.63	-1.9%	PASS
05/08/07	07:03	INST	5.0	20	0.10	+0.5%	4.67	-1.7%	PASS
05/08/07	07:40	SYST	11.0	20	-1.25	-6.3%	9.50	-7.5%	FAIL
05/08/07	10:03	INST	5.0	20	0.11	+0.6%	4.71	-1.5%	PASS
05/08/07	13:03	INST	5.0	20	0.11	+0.6%	4.62	-1.9%	PASS
05/08/07	16:03	INST	5.0	20	0.11	+0.6%	4.64	-1.8%	PASS
05/08/07	19:03	INST	5.0	20	0.11	+0.6%	4.64	-1.8%	PASS
05/08/07	22:03	INST	5.0	20	0.11	+0.6%	4.70	-1.5%	PASS
05/09/07	01:03	INST	5.0	20	0.11	+0.6%	4.72	-1.4%	PASS
05/09/07	04:03	INST	5.0	20	0.11	+0.6%	4.71	-1.5%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/09/07	07:03	INST	5.0	20	0.11	+0.6%	4.63	-1.9%	PASS
05/09/07	07:40	SYST	11.0	20	-1.77	-8.9%	9.31	-8.5%	FAIL
05/09/07	10:03	INST	5.0	20	0.10	+0.5%	4.69	-1.6%	PASS
05/09/07	13:03	INST	5.0	20	0.10	+0.5%	4.61	-2.0%	PASS
05/09/07	16:03	INST	5.0	20	0.11	+0.6%	4.69	-1.6%	PASS
05/09/07	19:03	INST	5.0	20	0.10	+0.5%	4.64	-1.8%	PASS
05/09/07	22:03	INST	5.0	20	0.10	+0.5%	4.61	-2.0%	PASS
05/10/07	01:03	INST	5.0	20	0.10	+0.5%	4.61	-2.0%	PASS
05/10/07	04:03	INST	5.0	20	0.10	+0.5%	4.69	-1.6%	PASS
05/10/07	07:03	INST	5.0	20	0.10	+0.5%	4.65	-1.8%	PASS
05/10/07	07:39	SYST	11.0	20	-1.73	-8.7%	9.03	-9.9%	FAIL
05/10/07	10:03	INST	5.0	20	0.11	+0.6%	4.65	-1.8%	PASS
05/10/07	13:03	INST	5.0	20	0.10	+0.5%	4.66	-1.7%	PASS
05/10/07	16:03	INST	5.0	20	0.10	+0.5%	4.62	-1.9%	PASS
05/10/07	19:03	INST	5.0	20	0.11	+0.6%	4.58	-2.1%	PASS
05/10/07	22:03	INST	5.0	20	0.10	+0.5%	4.63	-1.9%	PASS
05/11/07	01:03	INST	5.0	20	0.11	+0.6%	4.63	-1.9%	PASS
05/11/07	04:03	INST	5.0	20	0.12	+0.6%	4.62	-1.9%	PASS
05/11/07	07:03	INST	5.0	20	0.12	+0.6%	4.66	-1.7%	PASS
05/11/07	07:39	SYST	11.0	20	-0.98	-4.9%	10.18	-4.1%	PASS
05/11/07	10:03	INST	5.0	20	0.13	+0.7%	4.67	-1.7%	PASS
05/11/07	13:03	INST	5.0	20	0.13	+0.7%	4.69	-1.6%	PASS
05/12/07	07:39	SYST	11.0	20	0.29	+1.5%	11.62	+3.1%	PASS
05/13/07	07:39	SYST	11.0	20	0.79	+4.0%	11.37	+1.9%	PASS
05/14/07	11:05	SYST	11.0	20	-0.13	-0.7%	10.27	-3.7%	PASS
05/15/07	07:39	SYST	11.0	20	-0.67	-3.4%	11.52	+2.6%	PASS
05/16/07	07:39	SYST	11.0	20	0.62	+3.1%	11.68	+3.4%	PASS
05/17/07	07:39	SYST	11.0	20	1.04	+5.2%	12.30	+6.5%	FAIL
05/18/07	07:39	SYST	11.0	20	0.49	+2.5%	11.28	+1.4%	PASS
05/19/07	07:39	SYST	11.0	20	-0.39	-2.0%	10.16	-4.2%	PASS
05/20/07	07:39	SYST	11.0	20	0.03	+0.2%	11.18	+0.9%	PASS
05/21/07	07:39	SYST	11.0	20	0.91	+4.6%	12.16	+5.8%	FAIL
05/22/07	07:39	SYST	11.0	20	-1.00	-5.0%	10.27	-3.7%	PASS
05/23/07	07:39	SYST	11.0	20	-0.83	-4.2%	10.68	-1.6%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/24/07	07:39	SYST	11.0	20	-0.18	-0.9%	10.64	-1.8%	PASS
05/25/07	07:39	SYST	11.0	20	0.60	+3.0%	11.34	+1.7%	PASS
05/26/07	07:39	SYST	11.0	20	1.13	+5.7%	12.38	+6.9%	FAIL
05/27/07	07:39	SYST	11.0	20	2.87	+14.4%	13.98	+14.9%	FAIL
05/28/07	07:39	SYST	11.0	20	2.43	+12.2%	13.98	+14.9%	FAIL
05/29/07	07:39	SYST	11.0	20	2.69	+13.5%	13.68	+13.4%	FAIL
05/30/07	07:39	SYST	11.0	20	-0.98	-4.9%	10.11	-4.5%	PASS
05/31/07	07:41	SYST	11.0	20	-0.83	-4.2%	9.73	-6.4%	FAIL
06/01/07	07:41	SYST	11.0	20	0.27	+1.4%	12.01	+5.1%	FAIL
06/02/07	07:41	SYST	11.0	20	0.07	+0.4%	10.23	-3.9%	PASS
06/03/07	07:41	SYST	11.0	20	0.28	+1.4%	10.87	-0.7%	PASS
06/04/07	07:41	SYST	11.0	20	0.08	+0.4%	10.59	-2.1%	PASS
06/05/07	07:41	SYST	11.0	20	1.39	+7.0%	12.88	+9.4%	FAIL
06/06/07	07:41	SYST	11.0	20	0.59	+3.0%	11.32	+1.6%	PASS
06/07/07	07:41	SYST	11.0	20	-0.47	-2.4%	10.04	-4.8%	PASS
06/08/07	07:41	SYST	11.0	20	0.29	+1.5%	10.29	-3.6%	PASS
06/09/07	07:41	SYST	11.0	20	1.42	+7.1%	11.93	+4.7%	FAIL
06/10/07	07:41	SYST	11.0	20	1.15	+5.8%	11.72	+3.6%	FAIL
06/11/07	07:41	SYST	11.0	20	0.47	+2.4%	11.08	+0.4%	PASS
06/12/07	07:41	SYST	11.0	20	0.82	+4.1%	10.69	-1.6%	PASS
06/13/07	07:41	SYST	11.0	20	1.21	+6.1%	12.84	+9.2%	FAIL
06/14/07	07:41	SYST	11.0	20	0.69	+3.5%	12.11	+5.6%	FAIL
06/15/07	07:41	SYST	11.0	20	1.02	+5.1%	12.12	+5.6%	FAIL
06/16/07	07:41	SYST	11.0	20	2.54	+12.7%	14.06	+15.3%	FAIL
06/17/07	07:41	SYST	11.0	20	0.92	+4.6%	12.67	+8.4%	FAIL
06/18/07	12:13	SYST	11.0	20	1.20	+6.0%	11.76	+3.8%	FAIL
06/19/07	07:41	SYST	11.0	20	-1.45	-7.3%	9.93	-5.4%	FAIL
06/20/07	07:41	SYST	11.0	20	1.05	+5.3%	12.63	+8.2%	FAIL
06/21/07	Manual Recalibration – No Calibration Check								
06/22/07	07:41	SYST	11.0	20	0.99	+5.0%	11.80	+4.0%	PASS
06/23/07	07:41	SYST	11.0	20	0.93	+4.7%	12.04	+5.2%	FAIL
06/24/07	07:41	SYST	5.0	20	0.35	+1.8%	5.25	+1.3%	PASS
06/25/07	07:41	SYST	5.0	20	0.47	+2.4%	5.52	+2.6%	PASS
06/26/07	07:42	SYST	5.0	20	0.22	+1.1%	5.32	+1.6%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
06/27/07	07:42	SYST	5.0	20	3.79	+19.0%	10.10	+25.5%	FAIL
06/28/07	07:42	SYST	11.0	20	-0.23	-1.2%	8.57	-12.2%	FAIL
06/29/07	07:42	SYST	11.0	20	0.02	+0.1%	10.05	-4.8%	PASS
06/30/07	07:42	SYST	11.0	20	-0.84	-4.2%	9.54	-7.3%	FAIL
07/01/07	07:42	SYST	11.0	20	-0.86	-4.3%	8.83	-10.9%	FAIL
07/02/07	07:42	SYST	11.0	20	-0.66	-3.3%	9.90	-5.5%	FAIL
07/03/07	07:42	SYST	11.0	20	-0.32	-1.6%	10.25	-3.8%	PASS
07/04/07	07:42	SYST	11.0	20	-0.11	-0.6%	9.90	-5.5%	FAIL
07/05/07	07:42	SYST	11.0	20	-1.12	-5.6%	9.82	-5.9%	FAIL
07/06/07	07:42	SYST	11.0	20	0.84	+4.2%	10.83	-0.9%	PASS
07/07/07	07:42	SYST	11.0	20	0.54	+2.7%	11.90	+4.5%	PASS
07/08/07	07:42	SYST	11.0	20	0.50	+2.5%	7.28	-18.6%	FAIL
07/09/07	07:42	SYST	11.0	20	0.23	+1.2%	10.80	-1.0%	PASS
07/10/07	10:50	SYST	11.0	20	1.14	+5.7%	10.52	-2.4%	FAIL
07/11/07	07:42	SYST	11.0	20	-1.55	-7.8%	11.65	+3.3%	FAIL
07/11/07	11:05	SYST	11.0	20	-0.95	-4.8%	16.98	+29.9%	FAIL
07/11/07	14:05	SYST	11.0	20	-1.38	-6.9%	17.52	+32.6%	FAIL
07/11/07	16:02	SYST	11.0	20	-0.53	-2.7%	10.52	-2.4%	PASS
07/11/07	17:05	SYST	11.0	20	-0.13	-0.7%	10.80	-1.0%	PASS
07/11/07	20:05	SYST	11.0	20	-0.27	-1.4%	11.08	+0.4%	PASS
07/11/07	23:05	SYST	11.0	20	0.02	+0.1%	11.06	+0.3%	PASS
07/12/07	02:05	SYST	11.0	20	-0.20	-1.0%	10.77	-1.2%	PASS
07/12/07	05:05	SYST	11.0	20	0.02	+0.1%	10.77	-1.2%	PASS
07/12/07	07:42	SYST	11.0	20	-0.43	-2.2%	10.93	-0.4%	PASS
07/12/07	08:05	SYST	11.0	20	0.12	+0.6%	10.36	-3.2%	PASS
07/12/07	11:05	SYST	11.0	20	-0.07	-0.4%	10.65	-1.8%	PASS
07/13/07	07:42	SYST	11.0	20	-0.50	-2.5%	10.61	-2.0%	PASS
07/14/07	07:42	SYST	11.0	20	-0.48	-2.4%	10.08	-4.6%	PASS
07/15/07	07:42	SYST	11.0	20	-0.37	-1.9%	10.70	-1.5%	PASS
07/16/07	07:42	SYST	11.0	20	-0.23	-1.2%	10.61	-2.0%	PASS
07/17/07	12:18	SYST	11.0	20	1.16	+5.8%	7.29	-18.6%	FAIL
07/17/07	14:21	SYST	11.0	20	-0.48	-2.4%	7.26	-18.7%	FAIL
07/18/07	07:48	SYST	11.0	20	-0.48	-2.4%	12.49	+7.5%	FAIL
07/18/07	12:33	SYST	11.0	20	-3.56	-17.8%	-4.88	-79.4%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/18/07	14:30	SYST	11.0	20	0.35	+1.8%	15.90	+24.5%	FAIL
07/18/07	19:20	SYST	11.0	20	0.16	+0.8%	10.99	-0.0%	PASS
07/19/07	07:43	SYST	11.0	20	1.81	+9.1%	8.26	-13.7%	FAIL
07/20/07	07:43	SYST	11.0	20	9.92	+49.6%	8.22	-13.9%	FAIL
07/20/07	14:27	SYST	11.0	20	2.41	+12.1%	17.31	+31.6%	FAIL
07/20/07	19:01	SYST	11.0	20	0.21	+1.1%	10.72	-1.4%	PASS
07/21/07	07:43	SYST	11.0	20	0.64	+3.2%	10.61	-2.0%	PASS
07/21/07	19:01	SYST	11.0	20	-0.23	-1.2%	11.24	+1.2%	PASS
07/22/07	07:43	SYST	11.0	20	-0.08	-0.4%	10.69	-1.6%	PASS
07/22/07	19:01	SYST	11.0	20	0.28	+1.4%	10.80	-1.0%	PASS
07/23/07	07:43	SYST	11.0	20	0.03	+0.2%	10.59	-2.1%	PASS
07/23/07	19:01	SYST	11.0	20	-1.32	-6.6%	9.34	-8.3%	FAIL
07/24/07	07:43	SYST	11.0	20	-0.10	-0.5%	10.69	-1.6%	PASS
07/25/07	07:43	SYST	11.0	20	-0.04	-0.2%	11.25	+1.3%	PASS
07/26/07	07:43	SYST	11.0	20	0.88	+4.4%	11.30	+1.5%	PASS
07/27/07	07:43	SYST	11.0	20	-0.18	-0.9%	10.66	-1.7%	PASS
07/28/07	07:43	SYST	11.0	20	0.90	+4.5%	12.39	+7.0%	FAIL
07/29/07	07:43	SYST	11.0	20	1.18	+5.9%	12.86	+9.3%	FAIL
07/30/07	07:43	SYST	11.0	20	1.29	+6.5%	12.11	+5.6%	FAIL
07/31/07	07:43	SYST	11.0	20	-0.22	-1.1%	10.77	-1.2%	PASS
08/01/07	07:44	SYST	11.0	20	2.47	+12.4%	12.59	+8.0%	FAIL
08/02/07	07:44	SYST	11.0	20	-0.30	-1.5%	10.82	-0.9%	PASS
08/03/07	07:44	SYST	11.0	20	0.96	+4.8%	11.84	+4.2%	PASS
08/04/07	07:44	SYST	11.0	20	0.99	+5.0%	12.01	+5.1%	FAIL
08/05/07	07:43	SYST	11.0	20	-0.71	-3.6%	9.89	-5.6%	FAIL
08/06/07	07:43	SYST	11.0	20	-0.03	-0.2%	10.70	-1.5%	PASS
08/07/07	07:42	SYST	11.0	20	0.54	+2.7%	11.77	+3.9%	PASS
08/08/07	07:42	SYST	11.0	20	0.77	+3.9%	11.50	+2.5%	PASS
08/09/07	07:42	SYST	11.0	20	-0.21	-1.1%	11.09	+0.4%	PASS
08/10/07	07:41	SYST	11.0	20	0.36	+1.8%	11.91	+4.6%	PASS
08/11/07	07:42	SYST	11.0	20	0.65	+3.3%	11.20	+1.0%	PASS
08/12/07	07:41	SYST	11.0	20	0.52	+2.6%	10.76	-1.2%	PASS
08/13/07	07:42	SYST	11.0	20	1.52	+7.6%	12.67	+8.4%	FAIL
08/14/07	07:41	SYST	11.0	20	-0.99	-5.0%	10.27	-3.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/15/07	07:42	SYST	11.0	20	0.83	+4.2%	11.28	+1.4%	PASS
08/16/07	07:41	SYST	11.0	20	1.32	+6.6%	11.34	+1.7%	FAIL
08/17/07	07:41	SYST	11.0	20	0.60	+3.0%	12.01	+5.1%	FAIL
08/18/07	07:41	SYST	11.0	20	0.18	+0.9%	11.45	+2.3%	PASS
08/19/07	07:41	SYST	11.0	20	0.30	+1.5%	12.63	+8.2%	FAIL
08/20/07	07:42	SYST	11.0	20	-0.01	-0.1%	11.25	+1.3%	PASS
08/21/07	07:35	SYST	11.0	20	-0.30	-1.5%	11.00	0.0%	PASS
08/22/07	07:35	SYST	11.0	20	0.29	+1.5%	11.36	+1.8%	PASS
08/23/07	07:35	SYST	11.0	20	2.38	+11.9%	13.32	+11.6%	FAIL
08/24/07	07:34	SYST	11.0	20	0.57	+2.9%	11.05	+0.3%	PASS
08/25/07	07:34	SYST	11.0	20	0.63	+3.2%	11.72	+3.6%	PASS
08/26/07	07:34	SYST	11.0	20	1.02	+5.1%	12.50	+7.5%	FAIL
08/27/07	07:34	SYST	11.0	20	0.81	+4.1%	12.02	+5.1%	FAIL
08/28/07	07:34	SYST	11.0	20	-0.72	-3.6%	13.03	+10.2%	FAIL
08/29/07	07:34	SYST	11.0	20	0.81	+4.1%	11.68	+3.4%	PASS
08/30/07	07:34	SYST	11.0	20	0.09	+0.5%	11.30	+1.5%	PASS
08/31/07	07:34	SYST	11.0	20	0.51	+2.6%	11.65	+3.3%	PASS
09/01/07	07:34	SYST	11.0	20	0.09	+0.5%	12.47	+7.4%	FAIL
09/02/07	07:34	SYST	11.0	20	0.17	+0.9%	12.04	+5.2%	FAIL
09/03/07	07:34	SYST	11.0	20	0.43	+2.2%	12.69	+8.5%	FAIL
09/04/07	07:34	SYST	11.0	20	1.17	+5.9%	12.96	+9.8%	FAIL
09/05/07	07:34	SYST	Calibrator Error						
09/05/07	13:55	SYST	11.0	20	-0.22	-1.1%	10.96	-0.2%	PASS
09/06/07	07:34	SYST	11.0	20	-2.81	-14.1%	7.39	-18.1%	FAIL
09/07/07	07:34	SYST	11.0	20	4.29	+21.5%	16.82	+29.1%	FAIL
09/08/07	07:34	SYST	11.0	20	0.52	+2.6%	10.68	-1.6%	PASS
09/09/07	07:34	SYST	11.0	20	1.17	+5.9%	11.91	+4.6%	FAIL
09/10/07	07:34	SYST	11.0	20	0.92	+4.6%	11.50	+2.5%	PASS
09/11/07	07:34	SYST	11.0	20	0.50	+2.5%	14.67	+18.4%	FAIL
09/12/07	07:34	SYST	11.0	20	-0.45	-2.3%	3.38	-38.1%	FAIL
09/13/07	07:34	SYST	11.0	20	0.01	+0.1%	13.17	+10.9%	FAIL
09/14/07	07:34	SYST	11.0	20	-0.02	-0.1%	11.06	+0.3%	PASS
09/15/07	07:34	SYST	11.0	20	0.86	+4.3%	10.59	-2.1%	PASS
09/16/07	07:34	SYST	11.0	20	2.01	+10.1%	8.89	-10.6%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
09/17/07	07:34	SYST	11.0	20	1.23	+6.2%	10.08	-4.6%	FAIL
09/18/07	07:34	SYST	11.0	20	7.06	+35.3%	7.03	-19.9%	FAIL
09/18/07	11:06	INST	11.0	20	0.42	+2.1%	11.40	+2.0%	PASS
09/18/07	11:38	SYST	11.0	20	-0.21	-1.1%	13.24	+11.2%	FAIL
09/18/07	12:01	SYST	11.0	20	6.71	+33.6%	7.28	-18.6%	FAIL
09/18/07	15:12	SYST	11.0	20	5.60	+28.0%	4.74	-31.3%	FAIL
09/19/07	07:34	SYST	11.0	20	6.64	+33.2%	7.28	-18.6%	FAIL
09/20/07	07:34	SYST	11.0	20	7.88	+39.4%	7.91	-15.5%	FAIL
09/21/07	07:34	SYST	5.0	20	0.25	+1.3%	5.19	+1.0%	PASS
09/22/07	07:34	SYST	11.0	20	1.42	+7.1%	11.96	+4.8%	FAIL
09/23/07	07:34	SYST	11.0	20	1.80	+9.0%	12.18	+5.9%	FAIL
09/24/07	07:34	SYST	11.0	20	1.75	+8.8%	12.50	+7.5%	FAIL
09/25/07	07:34	SYST	11.0	20	1.91	+9.6%	11.54	+2.7%	FAIL
09/25/07	11:30	SYST	11.0	20	0.47	+2.4%	10.79	-1.1%	PASS
09/26/07	07:34	SYST	11.0	20	0.85	+4.3%	11.64	+3.2%	PASS
09/27/07	07:34	SYST	11.0	20	1.52	+7.6%	12.10	+5.5%	FAIL
09/28/07	07:34	SYST	11.0	20	1.49	+7.5%	12.69	+8.5%	FAIL
09/29/07	07:34	SYST	Calibrator Error						
09/30/07	07:34	SYST	Calibrator Error						
10/01/07	07:34	SYST	Calibrator Error						
10/01/07	16:50	SYST	11.0	20	-0.46	-2.3%	9.94	-5.3%	FAIL
10/02/07	07:36	SYST	11.0	20	-0.26	-1.3%	11.80	+4.0%	PASS
10/02/07	14:43	SYST	11.0	20	7.69	+38.5%	7.38	-18.1%	FAIL
10/03/07	07:36	SYST	11.0	20	0.09	+0.5%	11.82	+4.1%	PASS
10/04/07	07:36	SYST	11.0	20	1.02	+5.1%	11.97	+4.9%	FAIL
10/05/07	07:36	SYST	11.0	20	0.33	+1.7%	12.02	+5.1%	FAIL
10/06/07	07:36	SYST	11.0	20	-0.30	-1.5%	10.37	-3.2%	PASS
10/07/07	07:36	SYST	Calibrator Error						
10/08/07	07:36	SYST	11.0	20	1.17	+5.9%	11.53	+2.7%	FAIL
10/09/07	07:36	SYST	11.0	20	-1.87	-9.4%	10.24	-3.8%	FAIL
10/10/07	08:26	SYST	11.0	20	0.21	+1.1%	11.57	+2.9%	PASS
10/11/07	07:35	SYST	Calibrator Error						
10/11/07	09:05	SYST	11.0	20	0.12	+0.6%	10.81	-0.9%	PASS
10/12/07	07:35	SYST	11.0	20	0.16	+0.8%	11.02	+0.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
10/13/07	07:35	SYST	Calibrator Error						
10/13/07	09:05	SYST	11.0	20	0.14	+0.7%	10.94	-0.3%	PASS
10/14/07	07:35	SYST	11.0	20	0.32	+1.6%	11.12	+0.6%	PASS
10/14/07	09:05	SYST	11.0	20	0.25	+1.3%	11.20	+1.0%	PASS
10/15/07	07:35	SYST	11.0	20	-0.11	-0.6%	11.00	0.0%	PASS
10/16/07	07:35	SYST	11.0	20	-0.17	-0.9%	11.04	+0.2%	PASS
10/17/07	07:35	SYST	11.0	20	-0.15	-0.8%	10.64	-1.8%	PASS
10/18/07	07:35	SYST	11.0	20	-0.11	-0.6%	10.68	-1.6%	PASS
10/19/07	07:35	SYST	11.0	20	0.01	+0.1%	10.62	-1.9%	PASS
10/20/07	07:35	SYST	11.0	20	0.12	+0.6%	11.25	+1.3%	PASS
10/21/07	07:35	SYST	11.0	20	0.12	+0.6%	11.11	+0.5%	PASS
10/22/07	07:35	SYST	11.0	20	0.20	+1.0%	11.27	+1.4%	PASS
10/23/07	07:35	SYST	11.0	20	0.27	+1.4%	11.72	+3.6%	PASS
10/24/07	07:35	SYST	Calibrator Error						
10/25/07	07:35	SYST	Calibrator Error						
10/26/07	07:35	SYST	11.0	20	-0.04	-0.2%	10.97	-0.1%	PASS
10/27/07	07:35	SYST	11.0	20	0.01	+0.1%	10.84	-0.8%	PASS
10/28/07	07:35	SYST	11.0	20	0.13	+0.7%	11.23	+1.2%	PASS
10/29/07	07:35	SYST	11.0	20	0.22	+1.1%	10.97	-0.1%	PASS
10/30/07	07:35	SYST	11.0	20	0.17	+0.9%	11.02	+0.1%	PASS
10/31/07	07:35	SYST	11.0	20	0.34	+1.7%	10.98	-0.1%	PASS
11/01/07	07:35	SYST	11.0	20	0.21	+1.1%	12.14	+5.7%	FAIL
11/02/07	07:35	SYST	11.0	20	-0.55	-2.8%	10.32	-3.4%	PASS
11/03/07	07:35	SYST	11.0	20	-0.05	-0.3%	11.10	+0.5%	PASS
11/04/07	07:35	SYST	11.0	20	-0.11	-0.6%	10.67	-1.7%	PASS
11/05/07	07:35	SYST	11.0	20	-0.09	-0.5%	10.32	-3.4%	PASS
11/06/07	07:35	SYST	11.0	20	0.10	+0.5%	11.07	+0.4%	PASS
11/07/07	07:35	SYST	11.0	20	-0.19	-1.0%	10.85	-0.8%	PASS
11/08/07	07:35	SYST	11.0	20	-0.06	-0.3%	11.00	0.0%	PASS
11/09/07	07:35	SYST	11.0	20	0.00	0.0%	10.92	-0.4%	PASS
11/09/07	12:50	SYST	11.0	20	0.31	+1.6%	11.68	+3.4%	PASS
11/10/07	07:35	SYST	11.0	20	0.06	+0.3%	11.17	+0.9%	PASS
11/11/07	07:35	SYST	11.0	20	0.16	+0.8%	11.31	+1.6%	PASS
11/12/07	17:18	SYST	11.0	20	0.20	+1.0%	11.27	+1.4%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
11/13/07	07:35	SYST	11.0	20	0.07	+0.4%	10.87	-0.7%	PASS
11/14/07	07:35	SYST	11.0	20	0.29	+1.5%	10.97	-0.1%	PASS
11/15/07	07:35	SYST	11.0	20	0.31	+1.6%	11.26	+1.3%	PASS
11/16/07	07:35	SYST	11.0	20	0.18	+0.9%	11.51	+2.6%	PASS
11/17/07	07:35	SYST	11.0	20	0.24	+1.2%	11.62	+3.1%	PASS
11/18/07	07:35	SYST	11.0	20	0.40	+2.0%	11.65	+3.3%	PASS
11/19/07	07:35	SYST	11.0	20	0.36	+1.8%	11.42	+2.1%	PASS
11/20/07	07:35	SYST	11.0	20	-0.50	-2.5%	10.13	-4.4%	PASS
11/21/07	07:35	SYST	11.0	20	0.31	+1.6%	11.45	+2.3%	PASS
11/22/07	07:35	SYST	11.0	20	0.38	+1.9%	11.78	+3.9%	PASS
11/23/07	07:35	SYST	11.0	20	0.56	+2.8%	11.59	+3.0%	PASS
11/24/07	Calibrator Error – No Calibration Check								
11/25/07	Calibrator Error – No Calibration Check								
11/26/07	07:35	SYST	11.0	20	0.57	+2.9%	11.34	+1.7%	PASS
11/27/07	07:35	SYST	11.0	20	0.17	+0.9%	11.07	+0.4%	PASS
11/28/07	14:41	SYST	11.0	20	0.16	+0.8%	10.92	-0.4%	PASS
11/29/07	07:35	SYST	11.0	20	-0.02	-0.1%	10.65	-1.8%	PASS
11/30/07	07:35	SYST	11.0	20	0.10	+0.5%	11.27	+1.4%	PASS
12/01/07	07:35	SYST	11.0	20	0.12	+0.6%	11.35	+1.8%	PASS
12/02/07	07:35	SYST	11.0	20	0.33	+1.7%	11.62	+3.1%	PASS
12/03/07	07:35	SYST	11.0	20	0.48	+2.4%	11.82	+4.1%	PASS
12/04/07	07:35	SYST	11.0	20	-0.07	-0.4%	11.07	+0.4%	PASS
12/05/07	07:35	SYST	11.0	20	0.08	+0.4%	11.17	+0.9%	PASS
12/06/07	07:35	SYST	11.0	20	0.27	+1.4%	11.01	+0.0%	PASS
12/07/07	07:35	SYST	11.0	20	0.32	+1.6%	11.01	+0.0%	PASS
12/08/07	07:35	SYST	11.0	20	0.41	+2.1%	11.83	+4.2%	PASS
12/09/07	07:35	SYST	11.0	20	0.77	+3.9%	12.15	+5.8%	FAIL
12/10/07	07:35	SYST	11.0	20	0.98	+4.9%	12.87	+9.4%	FAIL
12/10/07	18:09	SYST	11.0	20	0.12	+0.6%	11.27	+1.4%	PASS
12/11/07	07:35	SYST	11.0	20	0.28	+1.4%	11.22	+1.1%	PASS
12/11/07	13:50	SYST	11.0	20	-0.27	-1.4%	10.88	-0.6%	PASS
12/12/07	07:35	SYST	11.0	20	0.15	+0.8%	11.71	+3.6%	PASS
12/13/07	07:35	SYST	11.0	20	-0.26	-1.3%	12.49	+7.5%	PASS
12/14/07	07:39	SYST	11.0	20	0.04	+0.2%	11.11	+0.5%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
12/14/07	16:44	SYST	Calibrator Error						
12/15/07	07:39	SYST	Calibrator Error						
12/15/07	16:44	SYST	11.0	20	0.15	+0.8%	11.07	+0.4%	PASS
12/16/07	07:39	SYST	11.0	20	0.18	+0.9%	11.31	+1.6%	PASS
12/17/07	07:39	SYST	11.0	20	-0.27	-1.4%	10.40	-3.0%	PASS
12/17/07	21:08	SYST	11.0	20	-0.26	-1.3%	10.34	-3.3%	PASS
12/18/07	07:39	SYST	11.0	20	-0.02	-0.1%	10.97	-0.1%	PASS
12/19/07	07:39	SYST	11.0	20	-0.02	-0.1%	11.08	+0.4%	PASS
12/19/07	13:50	SYST	11.0	20	0.00	0.0%	11.16	+0.8%	PASS
12/19/07	16:54	SYST	11.0	20	0.00	0.0%	11.12	+0.6%	PASS
12/20/07	07:39	SYST	11.0	20	0.01	+0.1%	11.21	+1.1%	PASS
12/20/07	10:16	SYST	11.0	20	0.00	0.0%	0.00	-55.0%	FAIL
12/20/07	11:04	SYST	11.0	20	-0.03	-0.2%	10.98	-0.1%	PASS
12/20/07	14:12	SYST	11.0	20	-0.02	-0.1%	11.06	+0.3%	PASS
12/20/07	16:44	SYST	11.0	20	0.02	+0.1%	11.55	+2.8%	PASS
12/21/07	07:37	SYST	11.0	20	0.00	0.0%	11.11	+0.5%	PASS
12/22/07	07:37	SYST	11.0	20	0.01	+0.1%	11.16	+0.8%	PASS
12/23/07	07:37	SYST	11.0	20	0.00	0.0%	11.05	+0.3%	PASS
12/24/07	07:37	SYST	11.0	20	0.03	+0.2%	11.13	+0.7%	PASS
12/25/07	07:37	SYST	11.0	20	0.09	+0.5%	11.69	+3.5%	PASS
12/26/07	07:37	SYST	11.0	20	0.09	+0.5%	11.67	+3.4%	PASS
12/27/07	07:37	SYST	11.0	20	-0.02	-0.1%	10.90	-0.5%	PASS
12/28/07	07:37	SYST	11.0	20	0.01	+0.1%	11.07	+0.4%	PASS
12/29/07	07:37	SYST	11.0	20	0.00	0.0%	10.94	-0.3%	PASS
12/30/07	07:37	SYST	11.0	20	0.02	+0.1%	10.85	-0.8%	PASS
12/31/07	07:37	SYST	11.0	20	0.01	+0.1%	10.72	-1.4%	PASS
01/01/08	07:37	SYST	11.0	20	0.00	0.0%	10.70	-1.5%	PASS
01/02/08	07:37	SYST	11.0	20	0.01	+0.1%	11.32	+1.6%	PASS
01/03/08	07:37	SYST	11.0	20	0.01	+0.1%	11.10	+0.5%	PASS
01/04/08	07:37	SYST	11.0	20	-0.01	-0.1%	11.19	+0.9%	PASS
01/05/08	07:37	SYST	11.0	20	-0.09	-0.5%	11.86	+4.3%	PASS
01/06/08	07:37	SYST	11.0	20	-0.12	-0.6%	12.06	+5.3%	FAIL
01/07/08	07:37	SYST	11.0	20	-0.12	-0.6%	12.38	+6.9%	FAIL
01/07/08	14:50	SYST	5.0	20	0.08	+0.4%	4.86	-0.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/08/08	07:37	SYST	5.0	20	0.14	+0.7%	4.85	-0.8%	PASS
01/09/08	07:37	SYST	5.0	20	0.00	0.0%	5.01	+0.0%	PASS
01/10/08	07:37	SYST	5.0	20	-0.05	-0.3%	4.89	-0.6%	PASS
01/10/08	14:02	SYST	11.0	20	-0.21	-1.1%	12.69	+8.5%	FAIL
01/11/08	07:37	SYST	11.0	20	-0.03	-0.2%	11.15	+0.8%	PASS
01/11/08	14:02	SYST	11.0	20	-0.05	-0.3%	11.16	+0.8%	PASS
01/12/08	07:37	SYST	11.0	20	-0.01	-0.1%	11.12	+0.6%	PASS
01/12/08	14:02	SYST	11.0	20	-0.01	-0.1%	11.14	+0.7%	PASS
01/13/08	07:37	SYST	11.0	20	0.00	0.0%	10.92	-0.4%	PASS
01/13/08	14:02	SYST	11.0	20	0.01	+0.1%	11.07	+0.4%	PASS
01/14/08	07:37	SYST	11.0	20	-0.02	-0.1%	11.03	+0.1%	PASS
01/14/08	14:02	SYST	11.0	20	0.02	+0.1%	11.11	+0.5%	PASS
01/15/08	07:37	SYST	11.0	20	0.00	0.0%	11.05	+0.3%	PASS
01/15/08	14:02	SYST	11.0	20	0.00	0.0%	10.96	-0.2%	PASS
01/16/08	07:37	SYST	11.0	20	0.02	+0.1%	10.96	-0.2%	PASS
01/16/08	14:03	SYST	11.0	20	0.10	+0.5%	11.00	0.0%	PASS
01/17/08	07:37	SYST	11.0	20	0.09	+0.5%	11.00	0.0%	PASS
01/17/08	14:02	SYST	11.0	20	0.11	+0.6%	11.18	+0.9%	PASS
01/18/08	07:37	SYST	11.0	20	-0.02	-0.1%	10.91	-0.4%	PASS
01/18/08	14:02	SYST	11.0	20	0.03	+0.2%	11.10	+0.5%	PASS
01/19/08	07:37	SYST	11.0	20	0.02	+0.1%	11.12	+0.6%	PASS
01/19/08	14:02	SYST	11.0	20	0.03	+0.2%	11.09	+0.4%	PASS
01/20/08	07:37	SYST	11.0	20	0.00	0.0%	10.97	-0.1%	PASS
01/20/08	14:02	SYST	11.0	20	0.07	+0.4%	11.12	+0.6%	PASS
01/21/08	07:37	SYST	11.0	20	0.10	+0.5%	11.26	+1.3%	PASS
01/21/08	14:02	SYST	11.0	20	0.12	+0.6%	11.10	+0.5%	PASS
01/22/08	07:37	SYST	11.0	20	0.02	+0.1%	10.80	-1.0%	PASS
01/22/08	14:02	SYST	11.0	20	0.03	+0.2%	10.69	-1.6%	PASS
01/23/08	07:37	SYST	11.0	20	-0.06	-0.3%	11.78	+3.9%	PASS
01/23/08	13:59	SYST	11.0	20	0.06	+0.3%	11.07	+0.4%	PASS
01/24/08	07:37	SYST	11.0	20	0.07	+0.4%	11.20	+1.0%	PASS
01/24/08	14:02	SYST	11.0	20	0.08	+0.4%	11.28	+1.4%	PASS
01/25/08	07:37	SYST	11.0	20	0.07	+0.4%	11.27	+1.4%	PASS
01/25/08	14:02	SYST	11.0	20	-0.03	-0.2%	11.09	+0.4%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/26/08	07:37	SYST	11.0	20	0.02	+0.1%	10.51	-2.5%	PASS
01/27/08	07:37	SYST	11.0	20	0.08	+0.4%	10.74	-1.3%	PASS
01/28/08	07:37	SYST	11.0	20	0.10	+0.5%	10.77	-1.2%	PASS
01/29/08	07:37	SYST	11.0	20	-0.05	-0.3%	10.53	-2.4%	PASS
01/30/08	07:37	SYST	11.0	20	0.01	+0.1%	10.48	-2.6%	PASS
01/31/08	07:37	SYST	11.0	20	-0.04	-0.2%	11.91	+4.6%	PASS
02/01/08	07:37	SYST	11.0	20	-0.04	-0.2%	10.87	-0.7%	PASS
02/02/08	07:37	SYST	11.0	20	0.11	+0.6%	10.71	-1.5%	PASS
02/03/08	07:37	SYST	11.0	20	0.11	+0.6%	10.72	-1.4%	PASS
02/04/08	07:37	SYST	11.0	20	0.12	+0.6%	10.63	-1.9%	PASS
02/05/08	07:37	SYST	11.0	20	0.03	+0.2%	11.10	+0.5%	PASS
02/06/08	07:37	SYST	11.0	20	0.07	+0.4%	11.16	+0.8%	PASS
02/07/08	07:37	SYST	11.0	20	-0.02	-0.1%	10.83	-0.9%	PASS
02/08/08	07:37	SYST	11.0	20	0.00	0.0%	11.00	0.0%	PASS
02/09/08	07:37	SYST	11.0	20	-0.01	-0.1%	10.95	-0.3%	PASS
02/10/08	07:37	SYST	11.0	20	-0.01	-0.1%	10.74	-1.3%	PASS
02/11/08	07:37	SYST	11.0	20	-0.12	-0.6%	11.43	+2.2%	PASS
02/12/08	07:37	SYST	11.0	20	0.03	+0.2%	10.78	-1.1%	PASS
02/13/08	07:37	SYST	11.0	20	0.12	+0.6%	10.59	-2.1%	PASS
02/14/08	07:37	SYST	11.0	20	0.05	+0.3%	10.94	-0.3%	PASS
02/15/08	07:37	SYST	11.0	20	0.13	+0.7%	11.28	+1.4%	PASS
02/16/08	07:36	SYST	11.0	20	0.08	+0.4%	11.00	0.0%	PASS
02/17/08	07:36	SYST	11.0	20	0.07	+0.4%	10.90	-0.5%	PASS
02/18/08	07:36	SYST	11.0	20	-0.02	-0.1%	11.43	+2.2%	PASS
02/19/08	07:36	SYST	11.0	20	-0.04	-0.2%	11.36	+1.8%	PASS
02/20/08	07:36	SYST	11.0	20	-0.10	-0.5%	11.46	+2.3%	PASS
02/20/08	15:23	SYST	11.0	20	0.20	+1.0%	11.01	+0.0%	PASS
02/21/08	07:36	SYST	11.0	20	-0.02	-0.1%	11.70	+3.5%	PASS
02/22/08	07:36	SYST	11.0	20	0.02	+0.1%	10.22	-3.9%	PASS
02/23/08	07:36	SYST	11.0	20	-0.02	-0.1%	11.58	+2.9%	PASS
02/24/08	07:36	SYST	11.0	20	-0.04	-0.2%	12.04	+5.2%	FAIL
02/25/08	07:36	SYST	11.0	20	0.05	+0.3%	11.47	+2.4%	PASS
02/26/08	07:36	SYST	11.0	20	-0.08	-0.4%	11.70	+3.5%	PASS
02/26/08	16:44	SYST	11.0	20	0.00	0.0%	11.18	+0.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/27/08	07:36	SYST	11.0	20	0.11	+0.6%	10.97	-0.1%	PASS
02/28/08	07:36	SYST	11.0	20	0.16	+0.8%	11.19	+0.9%	PASS
02/29/08	07:36	SYST	11.0	20	-0.01	-0.1%	10.60	-2.0%	PASS
03/01/08	07:36	SYST	11.0	20	-0.01	-0.1%	10.98	-0.1%	PASS
03/02/08	07:36	SYST	11.0	20	0.00	0.0%	11.07	+0.4%	PASS
03/03/08	07:36	SYST	11.0	20	-0.01	-0.1%	10.90	-0.5%	PASS
03/04/08	07:36	SYST	11.0	20	0.14	+0.7%	11.07	+0.4%	PASS
03/05/08	07:36	SYST	11.0	20	0.12	+0.6%	10.75	-1.3%	PASS
03/06/08	07:36	SYST	11.0	20	-0.13	-0.7%	10.68	-1.6%	PASS
03/07/08	07:35	SYST	11.0	20	-0.03	-0.2%	11.31	+1.6%	PASS
03/08/08	07:35	SYST	11.0	20	-0.01	-0.1%	11.28	+1.4%	PASS
03/09/08	07:35	SYST	11.0	20	0.01	+0.1%	11.28	+1.4%	PASS
03/10/08	07:35	SYST	11.0	20	0.05	+0.3%	11.41	+2.1%	PASS
03/11/08	07:35	SYST	11.0	20	0.01	+0.1%	10.78	-1.1%	PASS
03/12/08	07:35	SYST	11.0	20	0.10	+0.5%	10.90	-0.5%	PASS
03/13/08	07:35	SYST	11.0	20	-0.05	-0.3%	11.33	+1.7%	PASS
03/14/08	07:35	SYST	11.0	20	0.01	+0.1%	11.50	+2.5%	PASS
03/15/08	07:35	SYST	11.0	20	-0.03	-0.2%	10.98	-0.1%	PASS
03/16/08	07:35	SYST	11.0	20	0.01	+0.1%	11.31	+1.6%	PASS
03/17/08	07:35	SYST	11.0	20	-0.05	-0.3%	11.37	+1.9%	PASS
03/18/08	07:35	SYST	11.0	20	0.10	+0.5%	11.35	+1.8%	PASS
03/19/08	07:35	SYST	11.0	20	0.07	+0.4%	11.55	+2.8%	PASS
03/20/08	07:35	SYST	11.0	20	-0.02	-0.1%	11.02	+0.1%	PASS
03/21/08	07:35	SYST	11.0	20	-0.01	-0.1%	11.03	+0.1%	PASS
03/22/08	07:35	SYST	11.0	20	0.11	+0.6%	10.99	-0.0%	PASS
03/23/08	07:35	SYST	11.0	20	-0.04	-0.2%	11.66	+3.3%	PASS
03/24/08	07:35	SYST	11.0	20	0.11	+0.6%	11.28	+1.4%	PASS
03/24/08	15:05	SYST	11.0	20	-0.23	-1.2%	10.88	-0.6%	PASS
03/25/08	07:35	SYST	11.0	20	-0.15	-0.8%	10.62	-1.9%	PASS
03/26/08	Communication Error – Data Unavailable								
03/27/08	Communication Error – Data Unavailable								
03/28/08	Communication Error – Data Unavailable								
03/29/08	Communication Error – Data Unavailable								
03/30/08	Communication Error – Data Unavailable								

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/31/08	07:35	SYST	11.0	20	0.67	+3.4%	11.71	+3.6%	PASS
04/01/08	07:35	SYST	11.0	20	0.70	+3.5%	11.44	+2.2%	PASS
04/02/08	07:35	SYST	11.0	20	0.66	+3.3%	11.79	+4.0%	PASS
04/03/08	07:35	SYST	11.0	20	0.67	+3.4%	11.87	+4.4%	PASS
04/04/08	07:35	SYST	11.0	20	0.69	+3.5%	11.77	+3.9%	PASS
04/05/08	07:35	SYST	11.0	20	0.63	+3.2%	11.42	+2.1%	PASS
04/06/08	07:35	SYST	11.0	20	0.67	+3.4%	11.73	+3.7%	PASS
04/07/08	07:35	SYST	11.0	20	0.61	+3.1%	11.36	+1.8%	PASS
04/08/08	07:35	SYST	11.0	20	0.67	+3.4%	11.53	+2.7%	PASS
04/09/08	07:41	SYST	11.0	20	0.63	+3.2%	17.55	+32.8%	FAIL
04/10/08	07:41	SYST	11.0	20	0.61	+3.1%	18.20	+36.0%	FAIL
04/10/08	16:29	SYST	11.0	20	0.43	+2.2%	13.17	+10.9%	FAIL
04/10/08	18:29	SYST	11.0	20	0.59	+3.0%	13.20	+11.0%	FAIL
04/10/08	20:29	SYST	11.0	20	0.62	+3.1%	13.16	+10.8%	FAIL
04/10/08	22:29	SYST	11.0	20	0.62	+3.1%	13.16	+10.8%	FAIL
04/11/08	00:29	SYST	11.0	20	0.63	+3.2%	13.18	+10.9%	FAIL
04/11/08	02:29	SYST	11.0	20	0.64	+3.2%	13.11	+10.6%	FAIL
04/11/08	04:29	SYST	11.0	20	0.62	+3.1%	13.01	+10.1%	FAIL
04/11/08	06:29	SYST	11.0	20	0.63	+3.2%	13.01	+10.1%	FAIL
04/11/08	07:41	SYST	11.0	20	0.64	+3.2%	13.03	+10.2%	FAIL
04/11/08	08:29	SYST	11.0	20	0.59	+3.0%	12.98	+9.9%	FAIL
04/11/08	10:29	SYST	11.0	20	0.65	+3.3%	13.00	+10.0%	FAIL
04/11/08	12:29	SYST	11.0	20	0.70	+3.5%	13.04	+10.2%	FAIL
04/12/08	07:41	SYST	11.0	20	0.06	+0.3%	9.41	-8.0%	FAIL
04/13/08	07:41	SYST	11.0	20	0.08	+0.4%	9.88	-5.6%	FAIL
04/14/08	07:41	SYST	11.0	20	0.13	+0.7%	9.60	-7.0%	FAIL
04/15/08	07:41	SYST	11.0	20	0.12	+0.6%	10.96	-0.2%	PASS
04/16/08	07:41	SYST	11.0	20	0.13	+0.7%	10.94	-0.3%	PASS
04/16/08	17:15	SYST	11.0	20	-0.04	-0.2%	11.17	+0.9%	PASS
04/17/08	07:41	SYST	11.0	20	0.10	+0.5%	11.11	+0.5%	PASS
04/18/08	07:41	SYST	11.0	20	-0.04	-0.2%	11.36	+1.8%	PASS
04/19/08	07:41	SYST	11.0	20	-0.05	-0.3%	11.39	+2.0%	PASS
04/20/08	07:41	SYST	11.0	20	-0.01	-0.1%	11.19	+0.9%	PASS
04/21/08	07:41	SYST	11.0	20	-0.02	-0.1%	11.45	+2.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
04/22/08	07:41	SYST	11.0	20	0.03	+0.2%	10.90	-0.5%	PASS
04/23/08	07:41	SYST	11.0	20	0.06	+0.3%	11.06	+0.3%	PASS
04/24/08	07:41	SYST	11.0	20	-0.13	-0.7%	11.06	+0.3%	PASS
04/25/08	07:41	SYST	11.0	20	-0.07	-0.4%	10.71	-1.5%	PASS
04/26/08	07:41	SYST	11.0	20	-0.08	-0.4%	10.86	-0.7%	PASS
04/27/08	07:41	SYST	11.0	20	0.02	+0.1%	11.12	+0.6%	PASS
04/28/08	07:41	SYST	11.0	20	0.01	+0.1%	11.21	+1.1%	PASS
04/29/08	07:41	SYST	11.0	20	0.06	+0.3%	11.14	+0.7%	PASS
04/30/08	07:41	SYST	11.0	20	0.05	+0.3%	11.03	+0.1%	PASS
05/01/08	07:41	SYST	11.0	20	0.17	+0.9%	11.45	+2.3%	PASS
05/02/08	07:41	SYST	11.0	20	-0.01	-0.1%	10.66	-1.7%	PASS
05/03/08	07:41	SYST	11.0	20	0.00	0.0%	10.38	-3.1%	PASS
05/04/08	07:41	SYST	11.0	20	0.08	+0.4%	10.74	-1.3%	PASS
05/05/08	07:41	SYST	11.0	20	0.14	+0.7%	10.64	-1.8%	PASS
05/06/08	07:41	SYST	11.0	20	0.05	+0.3%	11.06	+0.3%	PASS
05/07/08	07:41	SYST	11.0	20	0.14	+0.7%	10.95	-0.3%	PASS
05/08/08	07:41	SYST	11.0	20	0.10	+0.5%	10.91	-0.4%	PASS
05/09/08	07:41	SYST	11.0	20	0.14	+0.7%	11.21	+1.1%	PASS
05/10/08	07:44	SYST	11.0	20	-0.15	-0.8%	11.05	+0.3%	PASS
05/11/08	07:45	SYST	11.0	20	-0.41	-2.1%	11.24	+1.2%	PASS
05/12/08	07:43	SYST	11.0	20	-0.15	-0.8%	11.30	+1.5%	PASS
05/13/08	07:43	SYST	11.0	20	0.07	+0.4%	11.76	+3.8%	PASS
05/14/08	07:43	SYST	11.0	20	0.15	+0.8%	12.02	+5.1%	FAIL
05/14/08	17:16	SYST	11.0	20	0.02	+0.1%	10.96	-0.2%	PASS
05/15/08	07:41	SYST	11.0	20	0.04	+0.2%	10.93	-0.4%	PASS
05/16/08	07:41	SYST	11.0	20	0.04	+0.2%	11.14	+0.7%	PASS
05/17/08	07:41	SYST	11.0	20	-0.03	-0.2%	11.38	+1.9%	PASS
05/18/08	07:41	SYST	11.0	20	-0.02	-0.1%	11.56	+2.8%	PASS
05/19/08	07:41	SYST	11.0	20	-0.02	-0.1%	11.63	+3.2%	PASS
05/20/08	07:41	SYST	11.0	20	0.07	+0.4%	11.22	+1.1%	PASS
05/21/08	07:41	SYST	11.0	20	-1.71	-8.6%	14.32	+16.6%	FAIL
05/22/08	07:41	SYST	5.0	20	-0.02	-0.1%	4.84	-0.8%	PASS
05/22/08	13:19	SYST	11.0	20	0.02	+0.1%	10.97	-0.1%	PASS
05/23/08	07:42	SYST	11.0	20	0.00	0.0%	10.55	-2.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/23/08	13:36	SYST	11.0	20	0.00	0.0%	11.01	+0.0%	PASS
05/24/08	07:42	SYST	11.0	20	-0.06	-0.3%	10.37	-3.2%	PASS
05/25/08	07:42	SYST	11.0	20	-0.12	-0.6%	9.64	-6.8%	FAIL
05/26/08	07:42	SYST	11.0	20	-0.18	-0.9%	9.21	-9.0%	FAIL
05/27/08	07:42	SYST	11.0	20	-0.28	-1.4%	9.47	-7.7%	FAIL
05/28/08	07:42	SYST	11.0	20	-0.25	-1.3%	10.62	-1.9%	PASS
05/29/08	07:42	SYST	11.0	20	-0.27	-1.4%	10.04	-4.8%	PASS
05/30/08	07:42	SYST	11.0	20	-0.21	-1.1%	9.42	-7.9%	FAIL
05/31/08	07:42	SYST	11.0	20	-0.18	-0.9%	9.21	-9.0%	FAIL
06/01/08	07:42	SYST	11.0	20	-0.19	-1.0%	8.94	-10.3%	FAIL
06/02/08	07:42	SYST	11.0	20	-0.20	-1.0%	9.00	-10.0%	FAIL
06/03/08	07:42	SYST	11.0	20	-0.20	-1.0%	8.73	-11.4%	FAIL
06/03/08	10:15	SYST	11.0	20	0.26	+1.3%	11.78	+3.9%	PASS
06/04/08	06:15	SYST	11.0	20	-0.09	-0.5%	10.75	-1.3%	PASS
06/04/08	07:42	SYST	11.0	20	-0.07	-0.4%	10.81	-0.9%	PASS
06/05/08	02:15	SYST	11.0	20	-0.05	-0.3%	10.79	-1.1%	PASS
06/05/08	07:42	SYST	11.0	20	-0.03	-0.2%	10.78	-1.1%	PASS
06/06/08	07:42	SYST	11.0	20	0.02	+0.1%	11.09	+0.4%	PASS
06/07/08	07:42	SYST	11.0	20	0.29	+1.5%	11.42	+2.1%	PASS
06/08/08	07:42	SYST	11.0	20	-0.06	-0.3%	11.57	+2.9%	PASS
06/09/08	07:42	SYST	11.0	20	-0.06	-0.3%	11.42	+2.1%	PASS
06/10/08	07:42	SYST	11.0	20	0.04	+0.2%	11.06	+0.3%	PASS
06/11/08	07:42	SYST	11.0	20	0.08	+0.4%	11.30	+1.5%	PASS
06/12/08	07:42	SYST	11.0	20	0.12	+0.6%	11.21	+1.1%	PASS
06/13/08	07:42	SYST	11.0	20	0.04	+0.2%	11.09	+0.4%	PASS
06/14/08	07:42	SYST	11.0	20	0.04	+0.2%	11.17	+0.9%	PASS
06/15/08	07:42	SYST	11.0	20	0.08	+0.4%	11.30	+1.5%	PASS
06/16/08	07:42	SYST	11.0	20	0.08	+0.4%	11.26	+1.3%	PASS
06/16/08	17:22	SYST	11.0	20	0.03	+0.2%	10.94	-0.3%	PASS
06/17/08	07:41	SYST	11.0	20	0.07	+0.4%	10.95	-0.3%	PASS
06/18/08	07:42	SYST	11.0	20	0.08	+0.4%	11.06	+0.3%	PASS
06/19/08	07:42	SYST	11.0	20	0.11	+0.6%	11.17	+0.9%	PASS
06/20/08	07:42	SYST	11.0	20	0.02	+0.1%	10.89	-0.5%	PASS
06/21/08	07:42	SYST	11.0	20	0.09	+0.5%	11.05	+0.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
06/22/08	07:42	SYST	11.0	20	0.11	+0.6%	11.06	+0.3%	PASS
06/23/08	07:42	SYST	11.0	20	0.15	+0.8%	11.19	+0.9%	PASS
06/24/08	07:42	SYST	Calibrator Error						
06/24/08	10:25	SYST	Calibrator Error						
06/25/08	07:42	SYST	11.0	20	0.06	+0.3%	8.02	-14.9%	FAIL
06/26/08	07:42	SYST	11.0	20	0.13	+0.7%	11.27	+1.4%	PASS
06/27/08	07:42	SYST	11.0	20	0.18	+0.9%	11.11	+0.5%	PASS
06/28/08	07:42	SYST	11.0	20	0.09	+0.5%	10.98	-0.1%	PASS
06/29/08	07:42	SYST	11.0	20	0.10	+0.5%	10.93	-0.4%	PASS
06/30/08	07:42	SYST	11.0	20	0.14	+0.7%	11.21	+1.1%	PASS
07/01/08	07:42	SYST	11.0	20	0.03	+0.2%	11.00	0.0%	PASS
07/02/08	07:42	SYST	11.0	20	0.10	+0.5%	11.14	+0.7%	PASS
07/03/08	07:42	SYST	11.0	20	0.15	+0.8%	11.26	+1.3%	PASS
07/04/08	07:42	SYST	11.0	20	0.02	+0.1%	11.33	+1.7%	PASS
07/05/08	07:42	SYST	11.0	20	0.05	+0.3%	11.93	+4.7%	PASS
07/06/08	07:42	SYST	11.0	20	0.07	+0.4%	11.47	+2.4%	PASS
07/07/08	07:42	SYST	11.0	20	0.15	+0.8%	11.17	+0.9%	PASS
07/08/08	07:42	SYST	11.0	20	-0.02	-0.1%	10.68	-1.6%	PASS
07/09/08	07:42	SYST	11.0	20	0.02	+0.1%	11.02	+0.1%	PASS
07/10/08	07:42	SYST	11.0	20	0.03	+0.2%	10.95	-0.3%	PASS
07/11/08	07:42	SYST	11.0	20	0.08	+0.4%	11.06	+0.3%	PASS
07/12/08	07:42	SYST	11.0	20	0.11	+0.6%	10.98	-0.1%	PASS
07/13/08	07:42	SYST	11.0	20	0.15	+0.8%	10.69	-1.6%	PASS
07/14/08	07:42	SYST	11.0	20	0.18	+0.9%	11.00	0.0%	PASS
07/15/08	07:42	SYST	11.0	20	0.03	+0.2%	11.45	+2.3%	PASS
07/16/08	07:42	SYST	11.0	20	0.04	+0.2%	11.56	+2.8%	PASS
07/17/08	07:42	SYST	11.0	20	0.05	+0.3%	10.87	-0.7%	PASS
07/18/08	07:42	SYST	11.0	20	0.09	+0.5%	10.97	-0.1%	PASS
07/19/08	07:42	SYST	11.0	20	0.11	+0.6%	11.18	+0.9%	PASS
07/20/08	07:42	SYST	11.0	20	0.14	+0.7%	10.98	-0.1%	PASS
07/21/08	07:42	SYST	11.0	20	0.16	+0.8%	11.10	+0.5%	PASS
07/22/08	07:42	SYST	11.0	20	-0.02	-0.1%	10.90	-0.5%	PASS
07/23/08	07:44	SYST	11.0	20	-2.40	-12.0%	10.18	-4.1%	FAIL
07/24/08	07:08	SYST	11.0	20	-0.04	-0.2%	11.15	+0.8%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/25/08	07:42	SYST	11.0	20	0.03	+0.2%	10.66	-1.7%	PASS
07/26/08	07:42	SYST	11.0	20	0.05	+0.3%	10.94	-0.3%	PASS
07/27/08	07:42	SYST	11.0	20	-0.03	-0.2%	10.85	-0.8%	PASS
07/28/08	07:42	SYST	11.0	20	0.09	+0.5%	10.96	-0.2%	PASS
07/28/08	16:49	SYST	11.0	20	-0.14	-0.7%	3.65	-36.8%	FAIL
07/29/08	07:42	SYST	11.0	20	-0.02	-0.1%	10.58	-2.1%	PASS
07/30/08	07:42	SYST	11.0	20	0.01	+0.1%	10.44	-2.8%	PASS
07/31/08	07:42	SYST	11.0	20	0.04	+0.2%	11.08	+0.4%	PASS
08/01/08	07:42	SYST	11.0	20	-3.06	-15.3%	2.33	-43.4%	FAIL
08/02/08	07:42	SYST	11.0	20	0.16	+0.8%	10.84	-0.8%	PASS
08/03/08	07:42	SYST	11.0	20	0.13	+0.7%	10.79	-1.1%	PASS
08/04/08	07:42	SYST	11.0	20	0.11	+0.6%	10.57	-2.2%	PASS
08/05/08	07:42	SYST	11.0	20	0.02	+0.1%	11.11	+0.5%	PASS
08/06/08	07:42	SYST	11.0	20	0.08	+0.4%	10.90	-0.5%	PASS
08/07/08	07:42	SYST	11.0	20	0.18	+0.9%	11.05	+0.3%	PASS
08/08/08	07:42	SYST	11.0	20	-0.03	-0.2%	10.73	-1.4%	PASS
08/09/08	07:42	SYST	11.0	20	0.01	+0.1%	10.99	-0.0%	PASS
08/10/08	07:42	SYST	11.0	20	0.05	+0.3%	11.06	+0.3%	PASS
08/11/08	07:42	SYST	11.0	20	0.05	+0.3%	11.17	+0.9%	PASS
08/12/08	07:42	SYST	11.0	20	0.04	+0.2%	11.06	+0.3%	PASS
08/12/08	16:25	INST	5.0	20	0.00	0.0%	4.96	-0.2%	PASS
08/12/08	22:27	INST	11.0	20	0.00	0.0%	10.92	-0.4%	PASS
08/13/08	07:42	SYST	5.0	20	0.03	+0.2%	2.96	-10.2%	FAIL
08/13/08	16:57	SYST	11.0	20	0.01	+0.1%	10.72	-1.4%	PASS
08/14/08	07:42	SYST	11.0	20	-0.02	-0.1%	10.23	-3.9%	PASS
08/14/08	17:01	SYST	11.0	20	0.03	+0.2%	10.65	-1.8%	PASS
08/15/08	07:42	SYST	11.0	20	0.23	+1.2%	11.06	+0.3%	PASS
08/16/08	07:42	SYST	11.0	20	0.00	0.0%	10.66	-1.7%	PASS
08/17/08	07:42	SYST	11.0	20	-0.09	-0.5%	11.02	+0.1%	PASS
08/18/08	07:42	SYST	11.0	20	-0.10	-0.5%	10.18	-4.1%	PASS
08/19/08	07:42	SYST	11.0	20	0.04	+0.2%	11.45	+2.3%	PASS
08/20/08	07:42	SYST	11.0	20	0.02	+0.1%	11.63	+3.2%	PASS
08/20/08	17:53	SYST	11.0	20	0.02	+0.1%	10.86	-0.7%	PASS
08/21/08	07:42	SYST	11.0	20	-0.01	-0.1%	10.92	-0.4%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/22/08	07:42	SYST	11.0	20	-0.06	-0.3%	10.74	-1.3%	PASS
08/23/08	07:42	SYST	11.0	20	-0.12	-0.6%	10.84	-0.8%	PASS
08/24/08	07:42	SYST	11.0	20	-0.10	-0.5%	11.13	+0.7%	PASS
08/25/08	07:42	SYST	11.0	20	0.01	+0.1%	10.81	-0.9%	PASS
08/26/08	07:42	SYST	11.0	20	0.01	+0.1%	10.73	-1.4%	PASS
08/27/08	07:42	SYST	11.0	20	-0.13	-0.7%	10.09	-4.6%	PASS
08/28/08	07:42	SYST	11.0	20	0.06	+0.3%	10.93	-0.4%	PASS
08/29/08	07:42	SYST	11.0	20	0.19	+1.0%	11.30	+1.5%	PASS
08/30/08	07:42	SYST	11.0	20	0.03	+0.2%	11.37	+1.9%	PASS
08/31/08	07:42	SYST	11.0	20	0.13	+0.7%	11.45	+2.3%	PASS
09/01/08	07:42	SYST	11.0	20	0.19	+1.0%	11.56	+2.8%	PASS
09/02/08	07:42	SYST	11.0	20	0.18	+0.9%	11.82	+4.1%	PASS
09/03/08	07:42	SYST	11.0	20	-0.02	-0.1%	11.04	+0.2%	PASS
09/04/08	07:42	SYST	11.0	20	0.11	+0.6%	10.98	-0.1%	PASS
09/05/08	07:42	SYST	11.0	20	-0.06	-0.3%	10.76	-1.2%	PASS
09/06/08	07:42	SYST	11.0	20	-0.02	-0.1%	10.95	-0.3%	PASS
09/07/08	07:42	SYST	11.0	20	-0.07	-0.4%	10.98	-0.1%	PASS
09/08/08	07:42	SYST	11.0	20	0.01	+0.1%	11.07	+0.4%	PASS
09/09/08	07:42	SYST	11.0	20	0.06	+0.3%	11.35	+1.8%	PASS
09/10/08	07:42	SYST	11.0	20	0.17	+0.9%	11.75	+3.8%	PASS
09/11/08	Maintenance Activities – No Calibration Check								
09/12/08	07:43	SYST	11.0	20	0.00	0.0%	0.46	-52.7%	FAIL
09/12/08	12:37	INST	5.0	20	0.00	0.0%	4.94	-0.3%	PASS
09/12/08	14:04	SYST	11.0	20	0.02	+0.1%	11.16	+0.8%	PASS
09/13/08	07:43	SYST	11.0	20	0.02	+0.1%	11.44	+2.2%	PASS
09/14/08	07:43	SYST	11.0	20	0.03	+0.2%	11.91	+4.6%	PASS
09/15/08	07:43	SYST	11.0	20	0.05	+0.3%	10.78	-1.1%	PASS
09/16/08	07:43	SYST	11.0	20	0.06	+0.3%	11.69	+3.5%	PASS
09/17/08	07:43	SYST	11.0	20	0.00	0.0%	11.05	+0.3%	PASS
09/18/08	07:43	SYST	11.0	20	0.00	0.0%	11.37	+1.9%	PASS
09/19/08	07:43	SYST	11.0	20	0.04	+0.2%	10.66	-1.7%	PASS
09/20/08	07:43	SYST	11.0	20	-0.02	-0.1%	10.22	-3.9%	PASS
09/21/08	07:43	SYST	11.0	20	0.02	+0.1%	10.09	-4.6%	PASS
09/22/08	07:43	SYST	11.0	20	0.08	+0.4%	10.26	-3.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
09/22/08	15:42	SYST	11.0	20	0.03	+0.2%	13.35	+11.8%	FAIL
09/23/08	07:43	SYST	11.0	20	0.05	+0.3%	13.25	+11.3%	FAIL
09/23/08	15:45	SYST	11.0	20	0.16	+0.8%	11.43	+2.2%	PASS
09/24/08	07:43	SYST	11.0	20	-0.06	-0.3%	11.14	+0.7%	PASS
09/25/08	07:43	SYST	11.0	20	-0.06	-0.3%	11.22	+1.1%	PASS
09/26/08	07:43	SYST	11.0	20	0.82	+4.1%	11.67	+3.4%	PASS
09/26/08	15:26	SYST	11.0	20	0.22	+1.1%	11.36	+1.8%	PASS
09/27/08	07:43	SYST	11.0	20	0.72	+3.6%	11.70	+3.5%	PASS
09/28/08	07:43	SYST	11.0	20	1.11	+5.6%	11.85	+4.3%	FAIL
09/29/08	07:43	SYST	11.0	20	1.57	+7.9%	11.22	+1.1%	FAIL
09/29/08	15:21	INST	11.0	20	0.04	+0.2%	10.67	-1.7%	PASS
09/30/08	07:43	SYST	11.0	20	0.14	+0.7%	4.97	-30.2%	FAIL
10/01/08	07:44	SYST	11.0	20	0.16	+0.8%	8.75	-11.3%	FAIL
10/01/08	12:02	INST	11.0	20	0.05	+0.3%	12.36	+6.8%	FAIL
10/01/08	14:53	INST	5.0	20	0.00	0.0%	5.08	+0.4%	PASS
10/01/08	16:32	SYST	11.0	20	0.06	+0.3%	10.80	-1.0%	PASS
10/02/08	07:44	SYST	11.0	20	0.09	+0.5%	10.77	-1.2%	PASS
10/03/08	07:44	SYST	11.0	20	-0.80	-4.0%	7.90	-15.5%	FAIL
10/03/08	17:22	SYST	11.0	20	0.02	+0.1%	11.14	+0.7%	PASS
10/04/08	07:44	SYST	11.0	20	0.03	+0.2%	11.18	+0.9%	PASS
10/05/08	07:44	SYST	11.0	20	0.07	+0.4%	11.03	+0.1%	PASS
10/06/08	07:44	SYST	11.0	20	0.12	+0.6%	10.96	-0.2%	PASS
10/07/08	07:44	SYST	11.0	20	0.00	0.0%	10.99	-0.0%	PASS
10/08/08	07:44	SYST	11.0	20	0.11	+0.6%	11.33	+1.7%	PASS
10/09/08	07:44	SYST	11.0	20	-0.05	-0.3%	10.77	-1.2%	PASS
10/10/08	07:44	SYST	11.0	20	5.16	+25.8%	57.46	+232%	FAIL
10/10/08	10:46	SYST	11.0	20	5.12	+25.6%	60.11	+246%	FAIL
10/10/08	15:24	INST	5.0	20	0.00	0.0%	4.76	-1.2%	PASS
10/10/08	16:44	SYST	11.0	20	0.05	+0.3%	5.06	-29.7%	FAIL
10/11/08	07:44	SYST	11.0	20	0.02	+0.1%	6.80	-21.0%	FAIL
10/12/08	07:44	SYST	11.0	20	0.03	+0.2%	4.98	-30.1%	FAIL
10/13/08	07:44	SYST	11.0	20	0.04	+0.2%	4.76	-31.2%	FAIL
10/14/08	07:44	SYST	11.0	20	-0.01	-0.1%	10.83	-0.9%	PASS
10/15/08	07:44	SYST	11.0	20	-0.04	-0.2%	10.63	-1.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
10/16/08	07:44	SYST	11.0	20	0.08	+0.4%	11.75	+3.8%	PASS
10/17/08	07:44	SYST	11.0	20	0.03	+0.2%	11.22	+1.1%	PASS
10/18/08	07:44	SYST	11.0	20	0.06	+0.3%	11.06	+0.3%	PASS
10/19/08	07:44	SYST	11.0	20	0.07	+0.4%	10.77	-1.2%	PASS
10/20/08	07:44	SYST	11.0	20	0.07	+0.4%	10.76	-1.2%	PASS
10/21/08	07:44	SYST	11.0	20	0.04	+0.2%	11.06	+0.3%	PASS
10/21/08	17:44	SYST	11.0	20	-0.12	-0.6%	10.20	-4.0%	PASS
10/22/08	Manual Recalibration – No Calibration Check								
10/23/08	04:30	SYST	11.0	20	0.22	+1.1%	10.52	-2.4%	PASS
10/23/08	07:44	SYST	11.0	20	0.58	+2.9%	9.97	-5.2%	FAIL
10/23/08	09:30	SYST	11.0	20	0.01	+0.1%	10.13	-4.4%	PASS
10/24/08	04:30	SYST	11.0	20	0.24	+1.2%	11.49	+2.5%	PASS
10/25/08	04:30	SYST	11.0	20	0.39	+2.0%	11.56	+2.8%	PASS
10/26/08	04:30	SYST	11.0	20	0.86	+4.3%	12.10	+5.5%	FAIL
10/26/08	06:45	SYST	11.0	20	0.01	+0.1%	11.31	+1.6%	PASS
10/27/08	04:30	SYST	11.0	20	0.57	+2.9%	12.25	+6.3%	FAIL
10/27/08	07:52	SYST	11.0	20	-0.05	-0.3%	11.56	+2.8%	PASS
10/27/08	14:30	SYST	11.0	20	0.10	+0.5%	10.90	-0.5%	PASS
10/28/08	07:44	SYST	11.0	20	0.18	+0.9%	11.06	+0.3%	PASS
10/28/08	14:30	SYST	11.0	20	0.01	+0.1%	10.96	-0.2%	PASS
10/29/08	07:44	SYST	11.0	20	-0.02	-0.1%	10.35	-3.3%	PASS
10/30/08	07:44	SYST	11.0	20	0.03	+0.2%	11.54	+2.7%	PASS
10/30/08	11:47	SYST	11.0	20	0.08	+0.4%	11.42	+2.1%	PASS
10/31/08	07:44	SYST	11.0	20	0.13	+0.7%	11.50	+2.5%	PASS
11/01/08	07:44	SYST	11.0	20	0.04	+0.2%	10.73	-1.4%	PASS
11/02/08	07:44	SYST	11.0	20	0.11	+0.6%	12.27	+6.4%	FAIL
11/03/08	07:44	SYST	11.0	20	0.16	+0.8%	10.42	-2.9%	PASS
11/04/08	17:44	SYST	11.0	20	0.04	+0.2%	11.21	+1.1%	PASS
11/05/08	07:44	SYST	11.0	20	0.13	+0.7%	11.27	+1.4%	PASS
11/06/08	07:44	SYST	11.0	20	-0.03	-0.2%	10.95	-0.3%	PASS
11/07/08	07:44	SYST	11.0	20	0.07	+0.4%	11.21	+1.1%	PASS
11/08/08	07:44	SYST	11.0	20	0.08	+0.4%	11.14	+0.7%	PASS
11/09/08	07:44	SYST	11.0	20	0.09	+0.5%	11.11	+0.5%	PASS
11/10/08	07:44	SYST	11.0	20	0.19	+1.0%	11.64	+3.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
11/11/08	07:44	SYST	11.0	20	0.02	+0.1%	11.18	+0.9%	PASS
11/12/08	07:44	SYST	11.0	20	0.07	+0.4%	10.82	-0.9%	PASS
11/13/08	07:44	SYST	11.0	20	0.05	+0.3%	10.90	-0.5%	PASS
11/14/08	07:44	SYST	11.0	20	0.07	+0.4%	10.99	-0.0%	PASS
11/15/08	07:44	SYST	11.0	20	0.10	+0.5%	11.30	+1.5%	PASS
11/16/08	07:44	SYST	11.0	20	0.11	+0.6%	11.25	+1.3%	PASS
11/17/08	07:44	SYST	11.0	20	0.10	+0.5%	11.29	+1.5%	PASS
11/18/08	07:44	SYST	11.0	20	0.03	+0.2%	10.86	-0.7%	PASS
11/19/08	07:44	SYST	11.0	20	0.27	+1.4%	12.20	+6.0%	FAIL
11/19/08	12:19	SYST	11.0	20	0.29	+1.5%	12.17	+5.9%	FAIL
11/19/08	15:19	SYST	11.0	20	-0.03	-0.2%	11.14	+0.7%	PASS
11/20/08	07:44	SYST	11.0	20	0.11	+0.6%	11.48	+2.4%	PASS
11/21/08	07:44	SYST	5.0	20	0.03	+0.2%	5.00	0.0%	PASS
11/22/08	07:44	SYST	5.0	20	-0.07	-0.4%	5.14	+0.7%	PASS
11/23/08	07:44	SYST	5.0	20	-0.05	-0.3%	5.15	+0.8%	PASS
11/24/08	07:43	SYST	5.0	20	0.20	+1.0%	5.44	+2.2%	PASS
11/25/08	07:43	SYST	5.0	20	0.08	+0.4%	5.18	+0.9%	PASS
11/26/08	Blowback Mode – No Calibration Check								
11/27/08	Blowback Mode – No Calibration Check								
11/28/08	Blowback Mode – No Calibration Check								
11/29/08	Blowback Mode – No Calibration Check								
11/30/08	Blowback Mode – No Calibration Check								
12/01/08	Blowback Mode – No Calibration Check								
12/02/08	Blowback Mode – No Calibration Check								
12/03/08	Blowback Mode – No Calibration Check								
12/04/08	Blowback Mode – No Calibration Check								
12/05/08	07:43	SYST	11.0	20	3.31	+16.6%	4.70	-31.5%	FAIL
12/06/08	07:43	SYST	11.0	20	-1.07	-5.4%	6.49	-22.6%	FAIL
12/07/08	Maintenance Activities – No Calibration Check								
12/08/08	Maintenance Activities – No Calibration Check								
12/09/08	07:33	SYST	11.0	20	0.80	+4.0%	9.69	-6.6%	FAIL
12/09/08	16:30	SYST	11.0	20	0.49	+2.5%	10.94	-0.3%	PASS
12/10/08	Manual Recalibration – No Calibration Check								
12/11/08	07:44	SYST	11.0	20	1.08	+5.4%	11.37	+1.9%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
12/12/08	16:42	SYST	11.0	20	-0.30	-1.5%	10.62	-1.9%	PASS
12/13/08	07:44	SYST	11.0	20	1.33	+6.7%	10.97	-0.1%	FAIL
12/14/08	07:44	SYST	11.0	20	1.54	+7.7%	10.54	-2.3%	FAIL
12/14/08	08:28	SYST	11.0	20	0.04	+0.2%	10.06	-4.7%	PASS
12/15/08	07:44	SYST	11.0	20	-0.42	-2.1%	0.20	-54.0%	FAIL
12/15/08	15:35	SYST	11.0	20	0.17	+0.9%	10.95	-0.3%	PASS
12/16/08	07:44	SYST	11.0	20	-0.05	-0.3%	11.16	+0.8%	PASS
12/17/08	07:44	SYST	11.0	20	-0.03	-0.2%	10.94	-0.3%	PASS
12/18/08	07:44	SYST	11.0	20	-0.97	-4.9%	8.22	-13.9%	FAIL
12/19/08	14:44	SYST	11.0	20	0.03	+0.2%	10.92	-0.4%	PASS
12/20/08	07:44	SYST	11.0	20	-0.08	-0.4%	10.87	-0.7%	PASS
12/21/08	07:44	SYST	11.0	20	-0.09	-0.5%	10.51	-2.5%	PASS
12/22/08	07:44	SYST	11.0	20	-0.12	-0.6%	10.80	-1.0%	PASS
12/23/08	07:44	SYST	11.0	20	-0.01	-0.1%	10.97	-0.1%	PASS
12/24/08	07:44	SYST	11.0	20	0.04	+0.2%	10.90	-0.5%	PASS
12/25/08	07:44	SYST	11.0	20	-0.02	-0.1%	11.22	+1.1%	PASS
12/26/08	07:44	SYST	11.0	20	0.08	+0.4%	11.37	+1.9%	PASS
12/27/08	07:44	SYST	11.0	20	0.02	+0.1%	12.07	+5.4%	FAIL
12/28/08	07:44	SYST	11.0	20	-0.06	-0.3%	10.74	-1.3%	PASS
12/29/08	07:44	SYST	11.0	20	-0.12	-0.6%	10.78	-1.1%	PASS
12/30/08	07:44	SYST	11.0	20	-0.09	-0.5%	10.96	-0.2%	PASS
12/31/08	07:44	SYST	11.0	20	-0.09	-0.5%	10.96	-0.2%	PASS
01/01/09	07:44	SYST	11.0	20	-0.10	-0.5%	10.96	-0.2%	PASS
01/02/09	07:44	SYST	11.0	20	-0.01	-0.1%	12.22	+6.1%	FAIL
01/02/09	09:44	SYST	11.0	20	-0.02	-0.1%	12.12	+5.6%	FAIL
01/03/09	09:44	SYST	11.0	20	0.02	+0.1%	12.28	+6.4%	FAIL
01/04/09	07:44	SYST	11.0	20	0.10	+0.5%	11.29	+1.5%	PASS
01/05/09	07:44	SYST	11.0	20	0.11	+0.6%	11.40	+2.0%	PASS
01/06/09	07:44	SYST	11.0	20	0.01	+0.1%	10.98	-0.1%	PASS
01/07/09	07:44	SYST	11.0	20	0.06	+0.3%	10.94	-0.3%	PASS
01/08/09	07:44	SYST	11.0	20	0.06	+0.3%	11.09	+0.4%	PASS
01/09/09	07:44	SYST	11.0	20	0.06	+0.3%	11.23	+1.2%	PASS
01/10/09	07:44	SYST	11.0	20	0.13	+0.7%	11.31	+1.6%	PASS
01/11/09	07:44	SYST	11.0	20	0.18	+0.9%	11.28	+1.4%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/12/09	07:44	SYST	11.0	20	0.21	+1.1%	11.40	+2.0%	PASS
01/13/09	07:44	SYST	11.0	20	0.05	+0.3%	11.09	+0.4%	PASS
01/14/09	07:44	SYST	11.0	20	0.16	+0.8%	11.23	+1.2%	PASS
01/15/09	07:44	SYST	11.0	20	0.08	+0.4%	11.29	+1.5%	PASS
01/16/09	07:44	SYST	11.0	20	0.10	+0.5%	11.43	+2.2%	PASS
01/17/09	07:44	SYST	11.0	20	0.03	+0.2%	10.92	-0.4%	PASS
01/18/09	07:44	SYST	11.0	20	0.06	+0.3%	10.93	-0.4%	PASS
01/19/09	07:44	SYST	11.0	20	0.07	+0.4%	11.06	+0.3%	PASS
01/20/09	07:44	SYST	11.0	20	0.04	+0.2%	11.11	+0.5%	PASS
01/21/09	07:44	SYST	11.0	20	0.02	+0.1%	10.72	-1.4%	PASS
01/22/09	07:44	SYST	11.0	20	0.01	+0.1%	11.27	+1.4%	PASS
01/23/09	07:44	SYST	11.0	20	0.01	+0.1%	11.26	+1.3%	PASS
01/24/09	07:44	SYST	11.0	20	0.01	+0.1%	11.13	+0.7%	PASS
01/25/09	07:44	SYST	11.0	20	0.02	+0.1%	11.16	+0.8%	PASS
01/26/09	07:44	SYST	11.0	20	0.05	+0.3%	11.32	+1.6%	PASS
01/27/09	07:44	SYST	11.0	20	0.01	+0.1%	11.09	+0.4%	PASS
01/27/09	17:05	SYST	11.0	20	0.03	+0.2%	11.01	+0.0%	PASS
01/28/09	07:44	SYST	11.0	20	0.05	+0.3%	11.06	+0.3%	PASS
01/29/09	02:44	SYST	11.0	20	2.59	+13.0%	12.27	+6.4%	FAIL
01/29/09	07:54	SYST	11.0	20	-2.07	-10.4%	9.50	-7.5%	FAIL
01/29/09	17:24	SYST	11.0	20	1.98	+9.9%	4.56	-32.2%	FAIL
01/30/09	00:04	SYST	11.0	20	0.06	+0.3%	11.29	+1.5%	PASS
01/30/09	08:14	SYST	11.0	20	-0.07	-0.4%	12.41	+7.1%	FAIL
01/30/09	10:10	SYST	11.0	20	0.03	+0.2%	11.23	+1.2%	PASS
01/30/09	18:05	SYST	11.0	20	0.09	+0.5%	11.34	+1.7%	PASS
01/31/09	07:33	SYST	11.0	20	0.07	+0.4%	11.00	0.0%	PASS
02/01/09	07:33	SYST	11.0	20	0.13	+0.7%	10.70	-1.5%	PASS
02/02/09	07:33	SYST	11.0	20	0.17	+0.9%	10.81	-0.9%	PASS
02/03/09	07:33	SYST	11.0	20	0.06	+0.3%	11.22	+1.1%	PASS
02/03/09	14:31	SYST	11.0	20	0.12	+0.6%	11.12	+0.6%	PASS
02/03/09	19:33	SYST	11.0	20	0.10	+0.5%	11.18	+0.9%	PASS
02/04/09	01:33	SYST	11.0	20	0.09	+0.5%	11.17	+0.9%	PASS
02/04/09	07:33	SYST	11.0	20	0.07	+0.4%	11.12	+0.6%	PASS
02/04/09	13:33	SYST	11.0	20	0.10	+0.5%	11.18	+0.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/04/09	16:33	SYST	11.0	20	0.00	0.0%	11.05	+0.3%	PASS
02/04/09	19:33	SYST	11.0	20	0.03	+0.2%	11.01	+0.0%	PASS
02/04/09	22:33	SYST	11.0	20	0.00	0.0%	10.98	-0.1%	PASS
02/05/09	01:33	SYST	11.0	20	0.03	+0.2%	11.15	+0.8%	PASS
02/05/09	04:33	SYST	11.0	20	0.05	+0.3%	11.50	+2.5%	PASS
02/05/09	07:33	SYST	11.0	20	0.06	+0.3%	11.13	+0.7%	PASS
02/05/09	10:33	SYST	11.0	20	0.07	+0.4%	11.11	+0.5%	PASS
02/05/09	16:33	SYST	11.0	20	0.05	+0.3%	11.56	+2.8%	PASS
02/05/09	19:33	SYST	11.0	20	0.00	0.0%	10.91	-0.4%	PASS
02/05/09	22:33	SYST	11.0	20	-0.03	-0.2%	10.95	-0.3%	PASS
02/06/09	01:33	SYST	11.0	20	0.00	0.0%	11.38	+1.9%	PASS
02/06/09	04:33	SYST	11.0	20	0.01	+0.1%	11.21	+1.1%	PASS
02/06/09	07:33	SYST	11.0	20	0.01	+0.1%	10.97	-0.1%	PASS
02/06/09	10:33	SYST	11.0	20	0.02	+0.1%	11.07	+0.4%	PASS
02/06/09	13:33	SYST	11.0	20	0.02	+0.1%	11.03	+0.1%	PASS
02/06/09	16:33	SYST	11.0	20	0.05	+0.3%	11.05	+0.3%	PASS
02/06/09	19:33	SYST	11.0	20	0.03	+0.2%	11.07	+0.4%	PASS
02/06/09	22:33	SYST	11.0	20	0.01	+0.1%	11.04	+0.2%	PASS
02/07/09	01:33	SYST	11.0	20	0.08	+0.4%	11.44	+2.2%	PASS
02/07/09	04:33	SYST	11.0	20	0.06	+0.3%	11.45	+2.3%	PASS
02/07/09	07:33	SYST	11.0	20	0.11	+0.6%	11.31	+1.6%	PASS
02/07/09	10:33	SYST	11.0	20	0.06	+0.3%	10.90	-0.5%	PASS
02/07/09	13:33	SYST	11.0	20	0.06	+0.3%	11.02	+0.1%	PASS
02/07/09	16:33	SYST	11.0	20	0.04	+0.2%	11.10	+0.5%	PASS
02/07/09	19:33	SYST	11.0	20	0.06	+0.3%	11.16	+0.8%	PASS
02/07/09	22:33	SYST	11.0	20	0.04	+0.2%	11.15	+0.8%	PASS
02/08/09	01:33	SYST	11.0	20	0.09	+0.5%	11.63	+3.2%	PASS
02/08/09	04:33	SYST	11.0	20	0.08	+0.4%	11.65	+3.3%	PASS
02/08/09	07:33	SYST	11.0	20	0.12	+0.6%	11.73	+3.7%	PASS
02/08/09	10:33	SYST	11.0	20	0.07	+0.4%	11.26	+1.3%	PASS
02/08/09	13:33	SYST	11.0	20	0.12	+0.6%	11.29	+1.5%	PASS
02/08/09	16:33	SYST	11.0	20	0.08	+0.4%	11.28	+1.4%	PASS
02/08/09	19:33	SYST	11.0	20	0.09	+0.5%	11.27	+1.4%	PASS
02/08/09	22:33	SYST	11.0	20	0.06	+0.3%	11.23	+1.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/09/09	01:33	SYST	11.0	20	0.15	+0.8%	11.87	+4.4%	PASS
02/09/09	04:33	SYST	11.0	20	0.13	+0.7%	11.77	+3.9%	PASS
02/09/09	07:33	SYST	11.0	20	0.12	+0.6%	11.22	+1.1%	PASS
02/09/09	10:33	SYST	11.0	20	0.08	+0.4%	11.22	+1.1%	PASS
02/09/09	13:33	SYST	11.0	20	0.11	+0.6%	11.31	+1.6%	PASS
02/09/09	16:33	SYST	11.0	20	0.09	+0.5%	11.12	+0.6%	PASS
02/09/09	19:33	SYST	11.0	20	0.10	+0.5%	11.24	+1.2%	PASS
02/09/09	22:33	SYST	11.0	20	-0.01	-0.1%	10.94	-0.3%	PASS
02/10/09	01:33	SYST	11.0	20	0.03	+0.2%	11.37	+1.9%	PASS
02/10/09	04:33	SYST	11.0	20	0.04	+0.2%	11.30	+1.5%	PASS
02/10/09	07:33	SYST	11.0	20	0.00	0.0%	10.66	-1.7%	PASS
02/11/09	07:33	SYST	11.0	20	0.03	+0.2%	11.26	+1.3%	PASS
02/11/09	14:46	SYST	11.0	20	0.04	+0.2%	10.90	-0.5%	PASS
02/12/09	No Calibration Check								
02/13/09	11:00	SYST	11.0	20	0.15	+0.8%	11.56	+2.8%	PASS
02/14/09	11:00	SYST	11.0	20	-0.30	-1.5%	0.00	-55.0%	FAIL
02/15/09	11:00	SYST	11.0	20	-0.28	-1.4%	12.04	+5.2%	FAIL
02/16/09	08:20	SYST	11.0	20	0.12	+0.6%	10.84	-0.8%	PASS
02/17/09	07:35	SYST	11.0	20	0.15	+0.8%	11.34	+1.7%	PASS
02/18/09	07:35	SYST	11.0	20	0.18	+0.9%	11.02	+0.1%	PASS
02/19/09	07:35	SYST	11.0	20	0.23	+1.2%	11.33	+1.7%	PASS
02/20/09	05:35	SYST	11.0	20	0.37	+1.9%	11.31	+1.6%	PASS
02/21/09	05:35	SYST	11.0	20	0.18	+0.9%	12.79	+9.0%	FAIL
02/21/09	07:35	SYST	11.0	20	0.05	+0.3%	10.94	-0.3%	PASS
02/22/09	05:41	SYST	11.0	20	0.01	+0.1%	11.06	+0.3%	PASS
02/23/09	00:05	SYST	11.0	20	-0.01	-0.1%	10.98	-0.1%	PASS
02/23/09	01:50	SYST	11.0	20	0.11	+0.6%	7.24	-18.8%	FAIL
02/23/09	02:21	SYST	11.0	20	-0.11	-0.6%	10.13	-4.4%	PASS
02/23/09	05:35	SYST	11.0	20	0.11	+0.6%	10.96	-0.2%	PASS
02/24/09	05:05	SYST	11.0	20	0.11	+0.6%	11.03	+0.1%	PASS
02/25/09	05:05	SYST	11.0	20	0.11	+0.6%	11.25	+1.3%	PASS
02/26/09	05:05	SYST	11.0	20	-0.03	-0.2%	10.55	-2.3%	PASS
02/26/09	19:04	INST	5.0	20	0.00	0.0%	5.00	0.0%	PASS
02/26/09	20:45	SYST	10.0	20	-0.05	-0.3%	9.99	-0.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/26/09	21:25	SYST	10.0	20	-0.09	-0.5%	9.96	-0.2%	PASS
02/27/09	19:25	SYST	11.0	20	0.16	+0.8%	11.78	+3.9%	PASS
02/28/09	05:04	SYST	11.0	20	-0.02	-0.1%	10.96	-0.2%	PASS
03/01/09	05:04	SYST	11.0	20	-0.11	-0.6%	10.62	-1.9%	PASS
03/01/09	15:47	SYST	11.0	20	0.07	+0.4%	10.93	-0.4%	PASS
03/02/09	05:05	SYST	11.0	20	0.32	+1.6%	11.02	+0.1%	PASS
03/02/09	10:32	SYST	11.0	20	-0.05	-0.3%	11.01	+0.0%	PASS
03/03/09	05:05	SYST	11.0	20	0.05	+0.3%	11.13	+0.7%	PASS
03/04/09	05:05	SYST	11.0	20	0.03	+0.2%	11.11	+0.5%	PASS
03/05/09	05:05	SYST	11.0	20	0.06	+0.3%	10.83	-0.9%	PASS
03/06/09	05:05	SYST	11.0	20	0.08	+0.4%	10.79	-1.1%	PASS
03/07/09	05:05	SYST	11.0	20	0.03	+0.2%	11.14	+0.7%	PASS
03/08/09	05:05	SYST	11.0	20	0.01	+0.1%	11.27	+1.4%	PASS
03/09/09	05:05	SYST	11.0	20	-0.03	-0.2%	11.07	+0.4%	PASS
03/10/09	05:05	SYST	11.0	20	0.15	+0.8%	11.29	+1.5%	PASS
03/11/09	05:05	SYST	11.0	20	-0.08	-0.4%	10.83	-0.9%	PASS
03/12/09	05:05	SYST	11.0	20	-0.20	-1.0%	11.02	+0.1%	PASS
03/13/09	05:05	SYST	11.0	20	0.21	+1.1%	11.14	+0.7%	PASS
03/14/09	05:05	SYST	11.0	20	0.16	+0.8%	11.25	+1.3%	PASS
03/15/09	05:05	SYST	11.0	20	0.20	+1.0%	11.48	+2.4%	PASS
03/16/09	05:05	SYST	11.0	20	0.19	+1.0%	11.48	+2.4%	PASS
03/17/09	05:05	SYST	11.0	20	0.02	+0.1%	11.05	+0.3%	PASS
03/18/09	05:05	SYST	11.0	20	0.03	+0.2%	11.28	+1.4%	PASS
03/19/09	05:05	SYST	11.0	20	-0.01	-0.1%	11.14	+0.7%	PASS
03/20/09	05:05	SYST	11.0	20	-0.37	-1.9%	10.64	-1.8%	PASS
03/21/09	05:05	SYST	11.0	20	0.10	+0.5%	10.95	-0.3%	PASS
03/22/09	05:05	SYST	11.0	20	-0.26	-1.3%	-0.27	-56.4%	FAIL
03/22/09	12:40	SYST	11.0	20	-0.03	-0.2%	11.03	+0.1%	PASS
03/22/09	16:10	SYST	11.0	20	0.00	0.0%	11.02	+0.1%	PASS
03/23/09	11:00	SYST	11.0	20	-0.06	-0.3%	10.87	-0.7%	PASS
03/23/09	11:33	SYST	11.0	20	-0.08	-0.4%	10.78	-1.1%	PASS
03/23/09	12:25	SYST	11.0	20	-0.07	-0.4%	10.72	-1.4%	PASS
03/24/09	05:05	SYST	11.0	20	0.10	+0.5%	11.10	+0.5%	PASS
03/24/09	05:38	SYST	11.0	20	0.09	+0.5%	11.15	+0.8%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/24/09	06:10	SYST	11.0	20	0.10	+0.5%	11.20	+1.0%	PASS
03/24/09	06:42	SYST	11.0	20	0.09	+0.5%	11.13	+0.7%	PASS
03/24/09	07:14	SYST	11.0	20	0.09	+0.5%	11.14	+0.7%	PASS
03/24/09	07:46	SYST	11.0	20	0.09	+0.5%	11.19	+0.9%	PASS
03/24/09	08:18	SYST	11.0	20	0.09	+0.5%	11.20	+1.0%	PASS
03/24/09	08:50	SYST	11.0	20	0.10	+0.5%	11.17	+0.9%	PASS
03/25/09	05:05	SYST	11.0	20	-0.02	-0.1%	10.78	-1.1%	PASS
03/26/09	11:25	SYST	11.0	20	0.00	0.0%	11.08	+0.4%	PASS
03/27/09	07:36	SYST	11.0	20	-0.07	-0.4%	11.10	+0.5%	PASS
03/28/09	07:36	SYST	11.0	20	0.02	+0.1%	11.17	+0.9%	PASS
03/29/09	07:36	SYST	11.0	20	0.32	+1.6%	11.87	+4.4%	PASS
03/30/09	07:36	SYST	11.0	20	0.32	+1.6%	11.81	+4.1%	PASS
03/31/09	07:36	SYST	11.0	20	0.06	+0.3%	11.51	+2.6%	PASS
04/01/09	07:36	SYST	11.0	20	0.67	+3.4%	11.74	+3.7%	PASS
04/02/09	07:36	SYST	11.0	20	-0.54	-2.7%	10.28	-3.6%	PASS
04/02/09	10:41	SYST	11.0	20	-0.01	-0.1%	10.56	-2.2%	PASS
04/03/09	07:35	SYST	11.0	20	0.07	+0.4%	10.90	-0.5%	PASS
04/04/09	07:35	SYST	11.0	20	0.06	+0.3%	10.61	-2.0%	PASS
04/05/09	07:35	SYST	11.0	20	0.07	+0.4%	10.46	-2.7%	PASS
04/06/09	07:35	SYST	11.0	20	0.02	+0.1%	10.69	-1.6%	PASS
04/07/09	07:35	SYST	11.0	20	0.00	0.0%	10.66	-1.7%	PASS
04/08/09	07:35	SYST	11.0	20	0.02	+0.1%	10.75	-1.3%	PASS
04/09/09	07:35	SYST	11.0	20	0.05	+0.3%	10.78	-1.1%	PASS
04/10/09	07:35	SYST	11.0	20	0.03	+0.2%	11.43	+2.2%	PASS
04/11/09	07:35	SYST	11.0	20	0.10	+0.5%	11.37	+1.9%	PASS
04/12/09	07:35	SYST	11.0	20	0.14	+0.7%	11.67	+3.4%	PASS
04/13/09	07:35	SYST	11.0	20	0.11	+0.6%	11.69	+3.5%	PASS
04/14/09	07:35	SYST	11.0	20	0.02	+0.1%	10.83	-0.9%	PASS
04/15/09	07:35	SYST	11.0	20	0.03	+0.2%	11.32	+1.6%	PASS
04/16/09	07:35	SYST	11.0	20	0.08	+0.4%	11.11	+0.5%	PASS
04/16/09	18:35	SYST	11.0	20	0.06	+0.3%	10.99	-0.0%	PASS
04/17/09	07:35	SYST	11.0	20	0.21	+1.1%	11.03	+0.1%	PASS
04/17/09	10:57	SYST	11.0	20	-0.04	-0.2%	10.87	-0.7%	PASS
04/18/09	07:35	SYST	11.0	20	0.02	+0.1%	10.82	-0.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
04/18/09	20:35	SYST	11.0	20	-0.19	-1.0%	10.17	-4.2%	PASS
04/19/09	09:35	SYST	11.0	20	-0.11	-0.6%	10.22	-3.9%	PASS
04/19/09	22:35	SYST	11.0	20	-0.11	-0.6%	10.55	-2.3%	PASS
04/20/09	11:35	SYST	11.0	20	-0.13	-0.7%	10.29	-3.6%	PASS
04/20/09	20:45	SYST	11.0	20	-0.01	-0.1%	11.04	+0.2%	PASS
04/21/09	07:59	SYST	11.0	20	-0.01	-0.1%	11.06	+0.3%	PASS
04/22/09	07:35	SYST	11.0	20	0.08	+0.4%	11.44	+2.2%	PASS
04/22/09	17:00	SYST	11.0	20	-0.04	-0.2%	10.77	-1.2%	PASS
04/23/09	05:00	SYST	11.0	20	-0.16	-0.8%	10.87	-0.7%	PASS
04/24/09	04:00	SYST	11.0	20	1.88	+9.4%	11.28	+1.4%	FAIL
04/25/09	04:00	SYST	11.0	20	0.64	+3.2%	11.29	+1.5%	PASS
04/26/09	04:00	SYST	11.0	20	1.69	+8.5%	12.75	+8.8%	FAIL
04/27/09	04:00	SYST	11.0	20	0.78	+3.9%	11.46	+2.3%	PASS
04/28/09	04:00	SYST	11.0	20	0.55	+2.8%	12.21	+6.1%	FAIL
04/29/09	04:00	SYST	11.0	20	-0.01	-0.1%	10.99	-0.0%	PASS
04/29/09	14:09	SYST	11.0	20	0.17	+0.9%	4.98	-30.1%	FAIL
04/30/09	04:00	SYST	11.0	20	-1.22	-6.1%	-0.50	-57.5%	FAIL
05/01/09	15:31	SYST	11.0	20	-0.01	-0.1%	11.02	+0.1%	PASS
05/02/09	04:00	SYST	11.0	20	-0.10	-0.5%	11.07	+0.4%	PASS
05/03/09	04:00	SYST	11.0	20	-0.06	-0.3%	10.91	-0.4%	PASS
05/04/09	04:00	SYST	11.0	20	-0.01	-0.1%	11.16	+0.8%	PASS
05/05/09	04:00	SYST	11.0	20	0.00	0.0%	11.01	+0.0%	PASS
05/06/09	04:00	SYST	11.0	20	-0.01	-0.1%	10.87	-0.7%	PASS
05/07/09	04:00	SYST	11.0	20	-0.03	-0.2%	10.82	-0.9%	PASS
05/08/09	04:00	SYST	11.0	20	-0.01	-0.1%	10.98	-0.1%	PASS
05/09/09	04:00	SYST	11.0	20	0.03	+0.2%	11.05	+0.3%	PASS
05/10/09	04:00	SYST	11.0	20	0.06	+0.3%	10.86	-0.7%	PASS
05/11/09	04:00	SYST	11.0	20	0.09	+0.5%	11.08	+0.4%	PASS
05/12/09	04:00	SYST	11.0	20	0.11	+0.6%	11.07	+0.4%	PASS
05/13/09	04:00	SYST	11.0	20	0.00	0.0%	10.85	-0.8%	PASS
05/14/09	04:00	SYST	11.0	20	-0.03	-0.2%	10.66	-1.7%	PASS
05/15/09	04:00	SYST	11.0	20	0.00	0.0%	11.35	+1.8%	PASS
05/16/09	04:00	SYST	11.0	20	0.04	+0.2%	11.23	+1.2%	PASS
05/17/09	04:00	SYST	11.0	20	0.05	+0.3%	11.44	+2.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/18/09	04:00	SYST	11.0	20	0.06	+0.3%	11.56	+2.8%	PASS
05/19/09	04:00	SYST	11.0	20	-0.01	-0.1%	11.17	+0.9%	PASS
05/20/09	04:00	SYST	11.0	20	0.01	+0.1%	10.85	-0.8%	PASS
05/21/09	04:00	SYST	11.0	20	-0.02	-0.1%	11.17	+0.9%	PASS
05/22/09	04:00	SYST	11.0	20	0.05	+0.3%	11.42	+2.1%	PASS
05/22/09	17:00	SYST	11.0	20	0.16	+0.8%	11.02	+0.1%	PASS
05/23/09	04:00	SYST	11.0	20	0.26	+1.3%	10.99	-0.0%	PASS
05/24/09	04:00	SYST	11.0	20	0.32	+1.6%	11.03	+0.1%	PASS
05/25/09	04:00	SYST	11.0	20	0.40	+2.0%	11.14	+0.7%	PASS
05/26/09	04:00	SYST	11.0	20	0.49	+2.5%	11.11	+0.5%	PASS
05/26/09	20:53	SYST	11.0	20	-0.03	-0.2%	10.82	-0.9%	PASS
05/27/09	04:00	SYST	11.0	20	0.11	+0.6%	11.27	+1.4%	PASS
05/28/09	04:00	SYST	11.0	20	0.02	+0.1%	10.82	-0.9%	PASS
05/29/09	04:00	SYST	11.0	20	0.03	+0.2%	10.86	-0.7%	PASS
05/30/09	04:00	SYST	11.0	20	0.05	+0.3%	11.03	+0.1%	PASS
05/31/09	04:00	SYST	11.0	20	0.10	+0.5%	11.18	+0.9%	PASS
06/01/09	04:00	SYST	11.0	20	0.00	0.0%	11.05	+0.3%	PASS
06/02/09	04:00	SYST	11.0	20	0.16	+0.8%	11.24	+1.2%	PASS
06/02/09	16:45	SYST	11.0	20	0.02	+0.1%	10.78	-1.1%	PASS
06/03/09	10:08	SYST	11.0	20	0.07	+0.4%	11.01	+0.0%	PASS
06/03/09	14:04	SYST	Calibrator Error						
06/04/09	04:00	SYST	Calibrator Error						
06/05/09	04:00	SYST	Calibrator Error						
06/05/09	13:10	SYST	11.0	20	-0.01	-0.1%	11.04	+0.2%	PASS
06/05/09	22:13	SYST	5.0	20	-0.01	-0.1%	4.91	-0.4%	PASS
06/06/09	04:00	SYST	5.0	20	-0.01	-0.1%	4.93	-0.4%	PASS
06/07/09	04:00	SYST	5.0	20	0.03	+0.2%	5.01	+0.0%	PASS
06/08/09	04:00	SYST	5.0	20	0.11	+0.6%	5.01	+0.0%	PASS
06/09/09	04:00	SYST	11.0	20	0.00	0.0%	10.99	-0.0%	PASS
06/10/09	04:00	SYST	11.0	20	0.08	+0.4%	11.24	+1.2%	PASS
06/10/09	14:45	SYST	11.0	20	2.33	+11.7%	11.17	+0.9%	FAIL
06/11/09	04:00	SYST	11.0	20	0.03	+0.2%	11.20	+1.0%	PASS
06/12/09	04:00	SYST	11.0	20	0.15	+0.8%	11.30	+1.5%	PASS
06/13/09	04:00	SYST	11.0	20	-0.01	-0.1%	11.29	+1.5%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
06/14/09	04:00	SYST	11.0	20	0.00	0.0%	11.11	+0.5%	PASS
06/15/09	04:00	SYST	11.0	20	0.00	0.0%	11.06	+0.3%	PASS
06/16/09	04:00	SYST	11.0	20	0.01	+0.1%	11.53	+2.7%	PASS
06/17/09	04:00	SYST	11.0	20	0.03	+0.2%	10.75	-1.3%	PASS
06/18/09	04:00	SYST	11.0	20	-0.02	-0.1%	10.78	-1.1%	PASS
06/19/09	04:00	SYST	11.0	20	-0.03	-0.2%	10.78	-1.1%	PASS
06/20/09	04:00	SYST	11.0	20	-0.09	-0.5%	10.52	-2.4%	PASS
06/21/09	04:00	SYST	11.0	20	-0.05	-0.3%	10.57	-2.2%	PASS
06/22/09	04:00	SYST	11.0	20	0.05	+0.3%	10.70	-1.5%	PASS
06/23/09	04:00	SYST	11.0	20	0.00	0.0%	11.04	+0.2%	PASS
06/24/09	04:00	SYST	11.0	20	0.05	+0.3%	11.13	+0.7%	PASS
06/25/09	04:00	SYST	11.0	20	0.10	+0.5%	11.84	+4.2%	PASS
06/26/09	04:00	SYST	11.0	20	0.00	0.0%	10.57	-2.2%	PASS
06/27/09	04:00	SYST	11.0	20	0.05	+0.3%	10.84	-0.8%	PASS
06/28/09	04:00	SYST	11.0	20	0.04	+0.2%	10.40	-3.0%	PASS
06/29/09	04:00	SYST	11.0	20	0.09	+0.5%	10.44	-2.8%	PASS
06/30/09	04:00	SYST	11.0	20	0.06	+0.3%	11.21	+1.1%	PASS
07/01/09	04:00	SYST	11.0	20	0.08	+0.4%	11.37	+1.9%	PASS
07/02/09	04:00	SYST	11.0	20	0.01	+0.1%	11.11	+0.5%	PASS
07/03/09	04:00	SYST	11.0	20	0.07	+0.4%	5.84	-25.8%	FAIL
07/04/09	04:00	SYST	6.9	20	0.11	+0.6%	11.15	+21.1%	FAIL
07/05/09	04:00	SYST	11.0	20	0.09	+0.5%	16.02	+24.9%	FAIL
07/06/09	04:00	SYST	11.0	20	0.11	+0.6%	11.09	+0.4%	PASS
07/07/09	04:00	SYST	11.0	20	0.11	+0.6%	11.23	+1.2%	PASS
07/08/09	04:00	SYST	11.0	20	0.24	+1.2%	11.46	+2.3%	PASS
07/09/09	04:00	SYST	11.0	20	-0.05	-0.3%	10.80	-1.0%	PASS
07/10/09	04:00	SYST	11.0	20	-0.09	-0.5%	11.25	+1.3%	PASS
07/11/09	No Calibration Check								
07/12/09	Blowback Mode – No Calibration Check								
07/13/09	Blowback Mode – No Calibration Check								
07/14/09	Maintenance Activities – No Calibration Check								
07/15/09	Maintenance Activities – No Calibration Check								
07/16/09	Maintenance Activities – No Calibration Check								
07/17/09	04:00	SYST	10.0	20	-0.15	-0.8%	10.18	+0.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/18/09	04:00	SYST	11.0	20	-0.22	-1.1%	11.50	+2.5%	PASS
07/19/09	04:00	SYST	11.0	20	-0.21	-1.1%	11.78	+3.9%	PASS
07/20/09	04:00	SYST	11.0	20	-0.25	-1.3%	11.83	+4.2%	PASS
07/21/09	04:00	SYST	11.0	20	-0.03	-0.2%	11.09	+0.4%	PASS
07/22/09	04:00	SYST	11.0	20	0.01	+0.1%	11.24	+1.2%	PASS
07/23/09	04:00	SYST	11.0	20	-0.03	-0.2%	11.31	+1.6%	PASS
07/23/09	16:40	SYST	11.0	20	-0.01	-0.1%	10.88	-0.6%	PASS
07/24/09	10:40	SYST	11.0	20	0.00	0.0%	11.08	+0.4%	PASS
07/25/09	04:00	SYST	11.0	20	0.06	+0.3%	11.47	+2.4%	PASS
07/26/09	04:00	SYST	11.0	20	0.06	+0.3%	11.59	+3.0%	PASS
07/27/09	04:00	SYST	11.0	20	0.10	+0.5%	11.74	+3.7%	PASS
07/28/09	04:00	SYST	11.0	20	0.02	+0.1%	10.75	-1.3%	PASS
07/29/09	04:00	SYST	11.0	20	-0.01	-0.1%	10.82	-0.9%	PASS
07/30/09	04:00	SYST	11.0	20	0.08	+0.4%	11.34	+1.7%	PASS
07/31/09	04:00	SYST	11.0	20	0.17	+0.9%	11.38	+1.9%	PASS
08/01/09	04:00	SYST	11.0	20	-0.07	-0.4%	10.85	-0.8%	PASS
08/02/09	04:00	SYST	11.0	20	-0.07	-0.3%	10.90	-0.5%	PASS
08/03/09	04:00	SYST	11.0	20	-0.05	-0.2%	10.82	-0.9%	PASS
08/04/09	04:00	SYST	11.0	20	-0.02	-0.1%	10.91	-0.5%	PASS
08/05/09	04:00	SYST	11.0	20	0.06	+0.3%	11.13	+0.6%	PASS
08/05/09	14:00	SYST	11.0	20	0.04	+0.2%	10.96	-0.2%	PASS
08/06/09	04:00	SYST	11.0	20	0.21	+1.1%	11.17	+0.9%	PASS
08/07/09	04:00	SYST	11.0	20	0.21	+1.1%	11.17	+0.9%	PASS
08/08/09	04:00	SYST	11.0	20	0.08	+0.4%	11.32	+1.6%	PASS
08/09/09	04:00	SYST	11.0	20	0.14	+0.7%	11.07	+0.3%	PASS
08/10/09	04:00	SYST	11.0	20	0.04	+0.2%	10.95	-0.2%	PASS
08/11/09	04:00	SYST	11.0	20	0.10	+0.5%	11.14	+0.7%	PASS
08/12/09	04:00	SYST	11.0	20	-0.04	-0.2%	11.07	+0.3%	PASS
08/13/09	04:00	SYST	11.0	20	-0.08	-0.4%	10.72	-1.4%	PASS
08/14/09	04:00	SYST	11.0	20	-0.07	-0.3%	11.11	+0.6%	PASS
08/15/09	04:00	SYST	11.0	20	0.00	0.0%	11.13	+0.7%	PASS
08/16/09	04:00	SYST	11.0	20	0.02	+0.1%	10.96	-0.2%	PASS
08/17/09	04:00	SYST	11.0	20	0.07	+0.4%	11.09	+0.4%	PASS
08/18/09	04:00	SYST	11.0	20	-0.24	-1.2%	11.08	+0.4%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/19/09	04:00	SYST	11.0	20	0.00	0.0%	11.02	+0.1%	PASS
08/20/09	04:00	SYST	11.0	20	0.02	+0.1%	11.26	+1.3%	PASS
08/21/09	04:00	SYST	11.0	20	0.08	+0.4%	11.15	+0.8%	PASS
08/22/09	04:00	SYST	11.0	20	0.03	+0.1%	11.04	+0.2%	PASS
08/23/09	04:00	SYST	11.0	20	0.05	+0.3%	12.08	+5.4%	FAIL
08/24/09	04:00	SYST	11.0	20	0.12	+0.6%	12.19	+5.9%	FAIL
08/25/09	04:00	SYST	11.0	20	0.15	+0.7%	12.42	+7.1%	FAIL
08/26/09	04:00	SYST	11.0	20	0.20	+1.0%	11.59	+2.9%	PASS
08/27/09	04:00	SYST	11.0	20	-0.09	-0.5%	11.08	+0.4%	PASS
08/28/09	04:00	SYST	11.0	20	-0.02	-0.1%	11.25	+1.2%	PASS
08/29/09	04:00	SYST	11.0	20	-0.03	-0.2%	11.00	0.0%	PASS
08/30/09	04:00	SYST	11.0	20	-1.20	-6.0%	26.17	+75.9%	FAIL
08/31/09	04:00	SYST	11.0	20	-1.35	-6.8%	25.96	+74.8%	FAIL
09/01/09	00:03	SYST	11.0	20	-1.34	-6.7%	26.49	+77.4%	FAIL
09/01/09	04:00	SYST	11.0	20	0.04	+0.2%	4.70	-31.5%	FAIL
09/01/09	13:10	SYST	11.0	20	0.01	+0.1%	4.78	-31.1%	FAIL
09/02/09	12:12	SYST	11.0	20	0.06	+0.3%	10.51	-2.5%	PASS
09/03/09	04:00	SYST	11.0	20	-0.03	-0.2%	10.86	-0.7%	PASS
09/04/09	04:00	SYST	11.0	20	-0.03	-0.1%	11.06	+0.3%	PASS
09/05/09	04:00	SYST	11.0	20	-0.02	-0.1%	11.06	+0.3%	PASS
09/06/09	04:00	SYST	11.0	20	0.00	+0.0%	10.77	-1.2%	PASS
09/07/09	04:00	SYST	11.0	20	-0.02	-0.1%	10.90	-0.5%	PASS
09/08/09	04:00	SYST	11.0	20	-0.02	-0.1%	11.07	+0.3%	PASS
09/09/09	04:00	SYST	11.0	20	-0.01	-0.1%	11.14	+0.7%	PASS
09/10/09	04:00	SYST	11.0	20	0.05	+0.2%	11.15	+0.7%	PASS
09/11/09	04:00	SYST	11.0	20	0.05	+0.3%	11.18	+0.9%	PASS
09/12/09	04:00	SYST	11.0	20	0.02	+0.1%	11.10	+0.5%	PASS
09/13/09	04:00	SYST	11.0	20	0.04	+0.2%	11.06	+0.3%	PASS
09/14/09	04:00	SYST	11.0	20	0.03	+0.2%	11.08	+0.4%	PASS
09/15/09	04:00	SYST	11.0	20	0.01	+0.1%	11.11	+0.5%	PASS
09/16/09	04:00	SYST	11.0	20	0.02	+0.1%	10.99	+0.0%	PASS
09/17/09	04:00	SYST	11.0	20	0.02	+0.1%	11.23	+1.2%	PASS
09/18/09	04:00	SYST	11.0	20	0.04	+0.2%	11.29	+1.5%	PASS
09/19/09	04:00	SYST	11.0	20	0.04	+0.2%	10.97	-0.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
09/20/09	04:00	SYST	11.0	20	0.05	+0.2%	11.09	+0.5%	PASS
09/21/09	04:00	SYST	11.0	20	0.05	+0.3%	11.10	+0.5%	PASS
09/22/09	04:00	SYST	11.0	20	0.06	+0.3%	11.04	+0.2%	PASS
09/23/09	04:00	SYST	11.0	20	0.04	+0.2%	10.99	-0.1%	PASS
09/24/09	04:00	SYST	11.0	20	0.11	+0.5%	11.11	+0.5%	PASS
09/25/09	04:00	SYST	11.0	20	-0.02	-0.1%	11.06	+0.3%	PASS
09/26/09	04:00	SYST	11.0	20	-0.02	-0.1%	11.15	+0.7%	PASS
09/27/09	04:00	SYST	11.0	20	0.03	+0.1%	11.04	+0.2%	PASS
09/28/09	04:00	SYST	11.0	20	0.00	+0.0%	10.82	-0.9%	PASS
09/29/09	04:00	SYST	11.0	20	-0.01	+0.0%	10.49	-2.6%	PASS
09/30/09	04:00	SYST	11.0	20	0.21	+1.1%	11.17	+0.9%	PASS

Appendix M. Inlet CEMS Monthly Maintenance Records

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _January 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _56_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
01/01/08 14:01		Updated calibration factors
01/03/08 13:31		Updated calibration factors
01/06/08 07:56	01/07/08 15:09 (31 hr)	Failed calibration checks Switch sampling to total U9/U7 Passed calibration check on 1/7
01/08/08 16:14		Updated calibration factors
01/10/08 14:21	01/11/08 07:56 (18 hr)	Failed calibration check Passed calibration check on 1/11
01/11/08 17:06		Updated calibration factors
01/15/08 13:54		Updated calibration factors
01/17/08 16:22		Updated calibration factors
01/21/08 16:55		Updated calibration factors
01/23/08 07:59	01/23/08 14:21 (7 hr)	Failed calibration check Manual recalibration Passed calibration check
01/25/08 13:09		Updated calibration factors
01/28/08 16:51		Updated calibration factors
01/30/08 14:07		Updated calibration factors
01/30/08 12:45		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _February 2008_
Number of Operating Hours in the month _696_
Number of Downtime Hours in the month _74_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
02/04/08 15:03		Updated calibration factors
02/06/08 12:38		Updated calibration factors
02/11/08 16:21		Updated calibration factors
02/13/08 16:55		Updated calibration factors
02/17/08 07:55	02/18/08 07:55 (24 hr)	Failed calibration check Switch sampling to U7 total/elem Passed calibration check on 2/18
02/18/08 11:44	02/19/08 07:55 (21 hr)	Manual recalibration Not followed by passing cal chk Passed calibration check on 2/19
02/20/08 13:42	02/20/07 15:42 (3 hr)	Manual recalibration Passed calibration check Updated calibration factors
02/21/08 13:21		Updated calibration factors
02/22/08 14:07		Updated calibration factors
02/24/08 07:55	02/25/08 07:55 (24 hr)	Failed calibration check Passed calibration check on 2/25
02/25/08 18:14		Updated calibration factors
02/26/08 12:42		Updated calibration factors
02/26/08 15:44	02/26/08 17:04 (2 hr)	Manual recalibration Updated calibration factors Passed calibration check
02/28/08 12:21		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _March 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _163_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
03/03/08 17:25		Updated calibration factors
03/05/08 16:53		Updated calibration factors
03/06/08 13:13		Updated calibration factors
03/10/08 13:30		Updated calibration factors
03/12/08 13:34		Updated calibration factors
03/14/08 11:06		Updated calibration factors
03/17/08 13:23		Updated calibration factors
03/19/08 11:58		Updated calibration factors
03/24/07 14:17	03/24/07 15:26 (2 hr)	Switch sampling to total U9/U7 Manual recalibration Passed calibration check
03/25/08 09:34	03/31/08 10:02 (145 hr)	Communication error Data not collected / data missing
03/31/07 07:54	03/31/07 23:59 (16 hr)	Failed calibration check No communication since 3/25 OOC to End of Month

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _April 2008_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _346_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
04/01/08 0:00	04/15/08 8:00 (344 hr)	OOC at Start of Month Failed calibration checks System reboot, default to U8 4/8 No communication until 4/10 Switch sampling to U8 total/elem Manual recalibration on 4/11 PMT voltage adjustment on 4/14 Manual recalibrations on 4/14 Passed calibration check on 4/15
04/16/08 11:14		Updated calibration factors
04/16/08 15:07		Updated calibration factors
04/16/08 16:04	04/16/08 17:34 (2 hr)	Manual recalibration Passed calibration check
04/17/08 12:05		Updated calibration factors Umbilical temperature to 120°C
04/21/08 14:12		Updated calibration factors
04/24/08 11:18		Updated calibration factors
04/28/08 13:12		Updated calibration factors
04/30/08 10:08	04/30/08 11:34 (0 hr)	Linearity check passed

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _May 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _282_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
05/01/08 13:06		Updated calibration factors
05/05/08 15:44		Updated calibration factors
05/08/08 17:36		Updated calibration factors
05/09/08 13:24	05/14/08 17:35 (125 hr)	Manual recalibrations Failed calibration check on 5/14 Manual recalibration on 5/14 Passed calibration check on 5/14
05/15/08 11:04		Updated calibration factors
05/19/08 13:09		Updated calibration factors
05/20/08 11:59	05/22/08 8:00 (44 hr)	Switch sampling U7 total/elem Failed calibration check Lamp replacement on 5/20 PMT voltage adjustment on 5/21 Manual recalibration Passed calibration check on 5/22 Eductor pressure is off 5/20 *
05/23/08 12:50	05/23/08 13:56 (1 hr)	Manual recalibration Passed calibration check
05/25/08 8:01	05/28/08 8:01 (72 hr)	Failed calibration checks Passed calibration check on 5/28
05/30/08 8:01	05/31/08 23:59 (40 hr)	Failed calibration checks OOC to End of Month

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _June 2008_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _107_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
06/01/08 0:00	06/03/08 10:34 (59 hr)	OOC at Start of Month Failed calibration checks Passed calibration check on 6/3
06/03/08 15:05		Updated calibration factors
06/05/08 12:05		Updated calibration factors
06/09/08 11:46		Updated calibration factors
06/12/08 10:24		Updated calibration factors
06/16/08 17:05		Updated calibration factors
06/19/08 10:20		Updated calibration factors
06/23/08 10:38		Updated calibration factors
06/24/08 8:01	06/26/08 8:01 (48 hr)	Invalid calibration check (fail) Failed calibration check on 6/25 Passed calibration check on 6/26
06/27/08 10:00		Updated calibration factors
06/30/08 11:29		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _July 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _168_
Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
7/3/08 10:10		Updated calibration factors
7/7/08 11:00		Updated calibration factors
7/14/08 9:53		Updated calibration factors
7/16/08 9:33		Updated calibration factors
7/21/08 10:52		Updated calibration factors
7/22/08 8:35	7/29/08 8:01 (168 hr)	System offline, ADA Sorb Screen Recalibration and pass check

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _August 2008_
Number of Operating Hours in the month _696_
Number of Downtime Hours in the month _137_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
8/1/08 7:26	8/2/08 8:01 (25 hr)	Mercury Lamp Replacement Switch sample to Unit 9 Hgt only Recalibration and pass check
8/4/08 10:46		Updated calibration factors
8/7/08 12:04		Updated calibration factors
8/12/08 14:22	8/13/08 17:16 (28 hr)	Switch sample to Unit 8 Hgt/Hg0 Recalibration and failed check Recalibration and pass check
8/14/08 12:51		Updated calibration factors
8/14/08 16:49	8/14/08 17:22 (1 hr)	Manual recal and pass check
8/15/08 11:35		Updated calibration factors
8/17/08 8:01	8/20/08 18:12 (83 hr)	Actuator valve failure Switch sample to Unit 9 Hgt only Updated cal factors & pass check
8/25/08 13:39		Updated calibration factors
8/27/08 16:30		Updated calibration factors
8/29/08 11:57		Updated calibration factors

Name of technician filling report _EZ_

Comments:
Unit 9 offline from 8/22/08 21:00 to 8/24/08 21:00 (-48 from Op Hrs)

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _September 2008_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _276_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
9/2/08 16:01		Updated calibration factors
9/10/08 14:55		Updated calibration factors
9/11/08 7:17	9/13/08 8:02 (48 hr)	Switch sample to Unit 8 Hgt/Hg0 Recalibrations / Repairs Recalibration and pass check
9/15/08 14:31		Updated calibration factors
9/16/08 10:36		Updated calibration factors
9/18/08 14:58		Updated calibration factors
9/19/08 12:44	9/20/08 8:02 (20 hr)	Manual recalibration failed Calibrator Temperature Fail Self-corrected, pass cal check
9/21/08 7:43	9/22/08 8:02 (24 hr)	Failed calibration check Passed calibration check
9/23/08 8:02	9/30/08 23:59 (184 hr)	Actuator valve failure OOC to End of Month

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _October 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _296_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
10/1/08 0:00	10/1/08 16:52 (17 hr)	OOC at Start of Month Recalibrated and pass check
10/2/08 12:20	10/3/08 17:42 (30 hr)	Updated cal factors (incorrect) Failed cal check 10/3 Updated cal factors (correct) Passed cal check
10/6/08 16:40		Updated calibration factors
10/8/08 15:09		Updated calibration factors
10/9/08 8:53	10/13/08 15:39 (103 hr)	System offline (maintenance) Mercury Lamp Replaced Actuator valve repair/clean Switch sample to Unit 8 Hgt/Hg0 Switch sample to Unit 9 Hgt only Recalibrated and pass check
10/15/08 10:23		Updated calibration factors
10/16/08 13:14		Updated calibration factors
10/20/08 15:27		Updated calibration factors
10/21/08 13:52	10/27/08 14:59 (145 hr)	PMT voltage adjustment Maintenance activities System offline, ADA Sorb Screen Switch sample to Unit 8 Hgt/Hg0 Recalibrated and pass check
10/30/08 11:35	10/30/08 12:07 (1 hr)	Manual Recal and pass check
10/31/08 11:17		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _November 2008_
Number of Operating Hours in the month _637_
Number of Downtime Hours in the month _175_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
11/2/08 8:03	11/3/08 8:03 (24 hr)	Failed calibration check Passed calibration check
11/3/08 7:58	11/4/08 18:13 (11 hr)	Unit 8 probe heater failed Failed calibration check Switch sample to Unit 9 Hgt only Recalibrated and pass check
11/5/08 10:41		Updated calibration factors
11/10/08 15:37		Updated calibration factors
11/12/08 16:09		Updated calibration factors
11/17/08 15:31		Updated calibration factors
11/19/08 8:03	11/19/08 16:06 (8 hr)	Failed calibration check Recalibrated and pass check
11/20/08 14:30		Linearity Check
11/25/08 11:45	While U9 off (0 hr)	Unit 9 offline 11/22 Unit 9 probe heater failed 11/25
11/25/08 12:12	11/30/08 23:59 (132 hr)	Switch sample to Unit 7 11/25 Unit 7 probe heater broken No operational probes to switch

Name of technician filling report _EZ_

Comments:
Unit 9 offline from 11/22/08 0:52 to End of Month but switched to Unit 7 probe at 11/25/08 12:12. (-83 from Op Hrs)

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _December 2008_
Number of Operating Hours in the month _563_
Number of Downtime Hours in the month _246_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
12/1/08 0:00	While U7 off (0 hr)	Unit 7 probe heater broken
12/2/08 2:32	12/2/08 23:59 (21 hr)	System maintenance all probes Probe cleanings and rebuild
12/3/08 0:00	12/9/08 9:37 (0 hr)	While U7 Offline System maintenance all probes Probe cleanings and rebuild
12/9/08 8:13	12/15/08 15:57 (152 hr)	Failed calibration check Switch sample to Unit 8 System offline: ADA Sorb Screen
12/17/08 15:08	12/19/08 15:13 (49 hr)	Mercury Lamp replaced Failed calibration check Unit 7 Controller Comm Error Switch sample to Unit 8 Hgt only Recalibration and pass check
12/22/08 12:20		Updated calibration factors
12/26/08 12:14		Updated calibration factors
12/27/08 8:13	12/28/08 8:13 (24 hr)	Failed calibration check Passed calibration check

Name of technician filling report _EZ_

Comments:
Unit 7 offline from 12/1/08 0:00 to 12/1/08 2:32 (-3 from Op Hrs)
Unit 7 online from 12/1/08 2:32 to 12/1/08 23:59
Unit 7 offline from 12/2/08 0:00 to 12/9/08 9:37 (-178 from Op Hrs)

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _January 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _76_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
1/2/09 8:13	1/4/09 8:13 (48 hr)	Failed calibration checks Passed calibration checks
1/5/09 20:29		Updated calibration factors
1/12/09 15:03		Updated calibration factors
1/14/09 22:03		Updated calibration factors
1/16/09 13:45		Updated calibration factors
1/21/09 11:05		Updated calibration factors
1/23/09 12:26		Updated calibration factors
1/26/09 20:06		Updated calibration factors
1/27/09 16:53	1/27/09 17:24 (1 hr)	Recalibration and pass check
1/29/09 0:45	1/30/09 0:33 (25 hr)	Maintenance on U9 probe (clean) affected cal on Unit 8 probe
1/30/09 8:43	1/30/09 10:39 (2 hr)	Failed calibration check Recalibration and pass check
1/30/09 23:40		Update calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _February 2009_
Number of Operating Hours in the month _629_
Number of Downtime Hours in the month _37_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
2/2/09 17:13		Updated calibration factors
2/4/09 14:20		Updated calibration factors
2/5/09 14:02	2/5/09 17:02 (3 hr)	Recalibrated and pass check
2/9/09 20:07		Updated calibration factors
2/10/09 15:53	2/11/09 8:02 (16 hr)	Switch sample to Unit 7 Recalibrated and pass check
2/11/09 13:32	2/11/09 15:15 (3 hr)	Switch sample to Unit 8 Recalibrated and pass check
2/13/09 18:11		Updated calibration factors
2/16/09 11:35		Updated calibration factors
2/20/09 6:35		Updated calibration factors
2/21/09 6:05	2/21/09 8:04 (2 hr)	Failed calibration check Cal factor update and pass check
2/23/09 2:09	2/23/09 2:50 (1 hr)	Failed calibration check Cal factor update and pass check
2/24/09 5:51		Updated calibration factors
2/25/09 6:05		Updated calibration factors
2/26/09 10:05	2/26/09 21:54 (12 hr)	Switch sample to Unit 7 Recalibration and pass check
2/27/09 20:03		Updated calibration factors

Name of technician filling report _EZ_

Comments:
Unit offline from 2/14/08 11:29 to 2/16/08 8:49 (-43 from Op Hrs)

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _March 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _58_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
3/1/09 14:21	3/1/09 16:16 (3 hr)	Probe switch to Unit 9 Recalibration and pass check
3/2/09 9:42	3/2/09 11:01 (2 hr)	Probe switch correction Recalibration and pass check
3/4/09 13:29		Update calibration factors
3/6/09 15:16		Update calibration factors
3/9/09 22:26		Update calibration factors
3/10/09 14:35		Update calibration factors
3/12/09 12:36		Update calibration factors
3/13/09 10:46		Update calibration factors
3/13/09 14:05		Linearity check
3/16/09 16:44		Update calibration factors
3/19/09 10:39		Update calibration factors
3/20/09 11:08		Update calibration factors
3/21/09 7:14	3/21/09 13:09 (31 hr)	Shelter power interrupt; offline Passed calibration check
3/22/09 14:19	3/22/09 16:39 (3 hr)	Maintenance cal from power out Recalibration and pass check
3/23/09 15:27		Update calibration factors
3/24/09 5:05	3/24/09 9:40 (5 hr)	System stuck in cal loop
3/24/09 12:29		Update calibration factors
3/24/09 16:06	3/25/09 5:34 (14 hr)	Maintenance cal from cal loop Recalibration and pass check
3/25/09 9:18		Update calibration factors
3/26/09 12:07		Update calibration factors
3/30/09 16:08		Update calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _April 2009_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _301_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
4/1/09 8:05	4/2/09 11:10 (27 hr)	Switch probe U9/U7 to U9 tot/elem Failed calibration checks Maintenance (tubing) Manual recalibration Passed calibration check
4/6/09 16:57		Updated calibration factors
4/9/09 14:52		Updated calibration factors
4/13/09 9:50		Updated calibration factors
4/16/09 11:00		Updated calibration factors
4/16/09 15:43	4/16/09 19:04 (3 hr)	Switch probe to U8 tot/elem Manual recalibration Passed calibration check
4/17/09 8:04	4/17/09 11:30 (4 hr)	Failed calibration check Manual recalibration Passed calibration check
4/18/09 8:04	4/20/09 21:05 (61 hr)	Failed calibration checks Error in elemental calibration Manual recal, pass cal check
4/22/09 10:00	4/30/09 23:59 (206 hr)	**Est Start Sorbent Screening** Manual recalibration Failed calibration checks End Sorbent Screening (4/29) Replaced mercury lamp (4/29) Switch probe to U8 tot/elem PMT voltage adjusted (4/30) Manual recalibration (4/30) OOC to End of Month

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _May 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _21_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
5/1/09 0:00	5/1/09 15:51 (16 hr)	OOC at Start of Month Switch probe to U9 tot/elem Manual recalibration Passed calibration check
5/7/09 12:45		Updated calibration factors
5/12/09 12:44		Updated calibration factors
5/14/09 13:23		Updated calibration factors
5/18/09 15:52		Updated calibration factors
5/20/09 15:10		Updated calibration factors
5/22/09 11:19		Updated calibration factors
5/22/09 15:02	5/22/09 17:33 (3 hr)	Switch probe to U7 total only Manual recalibration Passed calibration check
5/26/09 20:20	5/26/09 21:13 (2 hr)	Manual recalibration Passed calibration check
5/27/09 12:46		Updated calibration factors
5/29/09 15:19		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _June 2009_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _95_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
6/2/09 16:41		Updated calibration factors
6/2/09 17:14	6/5/09 13:39 (69 hr)	Failed calibration check Config change to U7 tot/elem Calibrator error (6/3) Calibrator repair (6/5) Manual recalibration Passed calibration check
6/5/09 13:54	6/5/09 22:33 (9 hr)	Switch probe to U9 tot/elem Manual recalibration Passed calibration check
6/8/09 21:33		Updated calibration factors
6/10/09 12:07	6/11/09 4:29 (17 hr)	Switch probe to U7 tot/elem Failed calibration check Updated calibration factors Passed calibration check
6/12/09 10:33		Updated calibration factors
6/12/09 12:04	6/12/09 13:37	Passed linearity check
6/16/09 14:39		Updated calibration factors
6/18/09 12:58		Updated calibration factors
6/22/09 15:04		Updated calibration factors
6/25/09 12:03		Updated calibration factors
6/29/09 20:04		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _July 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _181_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
7/1/09 12:41		Updated calibration factors Sampling Unit 7 total/elem
7/3/09 4:29	7/6/09 4:29 (73 hr)	Failed calibration checks Passed calibration check on 7/6
7/6/09 13:39		Updated calibration factors
7/8/09 13:39		Updated calibration factors
7/10/09 10:49		Updated calibration factors
7/11/09 4:29	7/12/09 4:29 (25 hr)	Fail cal chk (calibrator error) Passed calibration check on 7/12
7/13/09 8:00	7/16/09 4:29 (69 hr)	Maintenance activities Cleaning mercury probe Sampling Unit 8 total/elem
7/16/09 8:58	7/16/09 10:12 (1 hr)	Manual recalibration Passed calibration check
7/16/09 12:23	7/16/09 13:36 (2 hr)	Manual recalibration Passed calibration check
7/20/09 18:05		Updated calibration factors
7/23/09 11:51		Updated calibration factors
7/23/09 15:24	7/23/09 17:09 (1 hr)	Switch to Unit 9 total only Updated calibration factors Manual recalibration Passed calibration check
7/27/09 22:09		Updated calibration factors
7/29/09 22:47		Updated calibration factors
7/31/09 10:16		Updated calibration factors
7/31/09 13:56	7/31/09 23:59 (10 hr)	Manual recalibrations Switch to Unit 8 total only OOC to End of Month

Name of technician filling report _EZ_
Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _August 2009_
Number of Operating Hours in the month _671_
Number of Downtime Hours in the month _84_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
8/1/09 0:00	8/1/09 4:29 (5 hr)	OOC at Start of Month Passed calibration check
8/5/09 11:15	8/5/09 14:29 (4 hr)	Switch to Unit 7 total only Manual recalibration Passed calibration check
8/6/09 10:15		Updated calibration factors
8/10/09 10:52		Updated calibration factors
8/13/09 13:08		Updated calibration factors
8/17/09 11:42		Switch to Unit 9 total only Updated calibration factors No down time, used prev factors
8/20/09 13:08		Updated calibration factors
8/24/09 22:45	8/25/09 4:29 (7 hr)	Unit 9 offline 8/21 (16hr valid) Fail calibration checks (offline) Unit 9 online 8/24 (+8hr grace)
8/29/09 4:29	8/31/09 23:59 (68 hr)	Mercury lamp replaced 9/28 Switch to Unit 8 total/elem Failed calibration checks PMT voltage adjustment on 8/31 Eductor pressure off OOC to End of Month

Name of technician filling report _EZ_

Comments:
Unit 8 offline 8/16 7:15 to 8/16 16:45 for 10 hours.
Unit 8 offline 8/21 20:00 to 8/24 14:45 for 63 hours.

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7-9 (Inlet)_ Month & Year _September 2009_
Number of Operating Hours in the month _716_
Number of Downtime Hours in the month _14_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
9/1/09 0:00	9/1/09 13:39 (14 hr)	OOC at Start of Month Failed calibration checks Passed calibration check on 9/1
9/1/09 14:27		Updated calibration factors
9/8/09 12:04		Updated calibration factors
9/9/09 15:25		Updated calibration factors
9/14/09 14:09		Updated calibration factors
9/16/09 11:32		Passed linearity check
9/17/09 10:30		Updated calibration factors
9/23/09 11:48		Updated calibration factors
9/28/09 20:07		Updated calibration factors
9/29/09 11:50		Updated calibration factors

Name of technician filling report _EZ_

Comments:
Unit 8 offline 9/6 21:45 to 9/7 0:45 for 4 hours.

Appendix N. Outlet CEMS Daily Average Mercury Concentrations

We Energies Presque Isle Unit 7–9 Baghouse Outlet

Mercury CEMS Average Daily Mercury Concentrations, 2006-2009.

Date	Elemental Mercury	Total Mercury
01/01/06	—	5.86
01/02/06	—	6.04
01/03/06	—	5.95
01/04/06	—	6.38
01/05/06	—	5.18
01/06/06	—	4.83
01/07/06	—	7.45
01/08/06	—	5.13
01/09/06	—	5.05
01/10/06	—	4.97
01/11/06	—	5.97
01/12/06	—	7.05
01/13/06	—	6.70
01/14/06	—	6.04
01/15/06	—	6.42
01/16/06	—	6.82
01/17/06	—	6.73
01/18/06	—	6.56
01/19/06	—	7.13
01/20/06	—	8.21
01/21/06	—	6.39
01/22/06	—	7.58
01/23/06	—	6.71
01/24/06	—	7.75
01/25/06	—	7.10
01/26/06	—	—
01/27/06	—	—
01/28/06	—	5.15
01/29/06	—	3.38
01/30/06	—	3.35

Date	Elemental Mercury	Total Mercury
01/31/06	—	3.78
02/01/06	—	3.31
02/02/06	—	2.54
02/03/06	—	0.97
02/04/06	—	0.83
02/05/06	—	0.45
02/06/06	—	4.03
02/07/06	—	5.28
02/08/06	—	3.97
02/09/06	—	4.32
02/10/06	—	4.59
02/11/06	—	4.69
02/12/06	—	4.50
02/13/06	—	4.45
02/14/06	—	5.04
02/15/06	—	4.59
02/16/06	—	4.38
02/17/06	—	3.86
02/18/06	—	2.76
02/19/06	—	4.20
02/20/06	—	4.58
02/21/06	—	—
02/22/06	—	2.98
02/23/06	—	2.20
02/24/06	—	1.47
02/25/06	—	1.94
02/26/06	—	0.99
02/27/06	—	0.92
02/28/06	—	0.44
03/01/06	—	0.38

Date	Elemental Mercury	Total Mercury
03/02/06	—	4.57
03/03/06	—	3.65
03/04/06	—	5.89
03/05/06	—	5.77
03/06/06	—	5.99
03/07/06	—	4.95
03/08/06	—	3.59
03/09/06	—	4.61
03/10/06	—	4.08
03/11/06	—	3.55
03/12/06	—	3.60
03/13/06	—	3.53
03/14/06	—	-0.01
03/15/06	—	-0.29
03/16/06	—	-0.06
03/17/06	—	-0.14
03/18/06	—	-0.15
03/19/06	—	-0.13
03/20/06	—	0.14
03/21/06	—	-0.31
03/22/06	—	0.18
03/23/06	—	-0.05
03/24/06	—	0.07
03/25/06	—	-0.19
03/26/06	—	-0.14
03/27/06	—	-0.21
03/28/06	—	-0.21
03/29/06	—	-0.26
03/30/06	—	0.01
03/31/06	—	0.01
04/01/06	—	-0.21
04/02/06	—	-0.07
04/03/06	—	-0.21

Date	Elemental Mercury	Total Mercury
04/04/06	—	-0.32
04/05/06	—	-0.07
04/06/06	—	-0.11
04/07/06	—	-0.23
04/08/06	—	0.09
04/09/06	—	0.04
04/10/06	—	-0.08
04/11/06	—	-0.11
04/12/06	—	-0.25
04/13/06	—	0.01
04/14/06	—	-0.05
04/15/06	—	-0.25
04/16/06	—	0.11
04/17/06	—	-0.15
04/18/06	—	-0.20
04/19/06	—	0.26
04/20/06	—	0.40
04/21/06	—	0.05
04/22/06	—	0.26
04/23/06	—	0.27
04/24/06	—	0.10
04/25/06	—	-0.46
04/26/06	—	-0.70
04/27/06	—	-0.46
04/28/06	—	-0.59
04/29/06	—	-0.69
04/30/06	—	-0.66
05/01/06	—	-0.33
05/02/06	—	0.25
05/03/06	—	0.12
05/04/06	—	-0.16
05/05/06	—	-0.37
05/06/06	—	-0.16

Date	Elemental Mercury	Total Mercury
05/07/06	—	-0.12
05/08/06	—	-0.18
05/09/06	—	-0.23
05/10/06	—	-0.24
05/11/06	—	-0.24
05/12/06	—	0.10
05/13/06	—	2.25
05/14/06	—	3.55
05/15/06	—	3.85
05/16/06	—	4.23
05/17/06	—	3.92
05/18/06	—	4.10
05/19/06	—	4.09
05/20/06	—	3.55
05/21/06	—	4.24
05/22/06	—	4.25
05/23/06	—	4.34
05/24/06	—	3.01
05/25/06	—	4.77
05/26/06	—	4.72
05/27/06	—	4.95
05/28/06	—	4.84
05/29/06	—	4.92
05/30/06	—	2.69
05/31/06	—	0.51
06/01/06	—	0.99
06/02/06	—	1.06
06/03/06	—	1.33
06/04/06	—	1.52
06/05/06	—	2.54
06/06/06	—	1.98
06/07/06	—	1.19
06/08/06	—	1.53

Date	Elemental Mercury	Total Mercury
06/09/06	—	1.34
06/10/06	—	1.23
06/11/06	—	1.41
06/12/06	—	4.08
06/13/06	—	12.21
06/14/06	—	6.03
06/15/06	—	4.57
06/16/06	—	2.75
06/17/06	—	3.02
06/18/06	—	1.45
06/19/06	—	0.74
06/20/06	—	0.91
06/21/06	—	0.71
06/22/06	—	1.34
06/23/06	—	1.13
06/24/06	—	1.72
06/25/06	—	1.51
06/26/06	—	1.53
06/27/06	—	1.70
06/28/06	—	1.24
06/29/06	—	0.93
06/30/06	—	6.77
07/01/06	—	5.60
07/02/06	—	4.72
07/03/06	—	4.63
07/04/06	—	4.38
07/05/06	—	4.34
07/06/06	—	4.52
07/07/06	—	4.65
07/08/06	—	4.53
07/09/06	—	4.44
07/10/06	—	4.35
07/11/06	—	4.09

Date	Elemental Mercury	Total Mercury
07/12/06	—	3.94
07/13/06	—	3.83
07/14/06	—	3.81
07/15/06	—	3.76
07/16/06	—	3.84
07/17/06	—	3.98
07/18/06	—	4.25
07/19/06	—	4.31
07/20/06	—	4.37
07/21/06	—	10.35
07/22/06	—	5.21
07/23/06	—	5.86
07/24/06	—	6.39
07/25/06	—	6.11
07/26/06	—	6.43
07/27/06	—	6.28
07/28/06	—	—
07/29/06	—	—
07/30/06	—	—
07/31/06	—	6.10
08/01/06	—	5.26
08/02/06	—	4.48
08/03/06	—	4.80
08/04/06	—	4.87
08/05/06	—	5.78
08/06/06	—	5.68
08/07/06	—	5.95
08/08/06	—	5.99
08/09/06	—	5.97
08/10/06	—	4.95
08/11/06	—	5.48
08/12/06	—	5.75
08/13/06	—	6.25

Date	Elemental Mercury	Total Mercury
08/14/06	—	5.22
08/15/06	—	6.50
08/16/06	—	6.13
08/17/06	—	6.16
08/18/06	—	4.91
08/19/06	—	3.48
08/20/06	—	4.28
08/21/06	—	4.65
08/22/06	—	3.06
08/23/06	—	2.64
08/24/06	—	2.86
08/25/06	—	2.98
08/26/06	—	2.72
08/27/06	—	2.08
08/28/06	—	2.03
08/29/06	—	3.80
08/30/06	—	8.05
08/31/06	—	1.52
09/01/06	—	1.00
09/02/06	—	1.06
09/03/06	—	0.94
09/04/06	—	0.61
09/05/06	—	0.67
09/06/06	—	0.60
09/07/06	—	0.84
09/08/06	—	0.62
09/09/06	—	0.77
09/10/06	—	1.48
09/11/06	—	2.38
09/12/06	—	2.30
09/13/06	—	2.32
09/14/06	—	2.60
09/15/06	—	2.86

Date	Elemental Mercury	Total Mercury
09/16/06	—	1.72
09/17/06	—	1.29
09/18/06	—	1.73
09/19/06	—	3.32
09/20/06	—	4.19
09/21/06	—	4.84
09/22/06	—	13.00
09/23/06	—	7.87
09/24/06	—	6.26
09/25/06	—	5.65
09/26/06	—	5.27
09/27/06	—	5.10
09/28/06	0.66	5.14
09/29/06	0.81	5.24
09/30/06	1.07	5.43
10/01/06	1.15	5.43
10/02/06	1.39	5.56
10/03/06	1.52	5.52
10/04/06	1.26	4.84
10/05/06	0.98	4.68
10/06/06	1.26	4.65
10/07/06	1.17	3.96
10/08/06	1.47	5.03
10/09/06	2.02	5.49
10/10/06	2.16	5.79
10/11/06	0.98	3.11
10/12/06	0.31	2.33
10/13/06	0.42	3.07
10/14/06	0.49	2.04
10/15/06	0.70	5.61
10/16/06	0.81	2.95
10/17/06	0.73	1.65
10/18/06	0.40	0.93

Date	Elemental Mercury	Total Mercury
10/19/06	0.48	1.87
10/20/06	0.54	3.70
10/21/06	0.68	4.31
10/22/06	0.73	3.96
10/23/06	0.97	4.30
10/24/06	1.05	3.45
10/25/06	0.52	1.63
10/26/06	0.59	1.74
10/27/06	0.51	1.56
10/28/06	0.50	0.79
10/29/06	0.46	0.72
10/30/06	0.62	0.78
10/31/06	0.63	0.64
11/01/06	0.52	0.65
11/02/06	0.88	0.79
11/03/06	1.65	1.21
11/04/06	2.08	1.48
11/05/06	2.44	1.83
11/06/06	2.43	1.95
11/07/06	1.71	1.39
11/08/06	0.72	1.11
11/09/06	0.68	0.45
11/10/06	—	—
11/11/06	—	—
11/12/06	—	—
11/13/06	0.98	2.21
11/14/06	0.73	2.20
11/15/06	0.79	2.31
11/16/06	0.74	1.94
11/17/06	0.83	2.17
11/18/06	1.00	1.74
11/19/06	1.33	3.56
11/20/06	1.27	4.23

Date	Elemental Mercury	Total Mercury
11/21/06	1.38	2.39
11/22/06	1.45	2.26
11/23/06	1.45	2.01
11/24/06	1.38	2.28
11/25/06	1.40	1.96
11/26/06	1.45	2.65
11/27/06	1.44	2.72
11/28/06	0.77	2.78
11/29/06	0.17	1.67
11/30/06	0.15	0.84
12/01/06	0.18	0.76
12/02/06	0.28	0.68
12/03/06	0.34	0.66
12/04/06	0.25	0.58
12/05/06	0.24	0.61
12/06/06	0.24	0.62
12/07/06	0.36	0.75
12/08/06	0.34	0.69
12/09/06	0.42	0.67
12/10/06	0.58	0.90
12/11/06	0.63	0.84
12/12/06	0.34	0.61
12/13/06	0.04	0.47
12/14/06	0.21	0.56
12/15/06	0.71	0.83
12/16/06	0.88	0.88
12/17/06	0.96	0.77
12/18/06	0.52	0.74
12/19/06	-0.69	-0.12
12/20/06	0.18	0.40
12/21/06	0.22	0.31
12/22/06	0.12	0.49
12/23/06	—	—

Date	Elemental Mercury	Total Mercury
12/24/06	—	—
12/25/06	—	—
12/26/06	—	—
12/27/06	-0.07	0.12
12/28/06	0.04	0.02
12/29/06	0.10	0.11
12/30/06	0.76	0.35
12/31/06	0.70	0.43
01/01/07	0.58	0.28
01/02/07	0.47	0.28
01/03/07	0.32	0.23
01/04/07	0.30	0.15
01/05/07	0.38	0.21
01/06/07	0.50	0.33
01/07/07	0.60	0.39
01/08/07	0.36	0.34
01/09/07	0.10	0.48
01/10/07	-0.05	0.38
01/11/07	-0.04	0.45
01/12/07	-0.01	0.31
01/13/07	0.02	0.81
01/14/07	-0.04	0.70
01/15/07	-0.02	0.57
01/16/07	0.03	0.56
01/17/07	0.01	0.37
01/18/07	-0.09	0.23
01/19/07	-0.03	0.12
01/20/07	0.58	0.74
01/21/07	0.70	0.58
01/22/07	0.95	0.73
01/23/07	0.93	0.81
01/24/07	0.20	0.41
01/25/07	0.23	0.23

Date	Elemental Mercury	Total Mercury
01/26/07	0.68	0.64
01/27/07	0.58	0.71
01/28/07	0.82	0.85
01/29/07	0.56	0.68
01/30/07	0.18	0.49
01/31/07	0.45	0.76
02/01/07	0.38	0.43
02/02/07	0.30	0.32
02/03/07	0.19	0.25
02/04/07	0.54	0.64
02/05/07	0.27	0.35
02/06/07	-0.02	0.26
02/07/07	-0.14	-0.11
02/08/07	0.27	0.06
02/09/07	0.34	0.36
02/10/07	0.24	0.29
02/11/07	0.43	0.79
02/12/07	0.75	1.09
02/13/07	0.45	1.05
02/14/07	0.20	0.80
02/15/07	0.18	0.50
02/16/07	0.06	0.36
02/17/07	0.17	0.48
02/18/07	0.14	0.37
02/19/07	0.08	0.40
02/20/07	0.20	0.56
02/21/07	0.30	0.70
02/22/07	0.39	0.54
02/23/07	0.34	2.06
02/24/07	2.23	3.02
02/25/07	-3.96	-3.97
02/26/07	0.01	0.04
02/27/07	0.01	0.04

Date	Elemental Mercury	Total Mercury
02/28/07	0.04	0.08
03/01/07	0.88	1.18
03/02/07	0.80	1.12
03/03/07	0.87	1.29
03/04/07	0.89	1.27
03/05/07	0.93	1.25
03/06/07	1.27	1.86
03/07/07	1.09	1.45
03/08/07	1.24	1.74
03/09/07	1.04	1.55
03/10/07	0.92	1.39
03/11/07	0.98	1.52
03/12/07	1.99	2.53
03/13/07	0.90	1.17
03/14/07	0.77	1.48
03/15/07	0.68	0.97
03/16/07	0.71	1.19
03/17/07	0.83	0.88
03/18/07	0.87	1.22
03/19/07	0.92	1.38
03/20/07	0.77	1.26
03/21/07	1.25	1.54
03/22/07	1.38	1.63
03/23/07	0.85	2.29
03/24/07	0.80	0.92
03/25/07	1.39	1.63
03/26/07	1.23	1.50
03/27/07	0.78	1.04
03/28/07	0.94	1.20
03/29/07	1.05	1.42
03/30/07	1.01	1.23
03/31/07	0.89	1.16
04/01/07	0.78	1.04

Date	Elemental Mercury	Total Mercury
04/02/07	0.71	0.96
04/03/07	0.03	0.27
04/04/07	0.12	0.38
04/05/07	0.80	0.76
04/06/07	0.29	0.45
04/07/07	0.13	0.33
04/08/07	0.01	0.22
04/09/07	0.16	0.38
04/10/07	0.28	0.46
04/11/07	0.11	0.35
04/12/07	-0.18	0.10
04/13/07	-0.09	0.17
04/14/07	0.04	0.36
04/15/07	0.14	4.60
04/16/07	0.38	5.25
04/17/07	0.30	5.02
04/18/07	0.11	2.04
04/19/07	-0.16	0.14
04/20/07	0.03	0.57
04/21/07	-0.03	0.68
04/22/07	-0.17	0.32
04/23/07	-0.29	0.13
04/24/07	0.18	0.59
04/25/07	0.58	0.92
04/26/07	0.46	0.62
04/27/07	0.15	0.26
04/28/07	0.20	0.39
04/29/07	0.42	0.60
04/30/07	0.36	0.33
05/01/07	0.14	0.25
05/02/07	0.12	0.22
05/03/07	0.28	0.40
05/04/07	0.42	0.45

Date	Elemental Mercury	Total Mercury
05/05/07	0.64	0.54
05/06/07	0.80	0.76
05/07/07	0.30	0.43
05/08/07	-0.09	0.31
05/09/07	0.20	0.49
05/10/07	-0.02	0.36
05/11/07	0.18	0.30
05/12/07	0.46	0.63
05/13/07	0.62	0.79
05/14/07	0.20	0.42
05/15/07	0.06	0.25
05/16/07	0.38	0.63
05/17/07	0.65	0.89
05/18/07	0.20	-5.11
05/19/07	-0.34	0.01
05/20/07	0.59	0.17
05/21/07	1.05	2.41
05/22/07	-0.58	1.05
05/23/07	-0.59	-0.39
05/24/07	1.57	0.97
05/25/07	-0.01	0.00
05/26/07	—	0.03
05/27/07	—	0.21
05/28/07	0.22	0.95
05/29/07	0.13	1.07
05/30/07	0.01	0.12
05/31/07	0.01	0.10
06/01/07	0.03	0.06
06/02/07	0.06	0.08
06/03/07	0.96	4.75
06/04/07	1.25	6.34
06/05/07	0.61	5.03
06/06/07	0.09	1.44

Date	Elemental Mercury	Total Mercury
06/07/07	0.00	0.12
06/08/07	0.05	0.21
06/09/07	0.07	0.30
06/10/07	0.11	0.91
06/11/07	0.09	0.69
06/12/07	0.08	0.46
06/13/07	0.10	0.54
06/14/07	0.13	0.98
06/15/07	0.26	2.72
06/16/07	0.18	1.52
06/17/07	0.22	1.94
06/18/07	0.24	2.65
06/19/07	0.15	1.75
06/20/07	0.20	2.34
06/21/07	0.18	1.99
06/22/07	0.08	0.71
06/23/07	0.06	0.53
06/24/07	0.06	0.50
06/25/07	0.07	0.62
06/26/07	0.07	0.52
06/27/07	0.06	0.33
06/28/07	0.07	0.31
06/29/07	0.09	0.49
06/30/07	0.08	0.32
07/01/07	0.09	0.39
07/02/07	0.10	0.52
07/03/07	0.09	0.50
07/04/07	0.09	0.47
07/05/07	0.10	0.42
07/06/07	0.10	0.45
07/07/07	0.10	0.33
07/08/07	0.10	0.30
07/09/07	0.12	0.47

Date	Elemental Mercury	Total Mercury
07/10/07	0.13	0.63
07/11/07	0.12	0.29
07/12/07	0.14	0.41
07/13/07	0.15	0.38
07/14/07	0.14	0.36
07/15/07	0.15	0.49
07/16/07	0.17	0.58
07/17/07	0.16	0.42
07/18/07	0.16	0.39
07/19/07	0.16	0.44
07/20/07	0.12	0.32
07/21/07	0.13	0.38
07/22/07	0.14	0.42
07/23/07	0.14	0.45
07/24/07	0.14	0.48
07/25/07	0.15	0.62
07/26/07	0.06	0.38
07/27/07	0.04	0.33
07/28/07	0.05	0.37
07/29/07	0.05	0.42
07/30/07	0.06	0.47
07/31/07	0.11	0.49
08/01/07	0.19	1.04
08/02/07	0.18	0.77
08/03/07	0.19	0.72
08/04/07	0.20	1.17
08/05/07	0.20	1.12
08/06/07	0.19	0.76
08/07/07	0.26	1.83
08/08/07	0.44	3.27
08/09/07	0.22	0.91
08/10/07	0.22	0.85
08/11/07	0.20	0.41

Date	Elemental Mercury	Total Mercury
08/12/07	0.20	0.45
08/13/07	0.22	0.48
08/14/07	0.21	0.47
08/15/07	0.22	0.41
08/16/07	0.23	0.50
08/17/07	0.26	0.51
08/18/07	0.26	0.56
08/19/07	0.24	0.42
08/20/07	0.24	0.53
08/21/07	0.24	0.45
08/22/07	0.18	0.56
08/23/07	0.05	0.37
08/24/07	0.04	0.30
08/25/07	0.04	0.22
08/26/07	0.06	0.34
08/27/07	0.06	0.36
08/28/07	0.06	0.24
08/29/07	-0.06	0.26
08/30/07	0.04	0.28
08/31/07	0.04	0.30
09/01/07	0.04	0.23
09/02/07	0.04	0.25
09/03/07	0.05	0.20
09/04/07	0.04	0.15
09/05/07	0.04	0.15
09/06/07	0.05	0.16
09/07/07	0.06	0.17
09/08/07	0.07	0.15
09/09/07	0.08	0.19
09/10/07	0.10	0.21
09/11/07	0.16	0.58
09/12/07	0.76	5.52
09/13/07	0.59	4.14

Date	Elemental Mercury	Total Mercury
09/14/07	0.32	1.95
09/15/07	0.04	0.00
09/16/07	0.07	0.07
09/17/07	0.09	0.32
09/18/07	0.06	0.36
09/19/07	0.06	0.45
09/20/07	0.08	0.43
09/21/07	0.08	0.59
09/22/07	0.12	0.66
09/23/07	0.15	0.84
09/24/07	0.15	0.83
09/25/07	0.12	0.61
09/26/07	0.13	0.55
09/27/07	0.14	0.60
09/28/07	0.23	0.54
09/29/07	-0.17	0.09
09/30/07	-0.32	0.18
10/01/07	-0.16	0.21
10/02/07	0.02	0.17
10/03/07	0.02	0.15
10/04/07	0.04	0.39
10/05/07	0.06	0.61
10/06/07	0.07	0.75
10/07/07	0.09	1.04
10/08/07	0.07	0.70
10/09/07	0.07	0.54
10/10/07	0.09	0.64
10/11/07	0.10	0.76
10/12/07	0.10	0.61
10/13/07	0.10	0.65
10/14/07	0.11	0.76
10/15/07	0.10	0.65
10/16/07	0.09	0.64

Date	Elemental Mercury	Total Mercury
10/17/07	0.08	0.59
10/18/07	0.07	0.52
10/19/07	0.06	0.44
10/20/07	0.07	0.50
10/21/07	0.08	0.54
10/22/07	0.08	0.63
10/23/07	0.08	0.73
10/24/07	0.09	0.73
10/25/07	0.10	0.97
10/26/07	0.09	0.88
10/27/07	0.07	0.71
10/28/07	0.06	0.28
10/29/07	0.08	0.68
10/30/07	0.06	0.49
10/31/07	0.04	0.47
11/01/07	0.05	0.34
11/02/07	0.06	0.42
11/03/07	0.06	0.47
11/04/07	0.08	1.01
11/05/07	0.07	0.90
11/06/07	0.08	0.83
11/07/07	0.07	0.52
11/08/07	0.05	0.28
11/09/07	0.06	0.32
11/10/07	0.06	0.43
11/11/07	0.05	0.41
11/12/07	0.05	0.55
11/13/07	0.06	0.49
11/14/07	0.08	0.46
11/15/07	0.08	0.41
11/16/07	0.10	0.52
11/17/07	0.10	0.42
11/18/07	0.13	0.68

Date	Elemental Mercury	Total Mercury
11/19/07	0.09	0.65
11/20/07	0.08	0.57
11/21/07	0.09	0.61
11/22/07	0.11	0.56
11/23/07	0.16	0.76
11/24/07	0.16	0.69
11/25/07	0.16	0.74
11/26/07	0.12	0.67
11/27/07	0.10	0.61
11/28/07	0.12	0.65
11/29/07	0.13	0.65
11/30/07	0.17	0.75
12/01/07	0.20	0.80
12/02/07	0.15	0.67
12/03/07	0.15	0.68
12/04/07	0.13	0.31
12/05/07	0.14	0.48
12/06/07	0.11	0.38
12/07/07	0.11	0.34
12/08/07	0.15	0.39
12/09/07	0.17	0.46
12/10/07	0.15	0.36
12/11/07	0.10	0.40
12/12/07	0.44	0.81
12/13/07	0.15	0.53
12/14/07	0.07	0.43
12/15/07	0.09	0.50
12/16/07	0.12	0.45
12/17/07	0.12	0.45
12/18/07	0.09	0.41
12/19/07	0.12	0.41
12/20/07	0.14	0.44
12/21/07	0.10	0.43

Date	Elemental Mercury	Total Mercury
12/22/07	0.09	0.36
12/23/07	0.08	0.32
12/24/07	0.10	0.40
12/25/07	0.10	0.44
12/26/07	0.08	0.51
12/27/07	0.06	0.46
12/28/07	0.03	0.26
12/29/07	0.02	0.09
12/30/07	0.02	0.08
12/31/07	0.02	0.08
01/01/08	0.02	0.07
01/02/08	0.10	1.34
01/03/08	0.31	3.33
01/04/08	0.02	0.07
01/05/08	0.00	0.03
01/06/08	0.01	0.08
01/07/08	0.01	0.09
01/08/08	0.01	0.13
01/09/08	0.01	0.21
01/10/08	-0.02	0.25
01/11/08	-0.01	0.45
01/12/08	0.00	0.49
01/13/08	0.00	0.47
01/14/08	0.04	0.98
01/15/08	0.06	0.62
01/16/08	0.00	0.46
01/17/08	-0.04	0.42
01/18/08	-0.03	0.43
01/19/08	0.01	0.70
01/20/08	0.03	0.58
01/21/08	0.04	0.58
01/22/08	0.01	0.48
01/23/08	0.02	0.47

Date	Elemental Mercury	Total Mercury
01/24/08	0.03	0.65
01/25/08	0.04	0.60
01/26/08	0.01	0.50
01/27/08	0.03	0.57
01/28/08	0.03	0.42
01/29/08	0.17	3.20
01/30/08	0.43	5.52
01/31/08	0.52	4.95
02/01/08	0.75	4.88
02/02/08	0.98	4.79
02/03/08	1.12	4.52
02/04/08	1.27	4.52
02/05/08	1.33	4.47
02/06/08	1.41	4.51
02/07/08	1.15	4.38
02/08/08	0.52	4.44
02/09/08	0.92	4.74
02/10/08	1.36	4.81
02/11/08	1.59	4.82
02/12/08	1.41	4.65
02/13/08	0.69	3.89
02/14/08	0.13	2.15
02/15/08	0.05	0.78
02/16/08	0.27	4.12
02/17/08	0.72	4.66
02/18/08	0.52	3.61
02/19/08	0.08	2.55
02/20/08	0.03	1.14
02/21/08	0.02	0.21
02/22/08	0.09	2.35
02/23/08	0.23	5.58
02/24/08	0.33	4.84
02/25/08	0.52	4.73

Date	Elemental Mercury	Total Mercury
02/26/08	0.38	2.87
02/27/08	0.16	1.62
02/28/08	0.28	3.17
02/29/08	0.13	1.17
03/01/08	0.05	0.41
03/02/08	0.19	2.06
03/03/08	0.05	0.68
03/04/08	0.19	3.03
03/05/08	0.40	4.89
03/06/08	0.27	4.52
03/07/08	0.52	5.46
03/08/08	0.79	5.14
03/09/08	1.01	5.07
03/10/08	1.22	4.93
03/11/08	1.19	4.46
03/12/08	0.37	3.56
03/13/08	0.11	1.76
03/14/08	0.17	4.05
03/15/08	0.16	3.44
03/16/08	0.19	4.72
03/17/08	0.42	5.30
03/18/08	0.15	2.42
03/19/08	0.01	0.72
03/20/08	0.11	3.12
03/21/08	0.15	4.04
03/22/08	0.30	3.70
03/23/08	0.56	4.41
03/24/08	0.22	1.46
03/25/08	0.01	0.37
03/26/08	—	—
03/27/08	—	—
03/28/08	0.02	0.74
03/29/08	0.02	0.74

Date	Elemental Mercury	Total Mercury
03/30/08	0.03	0.74
03/31/08	0.03	0.68
04/01/08	0.03	0.64
04/02/08	0.04	0.70
04/03/08	0.04	0.71
04/04/08	0.04	0.66
04/05/08	0.05	0.72
04/06/08	0.05	0.75
04/07/08	0.05	0.72
04/08/08	0.07	0.78
04/09/08	0.03	0.76
04/10/08	0.02	0.69
04/11/08	0.01	0.60
04/12/08	0.00	0.63
04/13/08	0.01	0.68
04/14/08	0.02	0.69
04/15/08	0.03	0.51
04/16/08	0.04	0.48
04/17/08	0.05	0.43
04/18/08	0.04	0.49
04/19/08	0.05	0.54
04/20/08	0.05	0.54
04/21/08	0.05	0.62
04/22/08	0.04	0.51
04/23/08	0.03	0.49
04/24/08	0.01	0.53
04/25/08	0.02	0.35
04/26/08	0.04	0.34
04/27/08	0.05	0.34
04/28/08	0.05	0.38
04/29/08	0.06	0.39
04/30/08	0.09	0.46
05/01/08	0.07	0.40

Date	Elemental Mercury	Total Mercury
05/02/08	0.00	0.36
05/03/08	0.01	0.34
05/04/08	0.02	0.36
05/05/08	0.02	0.27
05/06/08	0.02	0.30
05/07/08	0.03	0.30
05/08/08	0.03	0.34
05/09/08	0.03	-0.05
05/10/08	0.01	-0.60
05/11/08	0.01	-0.66
05/12/08	0.02	-0.53
05/13/08	0.03	-0.27
05/14/08	0.03	-0.04
05/15/08	0.03	0.58
05/16/08	0.02	0.13
05/17/08	0.02	0.00
05/18/08	0.02	0.00
05/19/08	0.02	0.00
05/20/08	0.00	0.00
05/21/08	0.00	0.00
05/22/08	-0.01	-0.01
05/23/08	0.00	-0.01
05/24/08	0.02	0.01
05/25/08	0.00	-0.01
05/26/08	0.02	0.01
05/27/08	0.02	0.02
05/28/08	0.02	0.02
05/29/08	0.02	0.02
05/30/08	0.10	0.29
05/31/08	0.03	0.09
06/01/08	0.04	0.49
06/02/08	0.21	4.51
06/03/08	0.38	4.90

Date	Elemental Mercury	Total Mercury
06/04/08	0.48	4.61
06/05/08	0.69	3.66
06/06/08	0.10	0.74
06/07/08	0.03	0.82
06/08/08	0.02	0.43
06/09/08	1.25	3.40
06/10/08	0.03	0.41
06/11/08	0.02	0.60
06/12/08	0.02	0.86
06/13/08	0.02	0.89
06/14/08	0.01	0.12
06/15/08	0.00	0.17
06/16/08	0.01	0.36
06/17/08	0.02	0.67
06/18/08	0.03	0.59
06/19/08	0.03	0.60
06/20/08	0.03	0.71
06/21/08	0.02	0.24
06/22/08	0.02	0.34
06/23/08	0.02	0.39
06/24/08	0.03	0.36
06/25/08	0.03	0.40
06/26/08	0.03	0.34
06/27/08	-0.39	-0.01
06/28/08	-0.87	-0.18
06/29/08	-0.83	-0.21
06/30/08	0.15	0.68
07/01/08	0.22	0.51
07/02/08	0.01	0.17
07/03/08	0.02	0.22
07/04/08	—	—
07/05/08	—	—
07/06/08	0.05	0.29

Date	Elemental Mercury	Total Mercury
07/07/08	0.03	0.21
07/08/08	0.01	0.24
07/09/08	0.02	0.26
07/10/08	0.03	0.25
07/11/08	0.03	0.30
07/12/08	0.04	0.37
07/13/08	0.04	0.30
07/14/08	0.04	0.38
07/15/08	0.03	0.54
07/16/08	0.02	0.50
07/17/08	0.01	0.58
07/18/08	-0.02	0.43
07/19/08	0.01	0.42
07/20/08	0.03	0.48
07/21/08	0.03	0.45
07/22/08	0.04	0.46
07/23/08	0.05	0.47
07/24/08	0.04	0.43
07/25/08	0.02	0.47
07/26/08	0.00	0.14
07/27/08	0.00	0.21
07/28/08	0.01	0.32
07/29/08	0.02	0.39
07/30/08	0.01	0.36
07/31/08	0.01	0.28
08/01/08	0.01	0.20
08/02/08	0.02	0.16
08/03/08	0.04	0.32
08/04/08	0.02	0.29
08/05/08	0.01	0.30
08/06/08	0.04	0.21
08/07/08	0.05	0.24
08/08/08	0.05	0.26

Date	Elemental Mercury	Total Mercury
08/09/08	0.06	0.23
08/10/08	0.08	0.29
08/11/08	0.07	0.34
08/12/08	0.04	0.33
08/13/08	0.07	0.35
08/14/08	0.03	0.28
08/15/08	-0.01	0.29
08/16/08	0.01	0.14
08/17/08	0.02	0.26
08/18/08	0.04	0.19
08/19/08	0.06	0.28
08/20/08	0.06	0.37
08/21/08	0.04	0.36
08/22/08	0.02	0.40
08/23/08	0.02	0.06
08/24/08	0.04	0.18
08/25/08	0.05	0.31
08/26/08	0.03	0.35
08/27/08	0.03	0.30
08/28/08	0.03	0.25
08/29/08	0.04	0.26
08/30/08	0.05	0.27
08/31/08	0.07	0.28
09/01/08	0.07	0.32
09/02/08	0.17	0.35
09/03/08	0.14	0.29
09/04/08	-0.01	0.19
09/05/08	-0.09	0.12
09/06/08	0.00	0.23
09/07/08	-0.04	0.21
09/08/08	-0.02	0.22
09/09/08	0.05	0.28
09/10/08	0.01	0.30

Date	Elemental Mercury	Total Mercury
09/11/08	0.14	0.40
09/12/08	0.10	0.33
09/13/08	0.00	0.25
09/14/08	0.01	0.22
09/15/08	0.02	0.25
09/16/08	0.03	0.45
09/17/08	0.03	0.45
09/18/08	0.04	0.55
09/19/08	0.02	0.54
09/20/08	0.04	0.32
09/21/08	0.05	0.39
09/22/08	0.07	0.49
09/23/08	0.06	0.49
09/24/08	0.03	0.38
09/25/08	-0.01	0.24
09/26/08	-0.03	0.34
09/27/08	0.01	0.27
09/28/08	0.03	0.32
09/29/08	0.04	0.46
09/30/08	0.06	0.50
10/01/08	0.07	0.42
10/02/08	0.08	0.24
10/03/08	0.08	0.46
10/04/08	0.03	0.37
10/05/08	0.04	0.32
10/06/08	0.05	0.51
10/07/08	0.05	0.51
10/08/08	0.03	0.46
10/09/08	0.03	0.47
10/10/08	0.04	0.47
10/11/08	0.06	0.55
10/12/08	0.08	0.68
10/13/08	0.05	0.70

Date	Elemental Mercury	Total Mercury
10/14/08	0.01	0.37
10/15/08	0.02	0.44
10/16/08	0.04	0.46
10/17/08	0.05	0.65
10/18/08	-0.01	0.68
10/19/08	0.00	0.61
10/20/08	0.01	0.68
10/21/08	0.02	0.68
10/22/08	0.03	0.66
10/23/08	0.03	0.61
10/24/08	0.02	0.57
10/25/08	0.03	0.48
10/26/08	0.07	0.35
10/27/08	-0.22	0.10
10/28/08	0.00	0.48
10/29/08	0.00	0.47
10/30/08	-0.03	0.61
10/31/08	-0.02	0.52
11/01/08	-0.06	0.41
11/02/08	-0.06	0.44
11/03/08	-0.02	0.55
11/04/08	0.01	0.56
11/05/08	0.09	0.39
11/06/08	0.11	0.40
11/07/08	0.12	0.29
11/08/08	0.13	0.32
11/09/08	0.13	0.33
11/10/08	0.10	0.37
11/11/08	0.02	0.30
11/12/08	0.04	0.40
11/13/08	0.02	0.30
11/14/08	0.00	0.02
11/15/08	0.00	0.15

Date	Elemental Mercury	Total Mercury
11/16/08	0.02	0.36
11/17/08	0.10	0.55
11/18/08	0.09	0.41
11/19/08	0.01	0.47
11/20/08	-0.02	0.69
11/21/08	0.04	0.81
11/22/08	0.20	0.25
11/23/08	0.24	0.42
11/24/08	0.17	0.50
11/25/08	0.02	0.48
11/26/08	0.00	0.65
11/27/08	0.05	0.58
11/28/08	0.16	0.63
11/29/08	0.19	0.64
11/30/08	0.21	0.60
12/01/08	0.15	0.13
12/02/08	0.02	0.01
12/03/08	0.03	0.02
12/04/08	0.03	0.02
12/05/08	0.02	0.02
12/06/08	0.05	0.05
12/07/08	0.06	0.06
12/08/08	0.06	0.06
12/09/08	0.04	0.11
12/10/08	0.05	0.46
12/11/08	0.03	0.39
12/12/08	0.04	0.56
12/13/08	—	0.72
12/14/08	—	0.77
12/15/08	0.12	1.16
12/16/08	0.08	1.22
12/17/08	-0.49	-0.22
12/18/08	-0.68	-0.25

Date	Elemental Mercury	Total Mercury
12/19/08	0.02	0.63
12/20/08	0.04	0.77
12/21/08	0.05	0.76
12/22/08	0.03	0.76
12/23/08	0.00	0.81
12/24/08	0.00	0.71
12/25/08	0.02	0.80
12/26/08	0.03	0.75
12/27/08	0.03	0.48
12/28/08	0.05	0.62
12/29/08	0.06	0.58
12/30/08	0.06	0.62
12/31/08	0.06	0.64
01/01/09	0.07	0.60
01/02/09	0.04	0.29
01/03/09	0.03	0.32
01/04/09	0.05	0.59
01/05/09	0.05	0.35
01/06/09	0.09	1.49
01/07/09	0.06	0.62
01/08/09	0.02	0.47
01/09/09	0.02	0.58
01/10/09	0.02	0.65
01/11/09	0.03	0.73
01/12/09	0.03	0.69
01/13/09	0.02	0.58
01/14/09	0.04	0.72
01/15/09	0.04	0.67
01/16/09	0.03	0.68
01/17/09	0.03	0.69
01/18/09	0.03	0.59
01/19/09	0.04	0.63
01/20/09	0.05	0.61

Date	Elemental Mercury	Total Mercury
01/21/09	0.05	0.63
01/22/09	0.07	0.61
01/23/09	0.05	0.57
01/24/09	0.02	0.58
01/25/09	0.03	0.58
01/26/09	0.05	0.67
01/27/09	0.03	0.70
01/28/09	0.04	0.42
01/29/09	0.04	0.29
01/30/09	0.03	0.20
01/31/09	0.03	0.34
02/01/09	0.06	0.41
02/02/09	0.07	0.44
02/03/09	0.07	0.48
02/04/09	0.05	0.77
02/05/09	0.03	0.70
02/06/09	0.05	0.78
02/07/09	0.06	0.68
02/08/09	0.06	0.75
02/09/09	0.05	0.73
02/10/09	-0.23	3.12
02/11/09	-0.17	4.52
02/12/09	0.27	5.03
02/13/09	0.32	4.32
02/14/09	0.31	2.56
02/15/09	0.52	3.64
02/16/09	0.46	2.49
02/17/09	0.17	2.13
02/18/09	0.12	1.27
02/19/09	0.11	1.46
02/20/09	0.06	0.39
02/21/09	0.06	1.59
02/22/09	0.05	0.77

Date	Elemental Mercury	Total Mercury
02/23/09	0.09	2.03
02/24/09	0.03	0.54
02/25/09	0.04	1.38
02/26/09	0.05	0.46
02/27/09	0.06	0.09
02/28/09	0.06	0.95
03/01/09	0.10	2.92
03/02/09	-0.20	3.61
03/03/09	-0.64	0.76
03/04/09	0.03	1.27
03/05/09	0.03	0.55
03/06/09	0.03	0.54
03/07/09	0.02	0.55
03/08/09	0.03	0.61
03/09/09	0.04	0.75
03/10/09	0.02	0.45
03/11/09	0.01	0.31
03/12/09	0.05	0.74
03/13/09	0.06	0.75
03/14/09	0.08	0.60
03/15/09	0.06	0.38
03/16/09	0.07	0.72
03/17/09	0.10	0.72
03/18/09	0.01	0.52
03/19/09	-0.01	0.43
03/20/09	0.02	0.54
03/21/09	0.02	0.76
03/22/09	0.03	0.87
03/23/09	0.03	0.61
03/24/09	0.02	0.27
03/25/09	0.03	0.36
03/26/09	0.04	0.38
03/27/09	0.06	0.43

Date	Elemental Mercury	Total Mercury
03/28/09	0.06	0.48
03/29/09	0.06	0.30
03/30/09	0.06	0.04
03/31/09	0.06	1.82
04/01/09	0.02	0.34
04/02/09	0.04	0.83
04/03/09	0.04	0.52
04/04/09	0.05	0.16
04/05/09	0.06	0.34
04/06/09	0.08	0.49
04/07/09	0.02	0.45
04/08/09	0.03	0.49
04/09/09	0.04	0.40
04/10/09	0.02	0.43
04/11/09	0.01	0.38
04/12/09	0.02	0.53
04/13/09	-0.03	0.61
04/14/09	-0.06	0.51
04/15/09	-0.01	0.60
04/16/09	0.02	0.67
04/17/09	0.01	0.71
04/18/09	0.02	0.59
04/19/09	0.02	0.60
04/20/09	0.01	0.47
04/21/09	-0.01	0.36
04/22/09	0.00	0.49
04/23/09	0.00	0.63
04/24/09	0.10	0.68
04/25/09	0.06	0.37
04/26/09	0.06	0.71
04/27/09	0.05	0.31
04/28/09	0.05	0.67
04/29/09	0.03	0.79

Date	Elemental Mercury	Total Mercury
04/30/09	0.00	0.55
05/01/09	0.01	0.51
05/02/09	0.02	0.12
05/03/09	0.02	0.28
05/04/09	0.03	0.49
05/05/09	0.03	0.51
05/06/09	0.04	0.47
05/07/09	0.04	0.46
05/08/09	0.04	0.09
05/09/09	0.03	0.52
05/10/09	0.05	0.33
05/11/09	0.04	0.58
05/12/09	0.02	0.46
05/13/09	0.02	0.30
05/14/09	0.08	0.61
05/15/09	0.07	0.57
05/16/09	0.03	0.31
05/17/09	0.04	0.35
05/18/09	0.05	0.39
05/19/09	0.04	0.42
05/20/09	0.03	0.49
05/21/09	0.03	0.40
05/22/09	0.04	0.50
05/23/09	0.05	0.21
05/24/09	0.05	0.31
05/25/09	0.04	0.20
05/26/09	0.06	0.38
05/27/09	0.03	0.15
05/28/09	0.01	0.18
05/29/09	0.03	0.36
05/30/09	0.03	0.38
05/31/09	0.03	0.44
06/01/09	0.04	0.56

Date	Elemental Mercury	Total Mercury
06/02/09	0.02	0.47
06/03/09	0.02	0.52
06/04/09	—	—
06/05/09	0.03	0.35
06/06/09	0.02	0.31
06/07/09	0.00	0.17
06/08/09	-0.03	0.39
06/09/09	0.03	0.34
06/10/09	0.05	0.31
06/11/09	0.05	0.32
06/12/09	0.05	0.47
06/13/09	0.07	0.48
06/14/09	0.08	0.27
06/15/09	0.10	0.32
06/16/09	0.11	0.36
06/17/09	0.10	0.26
06/18/09	0.09	0.32
06/19/09	0.08	0.30
06/20/09	0.08	0.25
06/21/09	0.07	0.21
06/22/09	0.08	0.43
06/23/09	0.06	0.33
06/24/09	0.03	0.31
06/25/09	0.03	0.32
06/26/09	0.03	0.31
06/27/09	0.04	0.32
06/28/09	0.04	0.18
06/29/09	0.04	0.25
06/30/09	0.04	0.18
07/01/09	0.04	0.11
07/02/09	0.11	0.41
07/03/09	0.13	0.42
07/04/09	0.13	0.46

Date	Elemental Mercury	Total Mercury
07/05/09	0.15	0.41
07/06/09	0.09	0.32
07/07/09	0.02	0.29
07/08/09	0.02	0.32
07/09/09	0.02	0.43
07/10/09	0.02	0.29
07/11/09	—	—
07/12/09	—	—
07/13/09	0.04	0.43
07/14/09	0.04	0.44
07/15/09	—	—
07/16/09	—	—
07/17/09	0.00	-0.14
07/18/09	0.00	-0.29
07/19/09	0.00	-0.24
07/20/09	0.01	0.03
07/21/09	0.03	0.44
07/22/09	0.03	0.37
07/23/09	0.02	0.36
07/24/09	0.01	0.47
07/25/09	0.01	0.39
07/26/09	0.02	0.43
07/27/09	0.03	0.46
07/28/09	0.01	0.23
07/29/09	0.01	0.17
07/30/09	0.01	0.18
07/31/09	0.02	0.17
08/01/09	0.03	0.18
08/02/09	0.02	0.18
08/03/09	0.03	0.22
08/04/09	0.02	0.26
08/05/09	0.01	0.29
08/06/09	0.02	0.32

Date	Elemental Mercury	Total Mercury
08/07/09	0.02	0.37
08/08/09	0.02	0.41
08/09/09	0.01	0.35
08/10/09	0.02	0.34
08/11/09	0.03	0.31
08/12/09	0.02	0.28
08/13/09	0.03	0.30
08/14/09	0.03	0.32
08/15/09	0.03	0.48
08/16/09	0.02	0.36
08/17/09	0.02	0.32
08/18/09	0.05	0.52
08/19/09	0.05	0.65
08/20/09	0.03	0.47
08/21/09	0.01	0.35
08/22/09	0.00	-0.06
08/23/09	0.01	0.14
08/24/09	0.01	0.24
08/25/09	0.00	0.00
08/26/09	-0.01	-0.05
08/27/09	-0.01	-0.04
08/28/09	—	—
08/29/09	—	—
08/30/09	—	—
08/31/09	—	—
09/01/09	—	—
09/02/09	—	—
09/03/09	—	—
09/04/09	—	—
09/05/09	—	—
09/06/09	—	—
09/07/09	—	—
09/08/09	—	—

Date	Elemental Mercury	Total Mercury
09/09/09	0.01	0.44
09/10/09	0.01	0.67
09/11/09	0.00	0.62
09/12/09	0.00	0.53
09/13/09	-0.02	0.39
09/14/09	0.00	0.59
09/15/09	0.01	0.53
09/16/09	0.02	0.65
09/17/09	0.03	0.61
09/18/09	0.07	0.49
09/19/09	0.09	0.73
09/20/09	0.36	0.91
09/21/09	0.30	0.72
09/22/09	0.11	0.61
09/23/09	0.18	0.59
09/24/09	0.24	0.71
09/25/09	0.39	0.89
09/26/09	0.56	1.12
09/27/09	0.76	0.88
09/28/09	0.75	1.17
09/29/09	0.02	0.47
09/30/09	0.03	0.51

Appendix O. Outlet CEMS Calibration Record

We Energies Presque Isle Unit 7–9 Baghouse Outlet

Mercury CEMS Calibration Check Record, 2006-2009.

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
12/19/05	00:02	INST	5.0	10	-0.01	-0.1%	4.88	-1.2%	PASS
12/19/05	09:29	ORIF	6.0	10	-0.36	-3.6%	4.94	-10.6%	FAIL
12/20/05	00:02	INST	5.0	10	0.00	+0.0%	4.47	-5.3%	PASS
12/20/05	11:17	ORIF	6.0	10	-0.02	-0.2%	5.72	-2.8%	PASS
12/21/05	00:02	INST	5.0	10	0.00	+0.0%	5.62	+6.2%	PASS
12/22/05	13:48	INST	5.0	10	-0.13	-1.3%	5.88	+8.8%	PASS
12/23/05	00:02	INST	5.0	10	0.02	+0.2%	4.85	-1.5%	PASS
12/23/05	00:10	ORIF	6.0	10	-0.37	-3.7%	6.08	+0.8%	PASS
12/24/05	00:02	INST	5.0	10	0.06	+0.6%	5.29	+2.9%	PASS
12/24/05	00:10	ORIF	6.0	10	0.20	+2.0%	5.95	-0.5%	PASS
12/25/05	No Data Available								
12/26/05	No Data Available								
12/27/05	No Data Available								
12/28/05	00:02	INST	5.0	10	-0.03	-0.3%	5.60	+6.0%	PASS
12/28/05	00:10	ORIF	6.0	10	-0.18	-1.8%	6.03	+0.3%	PASS
12/29/05	00:02	INST	5.0	10	0.03	+0.3%	0.49	-45.1%	FAIL
12/30/05	00:02	INST	5.0	10	-0.07	-0.7%	4.46	-5.4%	PASS
12/30/05	00:10	ORIF	6.0	10	-0.10	-1.0%	3.26	-27.4%	FAIL
12/31/05	00:02	INST	5.0	10	-0.01	-0.1%	4.78	-2.2%	PASS
12/31/05	00:10	ORIF	6.0	10	-0.06	-0.6%	6.28	+2.8%	PASS
01/01/06	00:02	INST	5.0	10	0.02	+0.2%	4.92	-0.8%	PASS
01/01/06	00:10	ORIF	6.0	10	-0.08	-0.8%	6.13	+1.3%	PASS
01/02/06	00:02	INST	5.0	10	0.01	+0.1%	4.90	-1.0%	PASS
01/02/06	00:10	ORIF	6.0	10	-0.04	-0.4%	6.33	+3.3%	PASS
01/03/06	00:02	INST	5.0	10	-0.01	-0.1%	5.00	+0.0%	PASS
01/03/06	00:10	ORIF	6.0	10	-0.05	-0.5%	6.51	+5.1%	PASS
01/04/06	00:02	INST	5.0	10	0.02	+0.2%	5.04	+0.4%	PASS
01/05/06	00:01	INST	5.0	10	0.02	+0.2%	4.96	-0.4%	PASS
01/05/06	00:10	ORIF	6.0	10	-0.39	-3.9%	6.44	+4.4%	PASS
01/06/06	00:02	INST	5.0	10	-0.02	-0.2%	4.43	-5.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/06/06	00:10	ORIF	6.0	10	-0.61	-6.1%	5.14	-8.6%	PASS
01/07/06	00:02	INST	5.0	10	0.00	+0.0%	4.39	-6.1%	PASS
01/07/06	00:10	ORIF	6.0	10	-0.20	-2.0%	5.47	-5.3%	PASS
01/08/06	00:02	INST	5.0	10	0.00	+0.0%	4.44	-5.6%	PASS
01/08/06	00:10	ORIF	6.0	10	-0.28	-2.8%	5.38	-6.2%	PASS
01/09/06	00:02	INST	5.0	10	-0.04	-0.4%	4.29	-7.1%	PASS
01/09/06	00:10	ORIF	6.0	10	-1.28	-12.8%	4.38	-16.2%	FAIL
01/10/06	No Calibration Check								
01/11/06	08:59	INST	5.0	10	0.06	+0.6%	4.53	-4.7%	PASS
01/11/06	09:14	ORIF	6.0	10	-0.67	-6.7%	6.27	+2.7%	PASS
01/12/06	00:10	ORIF	6.0	10	-0.21	-2.1%	6.32	+3.2%	PASS
01/13/06	00:02	INST	5.0	10	0.01	+0.1%	5.21	+2.1%	PASS
01/13/06	00:10	ORIF	6.0	10	0.13	+1.3%	6.60	+6.0%	PASS
01/14/06	00:02	INST	5.0	10	-0.02	-0.2%	4.76	-2.4%	PASS
01/14/06	00:10	ORIF	6.0	10	0.04	+0.4%	6.60	+6.0%	PASS
01/14/06	07:36	ORIF	6.0	10	-0.24	-2.4%	6.40	+4.0%	PASS
01/15/06	00:02	INST	5.0	10	0.23	+2.3%	2.73	-22.7%	FAIL
01/15/06	07:36	ORIF	6.0	10	-0.35	-3.5%	6.35	+3.5%	PASS
01/16/06	00:02	INST	5.0	10	-0.01	-0.1%	4.94	-0.6%	PASS
01/16/06	07:36	ORIF	6.0	10	0.03	+0.3%	6.99	+9.9%	PASS
01/17/06	00:02	INST	5.0	10	0.02	+0.2%	4.88	-1.2%	PASS
01/17/06	07:36	ORIF	6.0	10	-0.22	-2.2%	6.92	+9.2%	PASS
01/18/06	00:02	INST	5.0	10	0.02	+0.2%	5.10	+1.0%	PASS
01/18/06	00:10	ORIF	6.0	10	-0.33	-3.3%	7.04	+10.4%	FAIL
01/18/06	07:36	ORIF	6.0	10	0.09	+0.9%	6.68	+6.8%	PASS
01/19/06	07:36	ORIF	6.0	10	-0.72	-7.2%	5.81	-1.9%	PASS
01/19/06	10:51	INST	5.0	10	-0.02	-0.2%	4.53	-4.7%	PASS
01/19/06	10:59	ORIF	6.0	10	-0.19	-1.9%	6.74	+7.4%	PASS
01/20/06	07:36	ORIF	6.0	10	0.60	+6.0%	7.78	+17.8%	FAIL
01/20/06	14:08	ORIF	6.0	10	0.31	+3.1%	9.17	+31.7%	FAIL
01/21/06	07:37	ORIF	6.0	10	-0.62	-6.2%	5.90	-1.0%	PASS
01/22/06	00:03	INST	5.0	10	-0.04	-0.4%	4.67	-3.3%	PASS
01/22/06	00:11	ORIF	6.0	10	-0.17	-1.7%	6.69	+6.9%	PASS
01/22/06	07:36	ORIF	6.0	10	-0.23	-2.3%	6.95	+9.5%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/23/06	00:03	INST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
01/23/06	00:11	ORIF	6.0	10	-0.59	-5.9%	6.75	+7.5%	PASS
01/23/06	07:36	ORIF	6.0	10	0.04	+0.4%	6.85	+8.5%	PASS
01/24/06	00:03	INST	5.0	10	-0.01	-0.1%	4.85	-1.5%	PASS
01/24/06	00:11	ORIF	6.0	10	-0.26	-2.6%	6.87	+8.7%	PASS
01/24/06	07:36	ORIF	6.0	10	0.36	+3.6%	7.17	+11.7%	FAIL
01/25/06	00:03	INST	5.0	10	0.01	+0.1%	5.07	+0.7%	PASS
01/25/06	00:11	ORIF	6.0	10	0.09	+0.9%	6.76	+7.6%	PASS
01/25/06	07:36	ORIF	6.0	10	-0.45	-4.5%	6.05	+0.5%	PASS
01/26/06	Data Not Available								
01/27/06	Data Not Available								
01/28/06	Data Not Available								
01/29/06	07:38	ORIF	12.0	15	0.61	+4.1%	14.10	+14.0%	FAIL
01/29/06	18:01	INST	5.3	10	0.01	+0.1%	5.29	+0.0%	PASS
01/30/06	07:37	ORIF	12.0	15	0.24	+1.6%	11.66	-2.3%	PASS
01/30/06	18:01	INST	5.0	15	-0.01	-0.1%	4.62	-2.5%	PASS
01/31/06	07:37	ORIF	12.0	15	0.24	+1.6%	11.56	-2.9%	PASS
02/01/06	07:37	ORIF	12.0	15	-0.08	-0.5%	11.78	-1.5%	PASS
02/02/06	07:37	ORIF	12.0	15	0.07	+0.5%	11.71	-1.9%	PASS
02/03/06	07:37	ORIF	12.0	15	0.12	+0.8%	12.15	+1.0%	PASS
02/03/06	20:42	ORIF	12.0	15	0.38	+2.5%	12.74	+4.9%	PASS
02/04/06	07:37	ORIF	12.0	15	0.24	+1.6%	12.23	+1.5%	PASS
02/05/06	07:37	ORIF	12.0	15	-0.02	-0.1%	11.57	-2.9%	PASS
02/06/06	07:37	ORIF	12.0	15	-0.17	-1.1%	10.52	-9.9%	FAIL
02/07/06	07:37	ORIF	12.0	15	-0.70	-4.7%	11.40	-4.0%	PASS
02/08/06	07:37	ORIF	12.0	15	-0.69	-4.6%	11.05	-6.3%	PASS
02/09/06	07:37	ORIF	12.0	15	-1.17	-7.8%	10.71	-8.6%	FAIL
02/10/06	07:37	ORIF	12.0	15	0.07	+0.5%	12.22	+1.5%	PASS
02/11/06	07:37	ORIF	12.0	15	0.14	+0.9%	12.31	+2.1%	PASS
02/12/06	07:37	ORIF	12.0	15	0.26	+1.7%	12.51	+3.4%	PASS
02/13/06	07:37	ORIF	12.0	15	-0.13	-0.9%	11.40	-4.0%	PASS
02/14/06	07:37	ORIF	12.0	15	-0.18	-1.2%	11.88	-0.8%	PASS
02/15/06	07:37	ORIF	12.0	15	0.33	+2.2%	12.70	+4.7%	PASS
02/16/06	07:37	ORIF	12.0	15	0.74	+4.9%	10.40	-10.7%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/17/06	07:37	ORIF	12.0	15	0.22	+1.5%	12.02	+0.1%	PASS
02/18/06	07:37	ORIF	6.0	15	0.42	+2.8%	4.63	-9.1%	FAIL
02/19/06	07:37	ORIF	6.0	15	0.88	+5.9%	4.10	-12.7%	FAIL
02/20/06	07:37	ORIF	6.0	15	0.02	+0.1%	6.20	+1.3%	PASS
02/21/06	07:37	ORIF	6.0	15	0.70	+4.7%	INC	INC	N/A
02/22/06	07:37	ORIF	6.0	15	0.51	+3.4%	7.06	+7.1%	FAIL
02/23/06	07:37	ORIF	6.0	15	0.07	+0.5%	6.25	+1.7%	PASS
02/24/06	07:37	ORIF	6.0	15	-0.18	-1.2%	5.59	-2.7%	PASS
02/25/06	07:37	ORIF	6.0	15	0.33	+2.2%	6.35	+2.3%	PASS
02/26/06	07:37	ORIF	6.0	15	-0.57	-3.8%	5.24	-5.1%	PASS
02/27/06	07:37	ORIF	6.0	15	-0.17	-1.1%	5.94	-0.4%	PASS
02/28/06	07:37	ORIF	6.0	15	0.31	+2.1%	6.08	+0.5%	PASS
03/01/06	07:37	ORIF	6.0	15	-0.38	-2.5%	5.60	-2.7%	PASS
03/02/06	07:37	ORIF	6.0	15	0.11	+0.7%	6.60	+4.0%	PASS
03/03/06	07:37	ORIF	6.0	15	-0.35	-2.3%	5.85	-1.0%	PASS
03/04/06	07:37	ORIF	6.0	15	-0.10	-0.7%	6.02	+0.1%	PASS
03/05/06	07:37	ORIF	6.0	15	0.11	+0.7%	6.04	+0.3%	PASS
03/06/06	07:37	ORIF	6.0	15	0.31	+2.1%	6.44	+2.9%	PASS
03/07/06	07:38	ORIF	6.0	15	-0.17	-1.1%	6.50	+3.3%	PASS
03/08/06	07:38	ORIF	6.0	15	0.45	+3.0%	6.92	+6.1%	PASS
03/09/06	07:38	ORIF	6.0	15	0.29	+1.9%	6.74	+4.9%	PASS
03/10/06	07:38	ORIF	6.0	15	0.18	+1.2%	6.20	+1.3%	PASS
03/11/06	07:38	ORIF	6.0	15	0.25	+1.7%	6.10	+0.7%	PASS
03/12/06	07:38	ORIF	6.0	15	-0.51	-3.4%	5.77	-1.5%	PASS
03/13/06	07:38	ORIF	6.0	15	0.40	+2.7%	6.45	+3.0%	PASS
03/14/06	07:38	ORIF	6.0	15	-0.55	-3.7%	5.22	-5.2%	PASS
03/15/06	07:38	ORIF	6.0	15	0.13	+0.9%	6.07	+0.5%	PASS
03/16/06	07:38	ORIF	6.0	15	-0.12	-0.8%	5.64	-2.4%	PASS
03/17/06	07:38	ORIF	6.0	15	0.13	+0.9%	6.02	+0.1%	PASS
03/18/06	No Calibration Check								
03/19/06	No Calibration Check								
03/20/06	No Calibration Check								
03/21/06	No Calibration Check								
03/22/06	No Calibration Check								

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/23/06	No Calibration Check								
03/24/06	No Calibration Check								
03/25/06	No Calibration Check								
03/26/06	No Calibration Check								
03/27/06	No Calibration Check								
03/28/06	No Calibration Check								
03/29/06	No Calibration Check								
03/30/06	07:39	ORIF	5.0	15	-0.03	-0.2%	4.81	-1.3%	PASS
03/31/06	07:39	ORIF	5.0	15	-0.17	-1.1%	5.15	+1.0%	PASS
04/02/06	07:39	ORIF	5.0	15	-0.53	-3.5%	3.97	-6.9%	FAIL
04/03/06	07:39	ORIF	5.0	15	0.10	+0.7%	5.09	+0.6%	PASS
04/04/06	07:39	ORIF	5.0	15	-0.80	-5.3%	4.11	-5.9%	PASS
04/05/06	07:37	ORIF	5.0	15	-0.30	-2.0%	5.18	+1.2%	PASS
04/06/06	07:37	ORIF	5.0	15	-0.59	-3.9%	4.26	-4.9%	PASS
04/07/06	07:37	ORIF	5.0	15	-0.47	-3.1%	4.80	-1.3%	PASS
04/08/06	07:37	ORIF	5.0	15	0.39	+2.6%	4.93	-0.5%	PASS
04/09/06	07:37	ORIF	5.0	15	0.03	+0.2%	5.08	+0.5%	PASS
04/10/06	07:37	ORIF	5.0	15	0.25	+1.7%	5.64	+4.3%	PASS
04/11/06	07:37	ORIF	5.0	15	-0.28	-1.9%	5.22	+1.5%	PASS
04/12/06	07:37	ORIF	5.0	15	0.13	+0.9%	6.24	+8.3%	FAIL
04/13/06	07:37	ORIF	5.0	15	0.03	+0.2%	4.85	-1.0%	PASS
04/14/06	07:37	ORIF	5.0	15	0.14	+0.9%	5.22	+1.5%	PASS
04/15/06	07:37	ORIF	5.0	15	0.09	+0.6%	5.20	+1.3%	PASS
04/16/06	07:37	ORIF	5.0	15	0.24	+1.6%	4.98	-0.1%	PASS
04/17/06	07:37	ORIF	5.0	15	-0.61	-4.1%	4.05	-6.3%	PASS
04/18/06	07:37	ORIF	5.0	15	-0.17	-1.1%	5.52	+3.5%	PASS
04/19/06	07:37	ORIF	5.0	15	-0.02	-0.1%	5.69	+4.6%	PASS
04/20/06	07:37	ORIF	5.0	15	0.66	+4.4%	5.71	+4.7%	PASS
04/21/06	No Calibration Check								
04/22/06	No Calibration Check								
04/23/06	No Calibration Check								
04/24/06	No Calibration Check								
04/25/06	No Calibration Check								
04/26/06	No Calibration Check								

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
04/27/06	No Calibration Check								
04/28/06	No Calibration Check								
04/29/06	No Calibration Check								
04/30/06	No Calibration Check								
05/01/06	No Calibration Check								
05/02/06	No Calibration Check								
05/03/06	No Calibration Check								
05/04/06	No Calibration Check								
05/05/06	No Calibration Check								
05/06/06	No Calibration Check								
05/07/06	No Calibration Check								
05/08/06	No Calibration Check								
05/09/06	No Calibration Check								
05/10/06	No Calibration Check								
05/11/06	No Calibration Check								
05/12/06	No Calibration Check								
05/13/06	No Calibration Check								
05/14/06	No Calibration Check								
05/15/06	No Calibration Check								
05/16/06	No Calibration Check								
05/17/06	No Calibration Check								
05/18/06	No Calibration Check								
05/19/06	07:39	ORIF	5.0	15	0.12	+0.8%	4.79	-1.4%	PASS
05/20/06	07:39	ORIF	5.0	15	0.02	+0.1%	4.71	-1.9%	PASS
05/21/06	07:39	ORIF	5.0	15	-0.25	-1.7%	4.31	-4.6%	PASS
05/22/06	07:39	ORIF	5.0	15	0.11	+0.7%	5.11	+0.7%	PASS
05/23/06	07:39	ORIF	5.0	15	-0.05	-0.3%	4.60	-2.7%	PASS
05/24/06	07:39	ORIF	5.0	15	-0.55	-3.7%	4.70	-2.0%	PASS
05/25/06	07:39	ORIF	5.0	15	-0.27	-1.8%	5.04	+0.3%	PASS
05/26/06	07:39	ORIF	5.0	15	-0.51	-3.4%	4.86	-0.9%	PASS
05/27/06	07:39	ORIF	5.0	15	-0.08	-0.5%	5.13	+0.9%	PASS
05/28/06	07:39	ORIF	5.0	15	-0.06	-0.4%	4.96	-0.3%	PASS
05/29/06	07:39	ORIF	5.0	15	0.16	+1.1%	5.29	+1.9%	PASS
05/30/06	07:39	ORIF	5.0	15	-0.11	-0.7%	5.26	+1.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/31/06	07:39	ORIF	5.0	15	-0.08	-0.5%	5.17	+1.1%	PASS
06/01/06	07:39	ORIF	5.0	15	-0.27	-1.8%	5.06	+0.4%	PASS
06/02/06	07:39	ORIF	5.0	15	0.50	+3.3%	5.28	+1.9%	PASS
06/03/06	07:39	ORIF	5.0	15	0.11	+0.7%	5.30	+2.0%	PASS
06/04/06	07:39	ORIF	5.0	15	0.36	+2.4%	5.35	+2.3%	PASS
06/05/06	07:39	ORIF	5.0	15	0.37	+2.5%	5.33	+2.2%	PASS
06/06/06	07:39	ORIF	5.0	15	-0.36	-2.4%	5.23	+1.5%	PASS
06/07/06	07:39	ORIF	5.0	15	0.08	+0.5%	5.49	+3.3%	PASS
06/08/06	07:39	ORIF	5.0	15	-0.34	-2.3%	5.31	+2.1%	PASS
06/09/06	07:39	ORIF	5.0	15	0.01	+0.1%	4.87	-0.9%	PASS
06/10/06	07:39	ORIF	5.0	15	0.05	+0.3%	3.90	-7.3%	FAIL
06/11/06	07:39	ORIF	5.0	15	0.11	+0.7%	3.70	-8.7%	FAIL
06/12/06	Data Unavailable								
06/13/06	07:39	ORIF	5.0	15	0.67	+4.5%	4.17	-5.5%	PASS
06/14/06	07:39	ORIF	12.0	15	-1.02	-6.8%	10.83	-7.8%	FAIL
06/15/06	07:39	ORIF	12.0	15	0.53	+3.5%	12.53	+3.5%	PASS
06/16/06	07:39	ORIF	12.0	15	0.38	+2.5%	12.10	+0.7%	PASS
06/17/06	07:39	ORIF	12.0	15	-0.04	-0.3%	11.95	-0.3%	PASS
06/18/06	07:39	ORIF	12.0	15	0.03	+0.2%	12.06	+0.4%	PASS
06/19/06	07:39	ORIF	12.0	15	-0.43	-2.9%	12.10	+0.7%	PASS
06/20/06	07:39	ORIF	12.0	15	-0.25	-1.7%	12.45	+3.0%	PASS
06/21/06	07:37	ORIF	12.0	15	-0.28	-1.9%	12.06	+0.4%	PASS
06/22/06	07:38	ORIF	12.0	15	-0.51	-3.4%	11.76	-1.6%	PASS
06/23/06	07:38	ORIF	12.0	15	0.51	+3.4%	12.29	+1.9%	PASS
06/24/06	07:38	ORIF	12.0	15	0.02	+0.1%	11.85	-1.0%	PASS
06/25/06	07:38	ORIF	12.0	15	-0.19	-1.3%	11.91	-0.6%	PASS
06/26/06	07:38	ORIF	12.0	15	0.29	+1.9%	12.07	+0.5%	PASS
06/27/06	07:38	ORIF	5.0	15	0.20	+1.3%	5.16	+1.1%	PASS
06/27/06	20:47	ORIF	5.0	15	0.08	+0.5%	9.52	+30.1%	FAIL
06/28/06	07:38	ORIF	10.0	15	-0.21	-1.4%	10.16	+1.1%	PASS
06/28/06	09:22	ORIF	10.0	15	-0.02	-0.1%	10.60	+4.0%	PASS
06/28/06	20:47	ORIF	10.0	15	-0.23	-1.5%	9.97	-0.2%	PASS
06/29/06	07:38	ORIF	10.0	15	-0.29	-1.9%	9.44	-3.7%	PASS
06/29/06	08:47	ORIF	10.0	15	0.24	+1.6%	10.52	+3.5%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
06/29/06	20:47	ORIF	10.0	15	-0.13	-0.9%	9.60	-2.7%	PASS
06/30/06	07:38	ORIF	10.0	15	0.76	+5.1%	10.89	+5.9%	PASS
06/30/06	08:47	ORIF	10.0	15	-0.09	-0.6%	9.80	-1.3%	PASS
07/01/06	07:39	ORIF	10.0	15	-0.32	-2.1%	10.14	+0.9%	PASS
07/02/06	07:39	ORIF	10.0	15	0.05	+0.3%	10.59	+3.9%	PASS
07/02/06	08:48	ORIF	10.0	15	-0.13	-0.9%	10.49	+3.3%	PASS
07/03/06	07:39	ORIF	10.0	15	0.13	+0.9%	10.46	+3.1%	PASS
07/03/06	08:47	ORIF	10.0	15	-0.05	-0.3%	10.16	+1.1%	PASS
07/04/06	07:39	ORIF	10.0	15	-0.06	-0.4%	10.06	+0.4%	PASS
07/04/06	20:47	ORIF	10.0	15	-0.02	-0.1%	10.02	+0.1%	PASS
07/05/06	07:39	ORIF	10.0	15	0.09	+0.6%	10.13	+0.9%	PASS
07/05/06	08:47	ORIF	10.0	15	-0.04	-0.3%	10.10	+0.7%	PASS
07/05/06	20:47	ORIF	10.0	15	-0.03	-0.2%	9.92	-0.5%	PASS
07/06/06	07:39	ORIF	10.0	15	0.06	+0.4%	10.07	+0.5%	PASS
07/06/06	08:47	ORIF	10.0	15	-0.04	-0.3%	10.03	+0.2%	PASS
07/06/06	20:47	ORIF	10.0	15	-0.03	-0.2%	10.07	+0.5%	PASS
07/07/06	07:39	ORIF	10.0	15	0.03	+0.2%	10.09	+0.6%	PASS
07/07/06	13:43	ORIF	10.0	15	-0.24	-1.6%	21.50	+76.7%	FAIL
07/08/06	07:39	ORIF	10.0	15	0.00	+0.0%	10.28	+1.9%	PASS
07/09/06	07:39	ORIF	10.0	15	-0.06	-0.4%	10.20	+1.3%	PASS
07/10/06	03:25	ORIF	10.0	15	-0.07	-0.5%	10.14	+0.9%	PASS
07/10/06	07:39	ORIF	10.0	15	-0.02	-0.1%	9.94	-0.4%	PASS
07/11/06	07:39	ORIF	10.0	15	-0.49	-3.3%	10.21	+1.4%	PASS
07/12/06	07:39	ORIF	10.0	15	-0.33	-2.2%	10.28	+1.9%	PASS
07/13/06	07:39	ORIF	10.0	15	-0.35	-2.3%	10.26	+1.7%	PASS
07/14/06	07:39	ORIF	10.0	15	-0.21	-1.4%	10.36	+2.4%	PASS
07/14/06	20:43	ORIF	10.0	15	-0.02	-0.1%	10.02	+0.1%	PASS
07/15/06	07:39	ORIF	10.0	15	0.24	+1.6%	10.29	+1.9%	PASS
07/15/06	08:43	ORIF	10.0	15	-0.04	-0.3%	9.90	-0.7%	PASS
07/15/06	14:43	ORIF	10.0	15	0.02	+0.1%	10.05	+0.3%	PASS
07/15/06	20:43	ORIF	10.0	15	0.11	+0.7%	10.21	+1.4%	PASS
07/16/06	07:39	ORIF	10.0	15	0.18	+1.2%	10.15	+1.0%	PASS
07/16/06	08:43	ORIF	10.0	15	0.02	+0.1%	10.06	+0.4%	PASS
07/16/06	20:43	ORIF	10.0	15	-0.04	-0.3%	10.17	+1.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/17/06	07:39	ORIF	10.0	15	0.12	+0.8%	10.10	+0.7%	PASS
07/17/06	20:43	ORIF	10.0	15	-0.11	-0.7%	9.93	-0.5%	PASS
07/18/06	02:43	ORIF	10.0	15	-0.12	-0.8%	10.02	+0.1%	PASS
07/18/06	09:10	ORIF	5.0	15	-0.55	-3.7%	4.45	-3.7%	PASS
07/18/06	14:43	ORIF	5.0	15	-0.23	-1.5%	5.51	+3.4%	PASS
07/18/06	20:43	ORIF	5.0	15	-0.20	-1.3%	4.99	-0.1%	PASS
07/19/06	02:43	ORIF	5.0	15	-0.20	-1.3%	4.99	-0.1%	PASS
07/19/06	07:40	ORIF	5.0	15	-0.24	-1.6%	4.96	-0.3%	PASS
07/19/06	08:43	ORIF	5.0	15	-0.15	-1.0%	5.00	+0.0%	PASS
07/19/06	14:43	ORIF	5.0	15	-0.25	-1.7%	4.84	-1.1%	PASS
07/19/06	20:43	ORIF	5.0	15	-0.21	-1.4%	5.07	+0.5%	PASS
07/20/06	02:43	ORIF	5.0	15	-0.15	-1.0%	5.10	+0.7%	PASS
07/20/06	07:40	ORIF	5.0	15	-0.18	-1.2%	5.11	+0.7%	PASS
07/20/06	08:43	ORIF	5.0	15	-0.27	-1.8%	5.04	+0.3%	PASS
07/20/06	14:43	ORIF	5.0	15	-0.20	-1.3%	5.08	+0.5%	PASS
07/20/06	20:43	ORIF	5.0	15	-0.17	-1.1%	5.05	+0.3%	PASS
07/21/06	07:40	ORIF	5.0	15	-0.22	-1.5%	5.00	+0.0%	PASS
07/22/06	02:43	ORIF	5.0	15	-0.42	-2.8%	-0.35	-35.7%	FAIL
07/22/06	07:40	ORIF	5.0	15	-1.29	-8.6%	-1.41	-42.7%	FAIL
07/22/06	14:43	SYST	5.0	15	-0.24		4.70		
07/23/06	07:40	ORIF	5.0	15	0.03	+0.2%	-0.05	-33.7%	FAIL
07/23/06	15:38	ORIF	5.0	15	0.07	+0.5%	-0.15	-34.3%	FAIL
07/24/06	07:40	ORIF	5.0	15	-0.48	-3.2%	-0.23	-34.9%	FAIL
07/25/06	07:40	ORIF	5.0	15	0.04	+0.3%	0.05	-33.0%	FAIL
07/26/06	07:40	ORIF	5.0	15	-0.63	-4.2%	-0.61	-37.4%	FAIL
07/27/06	07:40	ORIF	5.0	15	0.11	+0.7%	-0.11	-34.1%	FAIL
07/28/06	Data Unavailable								
07/29/06	Data Unavailable								
07/30/06	Data Unavailable								
07/31/06	10:40	INST	8.0	15	0.00	+0.0%	2.90	-34.0%	FAIL
07/31/06	10:50	SYST	8.0	15	-0.28	-1.9%	7.94	-0.4%	PASS
07/31/06	15:00	INST	8.0	15	0.02	+0.1%	2.88	-34.1%	FAIL
07/31/06	15:21	INST	8.0	15	0.00	+0.0%	2.97	-33.5%	FAIL
07/31/06	17:00	INST	8.0	15	0.01	+0.1%	2.97	-33.5%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/31/06	17:20	SYST	8.0	15	-0.43	-2.9%	8.14	+0.9%	PASS
08/01/06	05:00	INST	8.0	15	0.01	+0.1%	3.01	-33.3%	FAIL
08/01/06	05:20	SYST	8.0	15	-0.39	-2.6%	8.10	+0.7%	PASS
08/01/06	07:40	ORIF	8.0	15	0.11	+0.7%	8.20	+1.3%	PASS
08/01/06	12:42	INST	8.0	15	0.01	+0.1%	3.01	-33.3%	FAIL
08/01/06	12:59	ORIF	8.0	15	0.17	+1.1%	8.08	+0.5%	PASS
08/01/06	13:17	SYST	8.0	15	0.02	+0.1%	7.82	-1.2%	PASS
08/01/06	16:26	INST	8.0	15	0.04	+0.3%	2.95	-33.7%	FAIL
08/01/06	16:38	SYST	8.0	15	-2.76	-18.4%	8.84	+5.6%	FAIL
08/01/06	20:33	INST	8.0	15	0.04	+0.3%	3.03	-33.1%	FAIL
08/02/06	07:40	ORIF	8.0	15	-1.14	-7.6%	7.43	-3.8%	FAIL
08/02/06	08:33	INST	8.0	15	-0.01	-0.1%	3.02	-33.2%	FAIL
08/02/06	08:53	SYST	8.0	15	-0.31	-2.1%	7.97	-0.2%	PASS
08/02/06	20:33	INST	8.0	15	0.02	+0.1%	2.89	-34.1%	FAIL
08/02/06	20:43	SYST	8.0	15	-1.09	-7.3%	7.89	-0.7%	FAIL
08/03/06	07:40	ORIF	8.0	15	0.02	+0.1%	8.38	+2.5%	PASS
08/03/06	08:33	INST	8.0	15	0.04	+0.3%	2.90	-34.0%	FAIL
08/03/06	08:43	SYST	8.0	15	-0.77	-5.1%	7.89	-0.7%	PASS
08/03/06	20:33	INST	8.0	15	0.03	+0.2%	2.88	-34.1%	FAIL
08/03/06	20:43	SYST	8.0	15	-0.85	-5.7%	8.15	+1.0%	PASS
08/04/06	07:40	ORIF	8.0	15	0.22	+1.5%	8.24	+1.6%	PASS
08/04/06	08:33	INST	8.0	15	0.04	+0.3%	2.91	-33.9%	FAIL
08/04/06	20:33	INST	8.0	15	0.02	+0.1%	2.92	-33.9%	FAIL
08/04/06	20:43	SYST	8.0	15	-1.49	-9.9%	7.66	-2.3%	FAIL
08/05/06	07:41	ORIF	8.0	15	0.01	+0.1%	8.48	+3.2%	PASS
08/05/06	08:33	INST	8.0	15	0.12	+0.8%	2.87	-34.2%	FAIL
08/05/06	08:43	SYST	8.0	15	-2.85	-19.0%	8.30	+2.0%	FAIL
08/05/06	20:33	INST	8.0	15	0.15	+1.0%	2.88	-34.1%	FAIL
08/05/06	20:43	SYST	8.0	15	-3.21	-21.4%	7.95	-0.3%	FAIL
08/06/06	07:41	ORIF	8.0	15	0.15	+1.0%	8.21	+1.4%	PASS
08/06/06	08:33	INST	8.0	15	0.15	+1.0%	2.90	-34.0%	FAIL
08/06/06	20:33	INST	8.0	15	0.05	+0.3%	3.01	-33.3%	FAIL
08/07/06	07:41	ORIF	8.0	15	-0.21	-1.4%	7.82	-1.2%	PASS
08/07/06	08:33	INST	8.0	15	0.04	+0.3%	2.88	-34.1%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/07/06	08:43	SYST	8.0	15	-1.10	-7.3%	7.37	-4.2%	FAIL
08/07/06	20:33	INST	8.0	15	0.04	+0.3%	2.90	-34.0%	FAIL
08/08/06	07:41	ORIF	8.0	15	0.06	+0.4%	8.84	+5.6%	PASS
08/08/06	08:33	INST	8.0	15	0.04	+0.3%	2.91	-33.9%	FAIL
08/09/06	07:41	ORIF	8.0	15	-0.06	-0.4%	8.73	+4.9%	PASS
08/10/06	07:41	ORIF	8.0	15	-1.38	-9.2%	7.26	-4.9%	FAIL
08/11/06	07:41	ORIF	8.0	15	-1.02	-6.8%	7.83	-1.1%	FAIL
08/12/06	07:41	ORIF	8.0	15	0.13	+0.9%	8.71	+4.7%	PASS
08/13/06	07:41	ORIF	8.0	15	0.23	+1.5%	9.03	+6.9%	FAIL
08/14/06	07:41	ORIF	11.0	20	-0.91	-4.6%	10.93	-0.4%	PASS
08/15/06	07:50	SYST	11.0	20	-0.09	-0.5%	10.31	-3.5%	PASS
08/15/06	12:50	SYST	11.0	20	1.98	+9.9%	11.49	+2.5%	FAIL
08/16/06	00:50	SYST	11.0	20	-0.04	-0.2%	10.28	-3.6%	PASS
08/17/06	No Calibration Check – Maintenance Activities								
08/18/06	07:41	ORIF	11.0	20	0.05	+0.3%	10.82	-0.9%	PASS
08/19/06	07:36	ORIF	11.0	20	0.30	+1.5%	11.21	+1.1%	PASS
08/20/06	07:36	ORIF	11.0	20	-0.01	-0.1%	11.37	+1.9%	PASS
08/20/06	09:14	SYST	11.0	20	0.05	+0.3%	10.90	-0.5%	PASS
08/21/06	07:36	ORIF	11.0	20	0.52	+2.6%	11.48	+2.4%	PASS
08/22/06	07:36	ORIF	11.0	20	-0.49	-2.5%	11.13	+0.7%	PASS
08/23/06	07:36	ORIF	11.0	20	0.07	+0.4%	10.77	-1.2%	PASS
08/24/06	07:36	ORIF	11.0	20	-0.12	-0.6%	10.92	-0.4%	PASS
08/25/06	07:36	ORIF	11.0	20	0.08	+0.4%	11.03	+0.1%	PASS
08/26/06	07:36	ORIF	11.0	20	-0.21	-1.1%	10.95	-0.3%	PASS
08/27/06	07:36	ORIF	11.0	20	-0.39	-2.0%	10.65	-1.8%	PASS
08/28/06	07:36	ORIF	11.0	20	0.02	+0.1%	11.07	+0.4%	PASS
08/29/06	07:36	ORIF	11.0	20	0.10	+0.5%	10.74	-1.3%	PASS
08/30/06	07:36	ORIF	5.0	10	-0.10	-1.0%	5.11	+1.1%	PASS
08/31/06	07:36	ORIF	5.0	10	-0.15	-1.5%	5.11	+1.1%	PASS
09/01/06	07:36	ORIF	5.0	10	-0.12	-1.2%	5.06	+0.6%	PASS
09/02/06	07:36	ORIF	5.0	10	0.15	+1.5%	5.20	+2.0%	PASS
09/03/06	07:36	ORIF	5.0	10	0.10	+1.0%	5.20	+2.0%	PASS
09/04/06	07:36	ORIF	5.0	10	-0.05	-0.5%	5.30	+3.0%	PASS
09/05/06	07:36	ORIF	5.0	10	-0.11	-1.1%	5.25	+2.5%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
09/06/06	07:36	ORIF	5.0	10	0.11	+1.1%	5.20	+2.0%	PASS
09/07/06	Data Unavailable								
09/08/06	07:36	ORIF	5.0	10	0.33	+3.3%	5.43	+4.3%	PASS
09/09/06	07:37	ORIF	5.0	10	0.02	+0.2%	5.26	+2.6%	PASS
09/10/06	07:37	ORIF	5.0	10	0.11	+1.1%	5.12	+1.2%	PASS
09/11/06	07:37	ORIF	5.0	10	0.22	+2.2%	5.36	+3.6%	PASS
09/12/06	07:37	ORIF	5.0	10	0.17	+1.7%	5.31	+3.1%	PASS
09/13/06	07:37	ORIF	5.0	10	-0.27	-2.7%	5.14	+1.4%	PASS
09/14/06	07:37	ORIF	5.0	10	-0.02	-0.2%	5.19	+1.9%	PASS
09/15/06	07:37	ORIF	5.0	10	-0.15	-1.5%	5.27	+2.7%	PASS
09/16/06	07:37	ORIF	5.0	10	0.38	+3.8%	5.46	+4.6%	PASS
09/17/06	07:37	ORIF	5.0	10	0.19	+1.9%	5.31	+3.1%	PASS
09/18/06	07:37	ORIF	5.0	10	0.10	+1.0%	5.49	+4.9%	PASS
09/19/06	07:37	ORIF	5.0	10	0.22	+2.2%	5.19	+1.9%	PASS
09/20/06	07:37	ORIF	5.0	10	0.47	+4.7%	5.21	+2.1%	PASS
09/21/06	07:37	ORIF	5.0	10	0.41	+4.1%	5.30	+3.0%	PASS
09/23/06	07:37	ORIF	5.0	10	0.28	+2.8%	5.32	+3.2%	PASS
09/24/06	07:37	ORIF	5.0	10	0.47	+4.7%	5.61	+6.1%	PASS
09/25/06	07:37	ORIF	5.0	10	0.47	+4.7%	5.33	+3.3%	PASS
09/26/06	07:37	ORIF	5.0	10	0.01	+0.1%	5.12	+1.2%	PASS
09/27/06	07:37	ORIF	5.0	10	-0.10	-1.0%	5.29	+2.9%	PASS
09/28/06	07:37	ORIF	5.0	10	0.04	+0.4%	5.46	+4.6%	PASS
09/28/06	13:26	SYST	5.0	10	-0.05	-0.5%	4.95	-0.5%	PASS
09/29/06	07:37	SYST	5.0	10	0.15	+1.5%	5.12	+1.2%	PASS
09/30/06	07:37	SYST	5.0	10	0.30	+3.0%	5.32	+3.2%	PASS
10/01/06	07:37	SYST	5.0	10	0.33	+3.3%	5.37	+3.7%	PASS
10/02/06	07:37	SYST	5.0	10	0.22	+2.2%	5.64	+6.4%	PASS
10/03/06	07:37	SYST	5.0	10	0.61	+6.1%	5.50	+5.0%	PASS
10/04/06	07:37	SYST	5.0	10	-0.55	-5.5%	5.01	+0.1%	PASS
10/05/06	07:37	SYST	5.0	10	-0.08	-0.8%	5.30	+3.0%	PASS
10/06/06	07:37	SYST	5.0	10	-0.02	-0.2%	4.80	-2.0%	PASS
10/07/06	07:37	SYST	5.0	10	-0.19	-1.9%	4.94	-0.6%	PASS
10/08/06	07:37	SYST	5.0	10	0.14	+1.4%	4.82	-1.8%	PASS
10/09/06	07:37	SYST	5.0	10	-0.06	-0.6%	5.19	+1.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
10/10/06	07:37	SYST	5.0	10	0.19	+1.9%	4.92	-0.8%	PASS
10/11/06	07:37	SYST	5.0	10	-0.33	-3.3%	4.63	-3.7%	PASS
10/12/06	07:37	SYST	5.0	10	-0.12	-1.2%	4.81	-1.9%	PASS
10/13/06	07:37	SYST	5.0	10	0.17	+1.7%	4.96	-0.4%	PASS
10/14/06	07:37	SYST	5.0	10	0.09	+0.9%	5.28	+2.8%	PASS
10/15/06	07:37	SYST	5.0	10	0.16	+1.6%	5.55	+5.5%	PASS
10/16/06	07:37	SYST	5.0	10	0.31	+3.1%	5.44	+4.4%	PASS
10/17/06	07:37	SYST	5.0	10	0.30	+3.0%	5.85	+8.5%	PASS
10/18/06	07:37	SYST	5.0	10	-0.11	-1.1%	4.70	-3.0%	PASS
10/19/06	07:37	SYST	5.0	10	-0.21	-2.1%	4.71	-2.9%	PASS
10/20/06	07:37	SYST	5.0	10	0.08	+0.8%	4.57	-4.3%	PASS
10/21/06	07:37	SYST	5.0	10	-0.10	-1.0%	4.65	-3.5%	PASS
10/22/06	07:37	SYST	5.0	10	0.07	+0.7%	4.62	-3.8%	PASS
10/23/06	07:37	SYST	5.0	10	0.14	+1.4%	5.04	+0.4%	PASS
10/24/06	07:37	SYST	5.0	10	0.59	+5.9%	5.12	+1.2%	PASS
10/25/06	07:37	SYST	5.0	10	-0.05	-0.5%	4.40	-6.0%	PASS
10/26/06	07:37	SYST	5.0	10	0.12	+1.2%	4.44	-5.6%	PASS
10/27/06	07:37	SYST	5.0	10	-0.17	-1.7%	4.61	-3.9%	PASS
10/28/06	07:37	SYST	5.0	10	0.05	+0.5%	4.52	-4.8%	PASS
10/29/06	07:37	SYST	5.0	10	0.03	+0.3%	4.41	-5.9%	PASS
10/30/06	07:37	SYST	5.0	10	0.08	+0.8%	4.47	-5.3%	PASS
10/31/06	07:37	SYST	5.0	10	0.28	+2.8%	4.94	-0.6%	PASS
11/01/06	07:37	SYST	5.0	10	0.18	+1.8%	5.01	+0.1%	PASS
11/02/06	07:37	SYST	5.0	10	0.04	+0.4%	5.13	+1.3%	PASS
11/03/06	07:37	SYST	5.0	10	0.65	+6.5%	5.52	+5.2%	PASS
11/04/06	07:37	SYST	5.0	10	0.79	+7.9%	5.85	+8.5%	PASS
11/05/06	07:37	SYST	5.0	10	1.35	+13.5%	6.16	+11.6%	FAIL
11/06/06	07:37	SYST	5.0	10	1.03	+10.3%	6.33	+13.3%	FAIL
11/07/06	07:37	SYST	5.0	10	0.99	+9.9%	6.30	+13.0%	FAIL
11/08/06	07:37	SYST	5.0	10	0.03	+0.3%	4.56	-4.4%	PASS
11/09/06	07:37	SYST	5.0	10	0.26	+2.6%	4.84	-1.6%	PASS
11/10/06	Data Unavailable								
11/11/06	Data Unavailable								
11/12/06	Data Unavailable								

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
11/13/06	Data Unavailable								
11/14/06	07:37	SYST	5.0	10	0.01	+0.1%	5.11	+1.1%	PASS
11/15/06	07:37	SYST	5.0	10	0.11	+1.1%	5.49	+4.9%	PASS
11/16/06	07:37	SYST	5.0	10	0.21	+2.1%	5.61	+6.1%	PASS
11/17/06	07:37	SYST	5.0	10	0.02	+0.2%	5.15	+1.5%	PASS
11/18/06	07:37	SYST	5.0	10	0.32	+3.2%	5.47	+4.7%	PASS
11/19/06	07:37	SYST	5.0	10	0.62	+6.2%	5.72	+7.2%	PASS
11/20/06	07:37	SYST	5.0	10	0.62	+6.2%	5.71	+7.1%	PASS
11/21/06	07:37	SYST	5.0	10	0.35	+3.5%	5.43	+4.3%	PASS
11/22/06	07:37	SYST	5.0	10	0.77	+7.7%	5.82	+8.2%	PASS
11/23/06	07:37	SYST	5.0	10	0.61	+6.1%	6.04	+10.4%	FAIL
11/24/06	07:37	SYST	5.0	10	0.57	+5.7%	5.88	+8.8%	PASS
11/25/06	07:37	SYST	5.0	10	0.41	+4.1%	6.00	+10.0%	FAIL
11/26/06	07:37	SYST	5.0	10	0.39	+3.9%	5.62	+6.2%	PASS
11/27/06	07:37	SYST	5.0	10	0.52	+5.2%	5.79	+7.9%	PASS
11/28/06	07:37	SYST	5.0	10	0.26	+2.6%	5.56	+5.6%	PASS
11/29/06	07:37	SYST	5.0	10	-0.09	-0.9%	4.96	-0.4%	PASS
11/30/06	07:37	SYST	5.0	10	-0.01	-0.1%	4.75	-2.5%	PASS
12/01/06	07:37	SYST	5.0	10	-0.04	-0.4%	4.94	-0.6%	PASS
12/02/06	07:37	SYST	5.0	10	0.12	+1.2%	4.97	-0.3%	PASS
12/03/06	07:37	SYST	5.0	10	-0.06	-0.6%	4.80	-2.0%	PASS
12/04/06	07:37	SYST	5.0	10	-0.07	-0.7%	4.78	-2.2%	PASS
12/05/06	07:37	SYST	5.0	10	0.18	+1.8%	4.52	-4.8%	PASS
12/06/06	07:37	SYST	5.0	10	0.07	+0.7%	5.13	+1.3%	PASS
12/07/06	07:37	SYST	5.0	10	0.39	+3.9%	4.84	-1.6%	PASS
12/08/06	07:37	SYST	5.0	10	0.05	+0.5%	4.88	-1.2%	PASS
12/09/06	07:37	SYST	5.0	10	0.16	+1.6%	5.27	+2.7%	PASS
12/10/06	07:37	SYST	5.0	10	0.38	+3.8%	5.06	+0.6%	PASS
12/11/06	07:37	SYST	5.0	10	0.57	+5.7%	5.12	+1.2%	PASS
12/12/06	07:37	SYST	5.0	10	0.35	+3.5%	5.07	+0.7%	PASS
12/13/06	07:37	SYST	5.0	10	-0.13	-1.3%	4.60	-4.0%	PASS
12/14/06	07:37	SYST	5.0	10	-0.43	-4.3%	4.87	-1.3%	PASS
12/15/06	07:37	SYST	5.0	10	0.39	+3.9%	5.19	+1.9%	PASS
12/16/06	07:37	SYST	5.0	10	0.34	+3.4%	5.28	+2.8%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
12/17/06	07:37	SYST	5.0	10	0.47	+4.7%	5.17	+1.7%	PASS
12/18/06	07:37	SYST	5.0	10	0.57	+5.7%	5.39	+3.9%	PASS
12/19/06	07:37	SYST	5.0	10	-0.73	-7.3%	4.44	-5.6%	PASS
12/20/06	07:37	SYST	5.0	10	-0.47	-4.7%	4.78	-2.2%	PASS
12/21/06	07:37	SYST	5.0	10	-0.16	-1.6%	5.02	+0.2%	PASS
12/22/06	07:37	SYST	5.0	10	-0.07	-0.7%	5.07	+0.7%	PASS
12/23/06	Data Unavailable								
12/24/06	Data Unavailable								
12/25/06	Data Unavailable								
12/26/06	Data Unavailable								
12/27/06	Data Unavailable								
12/28/06	07:38	SYST	5.0	10	-0.59	-5.9%	5.17	+1.7%	PASS
12/29/06	07:38	SYST	5.0	10	-0.27	-2.7%	5.14	+1.4%	PASS
12/30/06	07:38	SYST	5.0	10	0.10	+1.0%	5.13	+1.3%	PASS
12/31/06	07:38	SYST	5.0	10	0.19	+1.9%	5.24	+2.4%	PASS
01/01/07	07:38	SYST	5.0	10	0.25	+2.5%	5.34	+3.4%	PASS
01/02/07	07:38	SYST	5.0	10	-0.13	-1.3%	5.39	+3.9%	PASS
01/03/07	07:38	SYST	5.0	10	-0.16	-1.6%	4.98	-0.2%	PASS
01/04/07	07:38	SYST	5.0	10	-0.05	-0.5%	4.94	-0.6%	PASS
01/05/07	07:38	SYST	5.0	10	-0.26	-2.6%	5.00	+0.0%	PASS
01/06/07	07:38	SYST	5.0	10	-0.30	-3.0%	5.44	+4.4%	PASS
01/07/07	07:38	SYST	5.0	10	-0.26	-2.6%	4.81	-1.9%	PASS
01/08/07	07:38	SYST	5.0	10	-0.06	-0.6%	5.19	+1.9%	PASS
01/09/07	07:38	SYST	5.0	10	0.10	+1.0%	5.50	+5.0%	PASS
01/10/07	07:38	SYST	5.0	10	0.18	+1.8%	5.04	+0.4%	PASS
01/11/07	07:38	SYST	5.0	10	-0.21	-2.1%	4.94	-0.6%	PASS
01/12/07	07:38	SYST	5.0	10	0.17	+1.7%	5.19	+1.9%	PASS
01/13/07	07:38	SYST	5.0	10	0.04	+0.4%	5.26	+2.6%	PASS
01/14/07	07:38	SYST	5.0	10	-0.04	-0.4%	4.50	-5.0%	PASS
01/15/07	07:38	SYST	5.0	10	-0.03	-0.3%	4.82	-1.8%	PASS
01/16/07	07:38	SYST	5.0	10	-0.02	-0.2%	5.02	+0.2%	PASS
01/17/07	07:38	SYST	5.0	10	-0.13	-1.3%	4.74	-2.6%	PASS
01/18/07	07:38	SYST	5.0	10	0.23	+2.3%	4.87	-1.3%	PASS
01/19/07	07:38	SYST	5.0	10	-0.25	-2.5%	5.20	+2.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/20/07	07:38	SYST	5.0	10	0.00	+0.0%	5.06	+0.6%	PASS
01/21/07	07:38	SYST	5.0	10	0.24	+2.4%	4.94	-0.6%	PASS
01/22/07	07:38	SYST	5.0	10	0.29	+2.9%	4.56	-4.4%	PASS
01/23/07	07:38	SYST	5.0	10	0.35	+3.5%	5.41	+4.1%	PASS
01/24/07	No Calibration Check – Maintenance Activities								
01/25/07	07:42	SYST	10.0	10	-0.07	-0.7%	9.98	-0.2%	PASS
01/26/07	07:42	SYST	10.0	10	-0.19	-1.9%	9.94	-0.6%	PASS
01/27/07	07:42	SYST	10.0	10	0.47	+4.7%	10.14	+1.4%	PASS
01/28/07	07:42	SYST	10.0	10	-0.07	-0.7%	10.08	+0.8%	PASS
01/28/07	08:40	SYST	10.0	10	-0.05	-0.5%	9.93	-0.7%	PASS
01/29/07	07:42	SYST	10.0	10	0.34	+3.4%	10.58	+5.8%	PASS
01/30/07	07:42	SYST	10.0	10	0.02	+0.2%	10.33	+3.3%	PASS
01/31/07	07:42	SYST	10.0	10	-0.08	-0.8%	9.51	-4.9%	PASS
02/01/07	No Calibration Check								
02/02/07	07:42	SYST	5.0	10	0.04	+0.4%	5.12	+1.2%	PASS
02/03/07	07:42	SYST	5.0	10	-0.33	-3.3%	4.63	-3.7%	PASS
02/04/07	07:42	SYST	5.0	10	0.00	+0.0%	5.34	+3.4%	PASS
02/05/07	07:42	SYST	5.0	10	0.19	+1.9%	5.24	+2.4%	PASS
02/06/07	07:42	SYST	5.0	10	0.28	+2.8%	5.13	+1.3%	PASS
02/07/07	07:42	SYST	5.0	10	-0.90	-9.0%	4.28	-7.2%	PASS
02/08/07	07:38	SYST	5.0	10	-0.70	-7.0%	5.52	+5.2%	PASS
02/09/07	07:38	SYST	5.0	10	-0.33	-3.3%	5.58	+5.8%	PASS
02/10/07	07:38	SYST	5.0	10	-0.01	-0.1%	5.09	+0.9%	PASS
02/11/07	07:38	SYST	5.0	10	0.00	+0.0%	4.97	-0.3%	PASS
02/12/07	07:38	SYST	5.0	10	0.25	+2.5%	5.64	+6.4%	PASS
02/13/07	07:38	SYST	5.0	10	0.71	+7.1%	5.57	+5.7%	PASS
02/14/07	07:38	SYST	5.0	10	-0.30	-3.0%	5.13	+1.3%	PASS
02/15/07	07:38	SYST	5.0	10	-0.01	-0.1%	5.03	+0.3%	PASS
02/16/07	07:38	SYST	5.0	10	-0.13	-1.3%	5.33	+3.3%	PASS
02/17/07	07:38	SYST	5.0	10	0.11	+1.1%	5.43	+4.3%	PASS
02/18/07	07:38	SYST	5.0	10	-0.12	-1.2%	4.85	-1.5%	PASS
02/19/07	07:38	SYST	5.0	10	-0.05	-0.5%	5.57	+5.7%	PASS
02/20/07	07:38	SYST	5.0	10	0.21	+2.1%	5.46	+4.6%	PASS
02/21/07	07:38	SYST	5.0	10	0.19	+1.9%	5.20	+2.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/22/07	07:38	SYST	5.0	10	-0.07	-0.7%	5.46	+4.6%	PASS
02/23/07	07:38	SYST	5.0	10	0.43	+4.3%	5.67	+6.7%	PASS
02/24/07	07:38	SYST	5.0	10	0.21	+2.1%	4.85	-1.5%	PASS
02/24/07	22:36	INST	5.0	10	0.05	+0.5%	5.26	+2.6%	PASS
02/25/07	07:39	SYST	5.0	10	-9.67	-96.7%	-4.46	-94.6%	FAIL
02/26/07	07:39	SYST	5.0	10	0.04	+0.4%	4.99	-0.1%	PASS
02/27/07	07:39	SYST	5.0	10	0.05	+0.5%	5.04	+0.4%	PASS
02/28/07	07:39	SYST	5.0	10	0.08	+0.8%	5.12	+1.2%	PASS
03/01/07	07:39	SYST	5.0	10	0.07	+0.7%	5.03	+0.3%	PASS
03/02/07	07:39	SYST	5.0	10	-0.09	-0.9%	4.72	-2.8%	PASS
03/03/07	07:39	SYST	5.0	10	-0.04	-0.4%	4.85	-1.5%	PASS
03/04/07	07:39	SYST	5.0	10	0.08	+0.8%	4.85	-1.5%	PASS
03/05/07	07:39	SYST	5.0	10	0.16	+1.6%	4.92	-0.8%	PASS
03/06/07	07:39	SYST	5.0	10	0.23	+2.3%	4.91	-0.9%	PASS
03/07/07	07:39	SYST	5.0	10	0.25	+2.5%	5.12	+1.2%	PASS
03/08/07	07:39	SYST	5.0	10	0.23	+2.3%	5.08	+0.8%	PASS
03/09/07	07:39	SYST	5.0	10	0.07	+0.7%	4.93	-0.7%	PASS
03/10/07	07:39	SYST	5.0	10	-0.04	-0.4%	4.98	-0.2%	PASS
03/11/07	07:39	SYST	5.0	10	0.07	+0.7%	4.83	-1.7%	PASS
03/12/07	07:39	SYST	5.0	10	-0.02	-0.2%	4.94	-0.6%	PASS
03/13/07	No Calibration Check – Maintenance Activities – Mercuric Chloride Generator Test								
03/14/07	No Calibration Check – Maintenance Activities – Mercuric Chloride Generator Test								
03/15/07	No Calibration Check – Maintenance Activities – Mercuric Chloride Generator Test								
03/16/07	07:40	SYST	10.0	10	-0.03	-0.3%	8.59	-14.1%	FAIL
03/17/07	07:40	SYST	10.0	10	-0.15	-1.5%	9.55	-4.5%	PASS
03/18/07	07:40	SYST	10.0	10	-0.09	-0.9%	9.40	-6.0%	PASS
03/19/07	07:40	SYST	10.0	10	0.28	+2.8%	10.62	+6.2%	PASS
03/20/07	07:40	SYST	10.0	10	-0.19	-1.9%	9.66	-3.4%	PASS
03/21/07	07:40	SYST	10.0	10	0.15	+1.5%	10.10	+1.0%	PASS
03/22/07	07:40	SYST	5.0	10	0.96	+9.6%	6.40	+14.0%	FAIL
03/23/07	07:40	SYST	5.0	10	0.05	+0.5%	4.85	-1.5%	PASS
03/24/07	07:40	SYST	5.0	10	0.04	+0.4%	4.93	-0.7%	PASS
03/25/07	07:40	SYST	5.0	10	0.45	+4.5%	5.67	+6.7%	PASS
03/26/07	07:40	SYST	5.0	10	0.79	+7.9%	6.19	+11.9%	FAIL

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/27/07	07:40	SYST	5.0	10	0.06	+0.6%	5.04	+0.4%	PASS
03/28/07	07:40	SYST	5.0	10	0.22	+2.2%	5.15	+1.5%	PASS
03/29/07	07:40	SYST	5.0	10	0.26	+2.6%	5.23	+2.3%	PASS
03/30/07	07:40	SYST	5.0	10	0.25	+2.5%	5.22	+2.2%	PASS
03/31/07	07:40	SYST	5.0	10	0.15	+1.5%	4.82	-1.8%	PASS
04/01/07	07:40	SYST	5.0	10	0.12	+1.2%	4.62	-3.8%	PASS
04/02/07	07:40	SYST	5.0	10	0.06	+0.6%	4.67	-3.3%	PASS
04/03/07	07:40	SYST	5.0	10	-0.05	-0.5%	4.54	-4.6%	PASS
04/04/07	07:40	SYST	5.0	10	0.15	+1.5%	5.11	+1.1%	PASS
04/04/07	12:15	SYST	5.0	10	0.05	+0.5%	5.21	+2.1%	PASS
04/05/07	07:40	SYST	5.0	10	-0.31	-3.1%	5.04	+0.4%	PASS
04/06/07	07:40	SYST	5.0	10	-0.03	-0.3%	4.85	-1.5%	PASS
04/07/07	07:40	SYST	5.0	10	-0.17	-1.7%	5.00	0.0%	PASS
04/08/07	07:40	SYST	5.0	10	-0.53	-5.3%	4.95	-0.5%	PASS
04/09/07	07:40	SYST	5.0	10	-0.21	-2.1%	5.02	+0.2%	PASS
04/10/07	07:41	SYST	5.0	10	-0.03	-0.3%	5.15	+1.5%	PASS
04/11/07	07:41	SYST	5.0	10	0.05	+0.5%	5.10	+1.0%	PASS
04/12/07	07:41	SYST	5.0	10	-0.36	-3.6%	4.80	-2.0%	PASS
04/13/07	07:41	SYST	5.0	10	-0.29	-2.9%	4.96	-0.4%	PASS
04/14/07	07:41	SYST	5.0	10	-0.47	-4.7%	5.06	+0.6%	PASS
04/15/07	07:41	SYST	5.0	10	-0.04	-0.4%	4.91	-0.9%	PASS
04/16/07	07:41	SYST	5.0	10	0.41	+4.1%	5.58	+5.8%	PASS
04/17/07	07:41	SYST	5.0	10	0.39	+3.9%	5.52	+5.2%	PASS
04/18/07	07:41	SYST	5.0	10	-0.02	-0.2%	4.96	-0.4%	PASS
04/19/07	07:41	SYST	5.0	10	0.02	+0.2%	4.71	-2.9%	PASS
04/20/07	07:41	SYST	5.0	10	0.04	+0.4%	4.93	-0.7%	PASS
04/21/07	07:41	SYST	5.0	10	-0.22	-2.2%	4.89	-1.1%	PASS
04/22/07	07:41	SYST	5.0	10	-0.06	-0.6%	4.84	-1.6%	PASS
04/23/07	07:41	SYST	5.0	10	-0.41	-4.1%	4.61	-3.9%	PASS
04/24/07	07:41	SYST	5.0	10	0.09	+0.9%	5.14	+1.4%	PASS
04/25/07	07:41	SYST	5.0	10	0.50	+5.0%	5.44	+4.4%	PASS
04/26/07	07:41	SYST	5.0	10	0.40	+4.0%	5.56	+5.6%	PASS
04/27/07	07:41	SYST	5.0	10	-0.27	-2.7%	4.72	-2.8%	PASS
04/28/07	07:41	SYST	5.0	10	-0.23	-2.3%	4.97	-0.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
04/29/07	07:41	SYST	5.0	10	0.17	+1.7%	4.77	-2.3%	PASS
04/30/07	07:41	SYST	5.0	10	0.03	+0.3%	5.00	+0.0%	PASS
05/01/07	07:41	SYST	5.0	10	-0.32	-3.2%	4.52	-4.8%	PASS
05/02/07	07:41	SYST	5.0	10	-0.40	-4.0%	4.57	-4.3%	PASS
05/03/07	07:41	SYST	5.0	10	-0.28	-2.8%	4.75	-2.5%	PASS
05/04/07	07:41	SYST	5.0	10	-0.25	-2.5%	4.76	-2.4%	PASS
05/05/07	07:41	SYST	5.0	10	0.07	+0.7%	5.21	+2.1%	PASS
05/06/07	07:41	SYST	5.0	10	0.25	+2.5%	4.99	-0.1%	PASS
05/07/07	07:41	SYST	5.0	10	0.28	+2.8%	4.98	-0.2%	PASS
05/08/07	07:41	SYST	5.0	10	-0.83	-8.3%	4.54	-4.6%	PASS
05/09/07	07:41	SYST	5.0	10	-0.06	-0.6%	4.80	-2.0%	PASS
05/10/07	07:40	SYST	5.0	10	-0.32	-3.2%	4.77	-2.3%	PASS
05/11/07	07:40	SYST	5.0	10	-0.23	-2.3%	4.83	-1.7%	PASS
05/12/07	07:40	SYST	5.0	10	0.01	+0.1%	4.89	-1.1%	PASS
05/13/07	07:40	SYST	5.0	10	0.07	+0.7%	5.11	+1.1%	PASS
05/14/07	07:40	SYST	5.0	10	0.15	+1.5%	4.81	-1.9%	PASS
05/15/07	07:40	SYST	5.0	10	-0.40	-4.0%	4.62	-3.8%	PASS
05/16/07	07:40	SYST	5.0	10	-0.05	-0.5%	4.86	-1.4%	PASS
05/17/07	07:40	SYST	5.0	10	0.39	+3.9%	4.82	-1.8%	PASS
05/18/07	07:40	SYST	5.0	10	0.32	+3.2%	4.77	-2.3%	PASS
05/19/07	07:40	SYST	5.0	10	-0.02	-0.2%	0.47	-45.3%	FAIL
05/20/07	07:40	SYST	5.0	10	0.00	+0.0%	0.46	-45.4%	FAIL
05/21/07	07:40	SYST	5.0	10	0.07	+0.7%	0.54	-44.6%	FAIL
05/21/07	16:47	SYST	5.0	10	0.08	+0.8%	4.99	-0.1%	PASS
05/22/07	07:40	SYST	5.0	10	-0.60	-6.0%	3.95	-10.5%	FAIL
05/23/07	07:40	SYST	5.0	10	-0.89	-8.9%	4.36	-6.4%	PASS
05/24/07	07:41	SYST	5.0	10	-0.16	-1.6%	4.54	-4.6%	PASS
05/25/07	07:41	SYST	5.0	10	-0.06	-0.6%	5.07	+0.7%	PASS
05/25/07	16:16	SYST	5.0	10	0.00	+0.0%	4.91	-0.9%	PASS
05/26/07	07:41	SYST	5.0	10	0.02	+0.2%	4.94	-0.6%	PASS
05/27/07	07:41	SYST	5.0	10	0.06	+0.6%	7.25	+22.5%	FAIL
05/28/07	07:41	SYST	5.0	10	0.09	+0.9%	7.43	+24.3%	FAIL
05/29/07	07:41	SYST	5.0	10	0.08	+0.8%	5.06	+0.6%	PASS
05/30/07	07:41	SYST	5.0	10	-0.01	-0.1%	4.78	-2.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/31/07	07:41	SYST	5.0	10	-0.02	-0.2%	4.62	-3.8%	PASS
06/01/07	07:41	SYST	5.0	10	-0.01	-0.1%	4.35	-6.5%	PASS
06/01/07	15:24	SYST	5.0	10	-0.01	-0.1%	4.97	-0.3%	PASS
06/02/07	07:41	SYST	5.0	10	0.02	+0.2%	4.92	-0.8%	PASS
06/03/07	07:41	SYST	5.0	10	0.09	+0.9%	5.06	+0.6%	PASS
06/04/07	07:41	SYST	5.0	10	0.42	+4.2%	5.56	+5.6%	PASS
06/05/07	07:41	SYST	5.0	10	-0.04	-0.4%	4.96	-0.4%	PASS
06/06/07	07:42	SYST	5.0	10	-0.07	-0.7%	4.96	-0.4%	PASS
06/07/07	07:42	SYST	5.0	10	-0.23	-2.3%	5.08	+0.8%	PASS
06/08/07	07:25	SYST	5.0	10	0.07	+0.7%	5.45	+4.5%	PASS
06/08/07	07:42	SYST	5.0	10	0.04	+0.4%	5.34	+3.4%	PASS
06/09/07	07:42	SYST	5.0	10	0.05	+0.5%	5.46	+4.6%	PASS
06/10/07	07:42	SYST	5.0	10	0.06	+0.6%	5.51	+5.1%	PASS
06/11/07	07:42	SYST	5.0	10	0.07	+0.7%	5.59	+5.9%	PASS
06/12/07	07:42	SYST	5.0	10	0.06	+0.6%	5.61	+6.1%	PASS
06/13/07	07:42	SYST	5.0	10	0.06	+0.6%	5.58	+5.8%	PASS
06/14/07	07:42	SYST	5.0	10	0.07	+0.7%	5.65	+6.5%	PASS
06/15/07	07:42	SYST	5.0	10	0.17	+1.7%	5.73	+7.3%	PASS
06/16/07	07:42	SYST	5.0	10	0.10	+1.0%	5.68	+6.8%	PASS
06/17/07	07:42	SYST	5.0	10	0.12	+1.2%	5.72	+7.2%	PASS
06/18/07	07:42	SYST	5.0	10	0.15	+1.5%	5.74	+7.4%	PASS
06/19/07	05:47	SYST	5.0	10	-0.02	-0.2%	4.96	-0.4%	PASS
06/20/07	04:40	SYST	5.0	10	0.00	+0.0%	5.03	+0.3%	PASS
06/21/07	06:00	SYST	5.0	10	0.04	+0.4%	5.05	+0.5%	PASS
06/22/07	06:00	SYST	5.0	10	-0.02	-0.2%	5.01	+0.1%	PASS
06/23/07	06:00	SYST	5.0	10	-0.03	-0.3%	4.99	-0.1%	PASS
06/24/07	06:00	SYST	5.0	10	-0.03	-0.3%	5.01	+0.1%	PASS
06/25/07	06:00	SYST	5.0	10	-0.02	-0.2%	5.05	+0.5%	PASS
06/26/07	06:00	SYST	5.0	10	-0.02	-0.2%	5.08	+0.8%	PASS
06/27/07	06:00	SYST	5.0	10	-0.02	-0.2%	5.00	+0.0%	PASS
06/28/07	06:00	SYST	5.0	10	-0.02	-0.2%	5.04	+0.4%	PASS
06/29/07	06:00	SYST	5.0	10	0.00	+0.0%	5.10	+1.0%	PASS
06/30/07	06:00	SYST	5.0	10	0.00	+0.0%	5.10	+1.0%	PASS
07/01/07	06:00	SYST	5.0	10	0.01	+0.1%	5.13	+1.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/02/07	06:00	SYST	5.0	10	0.03	+0.3%	5.16	+1.6%	PASS
07/03/07	06:00	SYST	5.0	10	0.02	+0.2%	5.11	+1.1%	PASS
07/04/07	06:00	SYST	5.0	10	0.01	+0.1%	5.15	+1.5%	PASS
07/05/07	06:00	SYST	5.0	10	0.01	+0.1%	5.13	+1.3%	PASS
07/06/07	06:00	SYST	5.0	10	0.02	+0.2%	4.99	-0.1%	PASS
07/07/07	06:00	SYST	5.0	10	0.03	+0.3%	5.16	+1.6%	PASS
07/07/07	07:35	SYST	5.0	10	0.03	+0.3%	5.14	+1.4%	PASS
07/08/07	06:00	SYST	5.0	10	0.02	+0.2%	5.07	+0.7%	PASS
07/08/07	07:35	SYST	5.0	10	0.02	+0.2%	5.04	+0.4%	PASS
07/09/07	06:00	SYST	5.0	10	0.04	+0.4%	5.16	+1.6%	PASS
07/09/07	07:35	SYST	5.0	10	0.04	+0.4%	5.17	+1.7%	PASS
07/10/07	06:00	SYST	5.0	10	0.05	+0.5%	5.20	+2.0%	PASS
07/10/07	07:35	SYST	5.0	10	0.04	+0.4%	5.20	+2.0%	PASS
07/11/07	06:00	SYST	5.0	10	0.05	+0.5%	5.18	+1.8%	PASS
07/11/07	07:35	SYST	5.0	10	0.05	+0.5%	5.16	+1.6%	PASS
07/12/07	07:35	SYST	5.0	10	0.07	+0.7%	5.21	+2.1%	PASS
07/13/07	07:35	SYST	5.0	10	0.08	+0.8%	5.29	+2.9%	PASS
07/14/07	07:35	SYST	5.0	10	0.06	+0.6%	5.27	+2.7%	PASS
07/15/07	07:35	SYST	5.0	10	0.08	+0.8%	5.27	+2.7%	PASS
07/16/07	07:35	SYST	5.0	10	0.10	+1.0%	5.32	+3.2%	PASS
07/17/07	07:35	SYST	5.0	10	0.09	+0.9%	5.38	+3.8%	PASS
07/18/07	07:35	SYST	5.0	10	0.08	+0.8%	5.25	+2.5%	PASS
07/19/07	07:35	SYST	5.0	10	0.09	+0.9%	5.33	+3.3%	PASS
07/20/07	07:36	SYST	5.0	10	0.05	+0.5%	5.10	+1.0%	PASS
07/21/07	07:36	SYST	5.0	10	0.06	+0.6%	5.18	+1.8%	PASS
07/22/07	07:36	SYST	5.0	10	0.07	+0.7%	5.13	+1.3%	PASS
07/23/07	07:36	SYST	5.0	10	0.07	+0.7%	5.17	+1.7%	PASS
07/24/07	07:36	SYST	5.0	10	0.07	+0.7%	5.15	+1.5%	PASS
07/25/07	07:36	SYST	5.0	10	0.06	+0.6%	5.19	+1.9%	PASS
07/26/07	07:43	SYST	5.0	10	0.06	+0.6%	5.15	+1.5%	PASS
07/27/07	07:43	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
07/28/07	07:43	SYST	5.0	10	0.02	+0.2%	4.93	-0.7%	PASS
07/29/07	07:43	SYST	5.0	10	0.02	+0.2%	4.99	-0.1%	PASS
07/30/07	07:43	SYST	5.0	10	0.02	+0.2%	4.94	-0.6%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/31/07	07:43	SYST	5.0	10	0.03	+0.3%	4.92	-0.8%	PASS
08/01/07	07:43	SYST	5.0	10	0.12	+1.2%	5.20	+2.0%	PASS
08/02/07	07:43	SYST	5.0	10	0.12	+1.2%	5.18	+1.8%	PASS
08/03/07	07:43	SYST	5.0	10	0.09	+0.9%	5.07	+0.7%	PASS
08/04/07	07:43	SYST	5.0	10	0.19	+1.9%	5.19	+1.9%	PASS
08/05/07	07:43	SYST	5.0	10	0.20	+2.0%	5.17	+1.7%	PASS
08/06/07	07:43	SYST	5.0	10	0.18	+1.8%	5.15	+1.5%	PASS
08/07/07	07:42	SYST	5.0	10	0.11	+1.1%	5.15	+1.5%	PASS
08/08/07	07:42	SYST	5.0	10	0.21	+2.1%	5.20	+2.0%	PASS
08/09/07	07:42	SYST	5.0	10	0.20	+2.0%	5.22	+2.2%	PASS
08/10/07	07:42	SYST	5.0	10	0.20	+2.0%	5.21	+2.1%	PASS
08/11/07	07:42	SYST	5.0	10	0.12	+1.2%	5.20	+2.0%	PASS
08/12/07	07:42	SYST	5.0	10	0.12	+1.2%	5.27	+2.7%	PASS
08/13/07	07:42	SYST	5.0	10	0.14	+1.4%	5.28	+2.8%	PASS
08/14/07	07:42	SYST	5.0	10	0.12	+1.2%	5.30	+3.0%	PASS
08/15/07	07:42	SYST	5.0	10	0.13	+1.3%	5.32	+3.2%	PASS
08/16/07	07:42	SYST	5.0	10	0.16	+1.6%	5.28	+2.8%	PASS
08/17/07	07:42	SYST	5.0	10	0.18	+1.8%	5.41	+4.1%	PASS
08/18/07	07:42	SYST	5.0	10	0.17	+1.7%	5.38	+3.8%	PASS
08/19/07	07:42	SYST	5.0	10	0.17	+1.7%	5.42	+4.2%	PASS
08/20/07	07:42	SYST	5.0	10	0.16	+1.6%	5.39	+3.9%	PASS
08/21/07	07:34	SYST	5.0	10	0.15	+1.5%	5.35	+3.5%	PASS
08/22/07	07:34	SYST	5.0	10	0.17	+1.7%	5.25	+2.5%	PASS
08/22/07	15:19	SYST	5.0	10	0.01	+0.1%	5.05	+0.5%	PASS
08/23/07	07:34	SYST	5.0	10	0.01	+0.1%	5.10	+1.0%	PASS
08/24/07	07:34	SYST	5.0	10	0.00	+0.0%	5.14	+1.4%	PASS
08/25/07	07:34	SYST	5.0	10	0.01	+0.1%	5.17	+1.7%	PASS
08/26/07	07:34	SYST	5.0	10	0.01	+0.1%	5.21	+2.1%	PASS
08/27/07	07:34	SYST	5.0	10	0.03	+0.3%	5.25	+2.5%	PASS
08/28/07	07:34	SYST	5.0	10	0.02	+0.2%	5.20	+2.0%	PASS
08/29/07	07:34	SYST	5.0	10	0.04	+0.4%	5.27	+2.7%	PASS
08/30/07	07:34	SYST	5.0	10	0.00	+0.0%	5.05	+0.5%	PASS
08/31/07	07:34	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
09/01/07	07:34	SYST	5.0	10	0.01	+0.1%	5.07	+0.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
09/02/07	07:34	SYST	5.0	10	0.00	+0.0%	5.04	+0.4%	PASS
09/03/07	07:34	SYST	5.0	10	0.01	+0.1%	5.09	+0.9%	PASS
09/04/07	07:34	SYST	5.0	10	0.01	+0.1%	5.13	+1.3%	PASS
09/05/07	07:34	SYST	5.0	10	0.01	+0.1%	5.05	+0.5%	PASS
09/06/07	07:34	SYST	5.0	10	0.02	+0.2%	5.12	+1.2%	PASS
09/07/07	07:34	SYST	5.0	10	0.02	+0.2%	5.05	+0.5%	PASS
09/08/07	07:34	SYST	5.0	10	0.04	+0.4%	5.12	+1.2%	PASS
09/09/07	07:34	SYST	5.0	10	0.04	+0.4%	5.17	+1.7%	PASS
09/10/07	07:34	SYST	5.0	10	0.06	+0.6%	5.19	+1.9%	PASS
09/11/07	07:34	SYST	5.0	10	0.10	+1.0%	5.35	+3.5%	PASS
09/12/07	07:35	SYST	5.0	10	0.26	+2.6%	5.58	+5.8%	PASS
09/13/07	07:35	SYST	5.0	10	0.33	+3.3%	5.73	+7.3%	PASS
09/14/07	07:35	SYST	5.0	10	-0.04	-0.4%	4.92	-0.8%	PASS
09/15/07	07:35	SYST	5.0	10	-0.17	-1.7%	4.83	-1.7%	PASS
09/16/07	07:35	SYST	5.0	10	-0.12	-1.2%	4.67	-3.3%	PASS
09/17/07	07:35	SYST	5.0	10	-0.13	-1.3%	4.73	-2.7%	PASS
09/18/07	07:35	SYST	5.0	10	-0.13	-1.3%	4.80	-2.0%	PASS
09/18/07	11:25	SYST	5.0	10	-0.29	-2.9%	3.51	-14.9%	FAIL
09/19/07	07:35	SYST	5.0	10	-0.01	-0.1%	4.91	-0.9%	PASS
09/20/07	07:35	SYST	5.0	10	0.03	+0.3%	5.07	+0.7%	PASS
09/21/07	07:35	SYST	5.0	10	0.01	+0.1%	5.00	+0.0%	PASS
09/22/07	07:35	SYST	5.0	10	0.04	+0.4%	5.05	+0.5%	PASS
09/23/07	07:35	SYST	5.0	10	0.07	+0.7%	5.11	+1.1%	PASS
09/24/07	07:35	SYST	5.0	10	0.09	+0.9%	5.17	+1.7%	PASS
09/25/07	07:35	SYST	5.0	10	0.06	+0.6%	5.10	+1.0%	PASS
09/26/07	07:35	SYST	5.0	10	0.06	+0.6%	5.18	+1.8%	PASS
09/27/07	07:35	SYST	5.0	10	0.08	+0.8%	5.12	+1.2%	PASS
09/28/07	07:35	SYST	5.0	10	0.09	+0.9%	5.24	+2.4%	PASS
09/29/07	07:36	SYST	5.0	10	-0.45	-4.5%	11.96	+69.6%	FAIL
09/30/07	07:36	SYST	5.0	10	-0.44	-4.4%	11.80	+68.0%	FAIL
10/01/07	07:36	SYST	5.0	10	-0.40	-4.0%	11.79	+67.9%	FAIL
10/01/07	14:43	SYST	5.0	10	0.01	+0.1%	5.02	+0.2%	PASS
10/02/07	07:36	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
10/03/07	07:36	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
10/04/07	07:36	SYST	5.0	10	0.02	+0.2%	4.92	-0.8%	PASS
10/05/07	07:36	SYST	5.0	10	0.04	+0.4%	5.02	+0.2%	PASS
10/06/07	07:36	SYST	5.0	10	0.06	+0.6%	5.05	+0.5%	PASS
10/07/07	07:36	SYST	5.0	10	0.07	+0.7%	5.05	+0.5%	PASS
10/08/07	07:36	SYST	5.0	10	0.05	+0.5%	4.96	-0.4%	PASS
10/09/07	07:36	SYST	5.0	10	0.04	+0.4%	4.98	-0.2%	PASS
10/10/07	07:36	SYST	5.0	10	0.07	+0.7%	5.12	+1.2%	PASS
10/11/07	07:36	SYST	5.0	10	0.08	+0.8%	5.15	+1.5%	PASS
10/12/07	07:36	SYST	5.0	10	0.05	+0.5%	4.92	-0.8%	PASS
10/13/07	07:36	SYST	5.0	10	0.10	+1.0%	4.86	-1.4%	PASS
10/14/07	07:36	SYST	5.0	10	0.07	+0.7%	4.88	-1.2%	PASS
10/15/07	07:36	SYST	5.0	10	0.09	+0.9%	4.89	-1.1%	PASS
10/16/07	07:36	SYST	5.0	10	0.07	+0.7%	4.92	-0.8%	PASS
10/17/07	07:36	SYST	5.0	10	0.06	+0.6%	4.82	-1.8%	PASS
10/18/07	07:36	SYST	5.0	10	0.05	+0.5%	4.75	-2.5%	PASS
10/19/07	07:36	SYST	5.0	10	0.05	+0.5%	4.67	-3.3%	PASS
10/20/07	07:36	SYST	5.0	10	0.04	+0.4%	4.63	-3.7%	PASS
10/21/07	07:36	SYST	5.0	10	0.06	+0.6%	4.73	-2.7%	PASS
10/22/07	07:36	SYST	5.0	10	0.06	+0.6%	4.75	-2.5%	PASS
10/23/07	07:36	SYST	5.0	10	0.01	+0.1%	5.01	+0.1%	PASS
10/24/07	07:36	SYST	5.0	10	0.02	+0.2%	5.01	+0.1%	PASS
10/25/07	07:36	SYST	5.0	10	0.04	+0.4%	5.09	+0.9%	PASS
10/26/07	07:36	SYST	5.0	10	0.05	+0.5%	5.01	+0.1%	PASS
10/27/07	07:36	SYST	5.0	10	0.01	+0.1%	5.08	+0.8%	PASS
10/28/07	07:36	SYST	5.0	10	-0.01	-0.1%	5.04	+0.4%	PASS
10/29/07	07:36	SYST	5.0	10	0.03	+0.3%	4.99	-0.1%	PASS
10/30/07	07:36	SYST	5.0	10	-0.01	-0.1%	4.99	-0.1%	PASS
10/31/07	07:36	SYST	5.0	10	-0.03	-0.3%	4.98	-0.2%	PASS
11/01/07	07:36	SYST	5.0	10	-0.03	-0.3%	4.96	-0.4%	PASS
11/02/07	07:36	SYST	5.0	10	0.00	+0.0%	4.96	-0.4%	PASS
11/03/07	07:36	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
11/04/07	07:36	SYST	5.0	10	0.01	+0.1%	4.93	-0.7%	PASS
11/05/07	07:36	SYST	5.0	10	0.00	+0.0%	4.85	-1.5%	PASS
11/06/07	07:36	SYST	5.0	10	0.01	+0.1%	4.93	-0.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
11/07/07	07:36	SYST	5.0	10	0.03	+0.3%	4.98	-0.2%	PASS
11/08/07	07:36	SYST	5.0	10	-0.01	-0.1%	4.92	-0.8%	PASS
11/09/07	07:36	SYST	5.0	10	-0.01	-0.1%	4.86	-1.4%	PASS
11/10/07	07:36	SYST	5.0	10	0.00	+0.0%	5.04	+0.4%	PASS
11/11/07	07:36	SYST	5.0	10	0.00	+0.0%	5.02	+0.2%	PASS
11/12/07	07:36	SYST	5.0	10	0.01	+0.1%	5.03	+0.3%	PASS
11/13/07	07:36	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
11/14/07	07:36	SYST	5.0	10	0.02	+0.2%	4.92	-0.8%	PASS
11/15/07	07:36	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
11/16/07	07:36	SYST	5.0	10	0.04	+0.4%	5.07	+0.7%	PASS
11/17/07	07:36	SYST	5.0	10	0.03	+0.3%	5.06	+0.6%	PASS
11/18/07	07:36	SYST	5.0	10	0.07	+0.7%	5.11	+1.1%	PASS
11/19/07	07:36	SYST	5.0	10	0.06	+0.6%	5.07	+0.7%	PASS
11/20/07	07:36	SYST	5.0	10	-0.03	-0.3%	4.94	-0.6%	PASS
11/21/07	07:36	SYST	5.0	10	-0.01	-0.1%	5.06	+0.6%	PASS
11/22/07	07:36	SYST	5.0	10	0.00	+0.0%	4.95	-0.5%	PASS
11/23/07	07:36	SYST	5.0	10	0.04	+0.4%	5.01	+0.1%	PASS
11/24/07	07:36	SYST	5.0	10	0.05	+0.5%	4.94	-0.6%	PASS
11/25/07	07:36	SYST	5.0	10	0.05	+0.5%	4.94	-0.6%	PASS
11/26/07	07:36	SYST	5.0	10	0.05	+0.5%	4.96	-0.4%	PASS
11/27/07	07:36	SYST	5.0	10	-0.01	-0.1%	4.90	-1.0%	PASS
11/28/07	07:36	SYST	5.0	10	0.02	+0.2%	5.01	+0.1%	PASS
11/29/07	07:36	SYST	5.0	10	0.02	+0.2%	4.97	-0.3%	PASS
11/30/07	07:36	SYST	5.0	10	0.07	+0.7%	4.96	-0.4%	PASS
12/01/07	07:36	SYST	5.0	10	0.11	+1.1%	5.13	+1.3%	PASS
12/02/07	07:36	SYST	5.0	10	0.04	+0.4%	4.89	-1.1%	PASS
12/03/07	07:36	SYST	5.0	10	0.03	+0.3%	5.03	+0.3%	PASS
12/04/07	07:36	SYST	5.0	10	0.05	+0.5%	4.97	-0.3%	PASS
12/05/07	07:36	SYST	5.0	10	0.08	+0.8%	4.97	-0.3%	PASS
12/06/07	07:36	SYST	5.0	10	0.00	+0.0%	4.99	-0.1%	PASS
12/07/07	07:36	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS
12/08/07	07:36	SYST	5.0	10	0.02	+0.2%	5.08	+0.8%	PASS
12/09/07	07:36	SYST	5.0	10	0.05	+0.5%	5.04	+0.4%	PASS
12/10/07	07:36	SYST	5.0	10	0.04	+0.4%	4.99	-0.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
12/11/07	07:36	SYST	5.0	10	-0.01	-0.1%	5.00	+0.0%	PASS
12/12/07	07:36	SYST	5.0	10	0.01	+0.1%	5.10	+1.0%	PASS
12/13/07	07:39	SYST	5.0	10	0.13	+1.3%	7.51	+25.1%	FAIL
12/13/07	13:50	SYST	11.0	20	-0.03	-0.2%	11.00	+0.0%	PASS
12/13/07	20:30	SYST	5.0	10	0.01	+0.1%	4.99	-0.1%	PASS
12/14/07	07:39	SYST	5.0	10	0.01	+0.1%	5.10	+1.0%	PASS
12/14/07	20:30	SYST	5.0	10	0.02	+0.2%	5.09	+0.9%	PASS
12/15/07	07:39	SYST	5.0	10	0.04	+0.4%	5.12	+1.2%	PASS
12/15/07	20:30	SYST	5.0	10	0.04	+0.4%	5.06	+0.6%	PASS
12/16/07	07:39	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
12/16/07	20:30	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
12/17/07	07:39	SYST	5.0	10	0.03	+0.3%	5.05	+0.5%	PASS
12/17/07	16:30	SYST	5.0	10	0.04	+0.4%	5.06	+0.6%	PASS
12/17/07	20:30	SYST	5.0	10	0.04	+0.4%	5.00	+0.0%	PASS
12/18/07	07:39	SYST	5.0	10	0.00	+0.0%	4.92	-0.8%	PASS
12/19/07	07:39	SYST	5.0	10	0.02	+0.2%	5.01	+0.1%	PASS
12/20/07	07:39	SYST	5.0	10	0.07	+0.7%	5.00	+0.0%	PASS
12/21/07	07:37	SYST	5.0	10	0.04	+0.4%	4.98	-0.2%	PASS
12/22/07	07:37	SYST	5.0	10	0.02	+0.2%	5.11	+1.1%	PASS
12/23/07	07:37	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
12/24/07	07:37	SYST	5.0	10	0.04	+0.4%	5.17	+1.7%	PASS
12/25/07	07:37	SYST	5.0	10	0.03	+0.3%	5.17	+1.7%	PASS
12/26/07	07:37	SYST	5.0	10	0.05	+0.5%	5.20	+2.0%	PASS
12/27/07	07:37	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS
12/28/07	07:37	SYST	5.0	10	-0.01	-0.1%	5.00	+0.0%	PASS
12/29/07	07:37	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS
12/30/07	07:37	SYST	5.0	10	0.01	+0.1%	5.08	+0.8%	PASS
12/31/07	07:37	SYST	5.0	10	0.01	+0.1%	5.10	+1.0%	PASS
01/01/08	07:37	SYST	5.0	10	0.01	+0.1%	5.12	+1.2%	PASS
01/02/08	07:37	SYST	5.0	10	0.00	+0.0%	5.04	+0.4%	PASS
01/03/08	07:37	SYST	5.0	10	0.01	+0.1%	5.00	+0.0%	PASS
01/04/08	07:37	SYST	5.0	10	0.00	+0.0%	5.03	+0.3%	PASS
01/05/08	07:37	SYST	5.0	10	-0.02	-0.2%	4.93	-0.7%	PASS
01/06/08	07:37	SYST	5.0	10	0.00	+0.0%	4.92	-0.8%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/07/08	07:37	SYST	5.0	10	0.00	+0.0%	4.90	-1.0%	PASS
01/08/08	07:37	SYST	5.0	10	-0.01	-0.1%	5.00	+0.0%	PASS
01/09/08	07:37	SYST	5.0	10	-0.01	-0.1%	5.06	+0.6%	PASS
01/10/08	07:37	SYST	5.0	10	-0.04	-0.4%	5.00	+0.0%	PASS
01/11/08	07:37	SYST	5.0	10	-0.04	-0.4%	4.87	-1.3%	PASS
01/12/08	07:37	SYST	5.0	10	-0.03	-0.3%	5.02	+0.2%	PASS
01/13/08	07:37	SYST	5.0	10	-0.03	-0.3%	5.06	+0.6%	PASS
01/14/08	07:37	SYST	5.0	10	0.01	+0.1%	5.10	+1.0%	PASS
01/15/08	07:37	SYST	5.0	10	0.04	+0.4%	5.21	+2.1%	PASS
01/16/08	07:37	SYST	5.0	10	0.00	+0.0%	4.83	-1.7%	PASS
01/17/08	07:37	SYST	5.0	10	-0.03	-0.3%	4.79	-2.1%	PASS
01/18/08	07:37	SYST	5.0	10	-0.07	-0.7%	4.91	-0.9%	PASS
01/19/08	07:37	SYST	5.0	10	-0.03	-0.3%	5.18	+1.8%	PASS
01/20/08	07:37	SYST	5.0	10	-0.01	-0.1%	5.27	+2.7%	PASS
01/21/08	07:37	SYST	5.0	10	0.01	+0.1%	5.37	+3.7%	PASS
01/22/08	07:37	SYST	5.0	10	-0.02	-0.2%	4.87	-1.3%	PASS
01/23/08	07:37	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
01/24/08	07:37	SYST	5.0	10	0.01	+0.1%	4.93	-0.7%	PASS
01/25/08	07:37	SYST	5.0	10	0.02	+0.2%	4.97	-0.3%	PASS
01/26/08	07:37	SYST	5.0	10	0.00	+0.0%	4.86	-1.4%	PASS
01/27/08	07:37	SYST	5.0	10	0.00	+0.0%	4.96	-0.4%	PASS
01/28/08	07:37	SYST	5.0	10	0.03	+0.3%	4.91	-0.9%	PASS
01/29/08	07:37	SYST	5.0	10	-0.04	-0.4%	4.90	-1.0%	PASS
01/30/08	07:37	SYST	5.0	10	-0.01	-0.1%	4.90	-1.0%	PASS
01/31/08	07:37	SYST	5.0	10	-0.01	-0.1%	5.15	+1.5%	PASS
02/01/08	07:37	SYST	5.0	10	0.03	+0.3%	4.93	-0.7%	PASS
02/02/08	07:37	SYST	5.0	10	0.05	+0.5%	4.98	-0.2%	PASS
02/03/08	07:37	SYST	5.0	10	0.05	+0.5%	4.95	-0.5%	PASS
02/04/08	07:37	SYST	5.0	10	0.04	+0.4%	4.95	-0.5%	PASS
02/05/08	07:37	SYST	5.0	10	0.01	+0.1%	4.92	-0.8%	PASS
02/06/08	07:37	SYST	5.0	10	0.03	+0.3%	4.87	-1.3%	PASS
02/07/08	07:37	SYST	5.0	10	0.03	+0.3%	4.91	-0.9%	PASS
02/08/08	07:37	SYST	5.0	10	0.03	+0.3%	4.90	-1.0%	PASS
02/09/08	07:37	SYST	5.0	10	0.01	+0.1%	4.90	-1.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/10/08	07:37	SYST	5.0	10	0.06	+0.6%	4.92	-0.8%	PASS
02/11/08	07:37	SYST	5.0	10	0.02	+0.2%	5.02	+0.2%	PASS
02/12/08	07:37	SYST	5.0	10	0.02	+0.2%	5.04	+0.4%	PASS
02/13/08	07:37	SYST	5.0	10	0.02	+0.2%	4.95	-0.5%	PASS
02/14/08	07:37	SYST	5.0	10	0.05	+0.5%	4.99	-0.1%	PASS
02/15/08	07:37	SYST	5.0	10	0.02	+0.2%	5.09	+0.9%	PASS
02/16/08	07:37	SYST	5.0	10	0.02	+0.2%	5.02	+0.2%	PASS
02/17/08	07:37	SYST	5.0	10	0.02	+0.2%	4.89	-1.1%	PASS
02/18/08	07:37	SYST	5.0	10	-0.02	-0.2%	4.87	-1.3%	PASS
02/19/08	07:37	SYST	5.0	10	0.00	+0.0%	5.06	+0.6%	PASS
02/20/08	07:37	SYST	5.0	10	0.01	+0.1%	5.16	+1.6%	PASS
02/21/08	07:37	SYST	5.0	10	0.02	+0.2%	5.35	+3.5%	PASS
02/22/08	07:37	SYST	5.0	10	0.01	+0.1%	4.92	-0.8%	PASS
02/23/08	07:37	SYST	5.0	10	0.02	+0.2%	4.84	-1.6%	PASS
02/24/08	07:37	SYST	5.0	10	0.02	+0.2%	4.90	-1.0%	PASS
02/25/08	07:37	SYST	5.0	10	0.02	+0.2%	4.85	-1.5%	PASS
02/26/08	07:37	SYST	5.0	10	0.02	+0.2%	5.02	+0.2%	PASS
02/27/08	07:37	SYST	5.0	10	0.00	+0.0%	5.15	+1.5%	PASS
02/28/08	07:37	SYST	5.0	10	0.01	+0.1%	5.17	+1.7%	PASS
02/29/08	07:37	SYST	5.0	10	0.01	+0.1%	5.08	+0.8%	PASS
03/01/08	07:37	SYST	5.0	10	0.00	+0.0%	5.02	+0.2%	PASS
03/02/08	07:37	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
03/03/08	07:37	SYST	5.0	10	0.02	+0.2%	4.98	-0.2%	PASS
03/04/08	07:37	SYST	5.0	10	0.02	+0.2%	5.10	+1.0%	PASS
03/05/08	07:37	SYST	5.0	10	0.04	+0.4%	5.02	+0.2%	PASS
03/06/08	07:37	SYST	5.0	10	0.03	+0.3%	5.00	+0.0%	PASS
03/07/08	07:37	SYST	5.0	10	0.01	+0.1%	5.09	+0.9%	PASS
03/08/08	07:37	SYST	5.0	10	0.03	+0.3%	5.02	+0.2%	PASS
03/09/08	07:37	SYST	5.0	10	0.01	+0.1%	5.06	+0.6%	PASS
03/10/08	07:37	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
03/11/08	07:37	SYST	5.0	10	0.01	+0.1%	4.95	-0.5%	PASS
03/11/08	14:26	INST	3.0	10	0.01	+0.1%	3.01	+0.1%	PASS
03/12/08	07:37	SYST	5.0	10	0.01	+0.1%	5.11	+1.1%	PASS
03/13/08	07:37	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/14/08	07:37	SYST	5.0	10	0.00	+0.0%	5.06	+0.6%	PASS
03/15/08	07:37	SYST	5.0	10	0.01	+0.1%	5.12	+1.2%	PASS
03/16/08	07:37	SYST	5.0	10	0.02	+0.2%	5.22	+2.2%	PASS
03/17/08	07:37	SYST	5.0	10	0.03	+0.3%	5.23	+2.3%	PASS
03/18/08	07:37	SYST	5.0	10	-0.01	-0.1%	4.97	-0.3%	PASS
03/19/08	07:37	SYST	5.0	10	-0.02	-0.2%	4.95	-0.5%	PASS
03/20/08	07:37	SYST	5.0	10	0.01	+0.1%	4.95	-0.5%	PASS
03/21/08	07:37	SYST	5.0	10	0.02	+0.2%	5.01	+0.1%	PASS
03/22/08	07:37	SYST	5.0	10	-0.01	-0.1%	4.95	-0.5%	PASS
03/23/08	07:37	SYST	5.0	10	0.00	+0.0%	4.97	-0.3%	PASS
03/24/08	07:37	SYST	5.0	10	-0.01	-0.1%	4.97	-0.3%	PASS
03/25/08	07:37	SYST	5.0	10	0.00	+0.0%	4.95	-0.5%	PASS
03/26/08	Communication Error – Data Unavailable								
03/27/08	Communication Error – Data Unavailable								
03/28/08	Communication Error – Data Unavailable								
03/29/08	07:37	SYST	5.0	10	0.01	+0.1%	5.07	+0.7%	PASS
03/30/08	07:37	SYST	5.0	10	0.01	+0.1%	5.03	+0.3%	PASS
03/31/08	07:37	SYST	5.0	10	0.02	+0.2%	5.04	+0.4%	PASS
04/01/08	07:37	SYST	5.0	10	0.01	+0.1%	4.98	-0.2%	PASS
04/02/08	07:37	SYST	5.0	10	0.02	+0.2%	5.11	+1.1%	PASS
04/03/08	07:37	SYST	5.0	10	0.03	+0.3%	5.03	+0.3%	PASS
04/04/08	07:37	SYST	5.0	10	0.02	+0.2%	5.02	+0.2%	PASS
04/05/08	07:37	SYST	5.0	10	0.03	+0.3%	5.02	+0.2%	PASS
04/06/08	07:37	SYST	5.0	10	0.03	+0.3%	5.06	+0.6%	PASS
04/07/08	07:37	SYST	5.0	10	0.03	+0.3%	5.03	+0.3%	PASS
04/08/08	07:37	SYST	5.0	10	0.04	+0.4%	5.14	+1.4%	PASS
04/09/08	07:42	SYST	5.0	10	0.00	+0.0%	5.20	+2.0%	PASS
04/10/08	07:42	SYST	5.0	10	-0.02	-0.2%	5.20	+2.0%	PASS
04/11/08	07:42	SYST	0.0	10	0.72	+7.2%	0.83	+8.3%	FAIL
04/11/08	14:20	SYST	0.0	10	0.89	+8.9%	0.84	+8.4%	FAIL
04/11/08	15:25	SYST	5.0	10	-0.02	-0.2%	5.09	+0.9%	PASS
04/12/08	07:42	SYST	5.0	10	-0.02	-0.2%	5.10	+1.0%	PASS
04/13/08	07:42	SYST	5.0	10	-0.01	-0.1%	5.21	+2.1%	PASS
04/14/08	07:42	SYST	5.0	10	-0.01	-0.1%	5.17	+1.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
04/15/08	07:42	SYST	5.0	10	0.01	+0.1%	5.04	+0.4%	PASS
04/16/08	07:42	SYST	5.0	10	0.02	+0.2%	4.94	-0.6%	PASS
04/16/08	14:10	INST	5.0	10	0.01	+0.1%	4.98	-0.2%	PASS
04/17/08	07:42	SYST	5.0	10	0.03	+0.3%	5.20	+2.0%	PASS
04/18/08	07:42	SYST	5.0	10	0.01	+0.1%	5.00	+0.0%	PASS
04/19/08	07:42	SYST	5.0	10	0.02	+0.2%	4.93	-0.7%	PASS
04/20/08	07:42	SYST	5.0	10	0.03	+0.3%	5.01	+0.1%	PASS
04/21/08	07:42	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
04/22/08	07:42	SYST	5.0	10	0.01	+0.1%	4.90	-1.0%	PASS
04/23/08	07:42	SYST	5.0	10	0.02	+0.2%	4.84	-1.6%	PASS
04/24/08	07:42	SYST	5.0	10	-0.01	-0.1%	5.00	+0.0%	PASS
04/25/08	07:42	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
04/26/08	07:42	SYST	5.0	10	0.02	+0.2%	4.96	-0.4%	PASS
04/27/08	07:42	SYST	5.0	10	0.03	+0.3%	5.00	+0.0%	PASS
04/28/08	07:42	SYST	5.0	10	0.03	+0.3%	5.08	+0.8%	PASS
04/29/08	07:42	SYST	5.0	10	0.03	+0.3%	5.12	+1.2%	PASS
04/30/08	07:42	SYST	5.0	10	0.04	+0.4%	5.02	+0.2%	PASS
04/30/08	15:36	INST	5.0	10	0.01	+0.1%	5.12	+1.2%	PASS
04/30/08	16:03	SYST	5.0	10	0.13	+1.3%	5.22	+2.2%	PASS
05/01/08	07:42	SYST	5.0	10	0.11	+1.1%	5.32	+3.2%	PASS
05/02/08	07:42	SYST	5.0	10	0.00	+0.0%	4.99	-0.1%	PASS
05/03/08	07:42	SYST	5.0	10	0.00	+0.0%	4.91	-0.9%	PASS
05/04/08	07:42	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
05/05/08	07:42	SYST	5.0	10	0.01	+0.1%	5.03	+0.3%	PASS
05/06/08	07:42	SYST	5.0	10	0.02	+0.2%	5.12	+1.2%	PASS
05/07/08	07:42	SYST	5.0	10	0.01	+0.1%	4.89	-1.1%	PASS
05/08/08	07:42	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
05/09/08	07:42	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
05/09/08	11:06	SYST	5.0	10	1.11	+11.1%	3.42	-15.8%	FAIL
05/10/08	07:42	SYST	5.0	10	-0.91	-9.1%	4.53	-4.7%	PASS
05/11/08	07:43	SYST	5.0	10	-0.92	-9.2%	4.53	-4.7%	PASS
05/12/08	07:42	SYST	5.0	10	-0.92	-9.2%	4.54	-4.6%	PASS
05/13/08	07:43	SYST	5.0	10	-0.91	-9.1%	4.55	-4.5%	PASS
05/14/08	07:43	SYST	5.0	10	-0.89	-8.9%	4.49	-5.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/14/08	15:12	SYST	5.0	10	0.01	+0.1%	5.00	+0.0%	PASS
05/15/08	07:41	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
05/16/08	07:41	SYST	5.0	10	-0.01	-0.1%	5.03	+0.3%	PASS
05/17/08	07:41	SYST	5.0	10	0.00	+0.0%	4.83	-1.7%	PASS
05/18/08	07:41	SYST	5.0	10	-0.01	-0.1%	4.93	-0.7%	PASS
05/19/08	07:41	SYST	5.0	10	0.01	+0.1%	4.92	-0.8%	PASS
05/20/08	07:41	SYST	5.0	10	0.00	+0.0%	4.92	-0.8%	PASS
05/21/08	07:41	SYST	5.0	10	0.01	+0.1%	4.98	-0.2%	PASS
05/22/08	07:41	SYST	5.0	10	-0.03	-0.3%	4.96	-0.4%	PASS
05/23/08	07:41	SYST	5.0	10	-0.02	-0.2%	5.02	+0.2%	PASS
05/24/08	07:41	SYST	5.0	10	0.00	+0.0%	5.10	+1.0%	PASS
05/25/08	07:41	SYST	5.0	10	-0.05	-0.5%	4.96	-0.4%	PASS
05/26/08	07:41	SYST	5.0	10	0.01	+0.1%	4.96	-0.4%	PASS
05/27/08	07:41	SYST	5.0	10	0.02	+0.2%	5.12	+1.2%	PASS
05/28/08	07:41	SYST	5.0	10	0.01	+0.1%	5.15	+1.5%	PASS
05/29/08	07:41	SYST	5.0	10	0.01	+0.1%	4.66	-3.4%	PASS
05/30/08	07:41	SYST	5.0	10	0.04	+0.4%	5.21	+2.1%	PASS
05/31/08	07:41	SYST	5.0	10	0.02	+0.2%	5.16	+1.6%	PASS
06/01/08	07:41	SYST	5.0	10	0.05	+0.5%	5.17	+1.7%	PASS
06/02/08	07:41	SYST	5.0	10	0.10	+1.0%	5.24	+2.4%	PASS
06/03/08	07:41	SYST	5.0	10	0.40	+4.0%	5.17	+1.7%	PASS
06/04/08	07:41	SYST	5.0	10	-0.04	-0.4%	4.97	-0.3%	PASS
06/05/08	07:41	SYST	5.0	10	-0.16	-1.6%	4.93	-0.7%	PASS
06/06/08	07:41	SYST	5.0	10	-0.28	-2.8%	4.92	-0.8%	PASS
06/07/08	07:41	SYST	5.0	10	0.00	+0.0%	5.02	+0.2%	PASS
06/08/08	07:41	SYST	5.0	10	-0.03	-0.3%	5.01	+0.1%	PASS
06/09/08	07:41	SYST	5.0	10	0.10	+1.0%	5.09	+0.9%	PASS
06/10/08	07:41	SYST	5.0	10	-0.11	-1.1%	4.99	-0.1%	PASS
06/11/08	07:41	SYST	5.0	10	-0.10	-1.0%	5.03	+0.3%	PASS
06/12/08	07:41	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
06/13/08	07:41	SYST	5.0	10	0.02	+0.2%	4.97	-0.3%	PASS
06/14/08	07:41	SYST	5.0	10	-0.02	-0.2%	4.97	-0.3%	PASS
06/15/08	07:41	SYST	5.0	10	-0.03	-0.3%	4.86	-1.4%	PASS
06/16/08	07:41	SYST	5.0	10	-0.01	-0.1%	4.93	-0.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
06/16/08	17:25	SYST	5.0	10	-0.02	-0.2%	4.98	-0.2%	PASS
06/17/08	07:41	SYST	5.0	10	0.01	+0.1%	4.98	-0.2%	PASS
06/18/08	07:41	SYST	5.0	10	-0.01	-0.1%	5.02	+0.2%	PASS
06/19/08	07:41	SYST	5.0	10	-0.01	-0.1%	4.99	-0.1%	PASS
06/20/08	07:41	SYST	5.0	10	-0.01	-0.1%	5.07	+0.7%	PASS
06/21/08	07:41	SYST	5.0	10	-0.02	-0.2%	5.02	+0.2%	PASS
06/22/08	07:41	SYST	5.0	10	-0.03	-0.3%	4.99	-0.1%	PASS
06/23/08	07:41	SYST	5.0	10	-0.02	-0.2%	5.04	+0.4%	PASS
06/24/08	07:41	SYST	5.0	10	0.00	+0.0%	5.11	+1.1%	PASS
06/25/08	07:41	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
06/26/08	07:41	SYST	5.0	10	-0.02	-0.2%	5.02	+0.2%	PASS
06/27/08	07:41	SYST	5.0	10	-0.01	-0.1%	5.05	+0.5%	PASS
06/28/08	07:43	SYST	5.0	10	-0.82	-8.2%	5.76	+7.6%	PASS
06/29/08	07:43	SYST	5.0	10	-0.80	-8.0%	5.97	+9.7%	PASS
06/30/08	07:43	SYST	5.0	10	-0.05	-0.5%	12.52	+75.2%	FAIL
06/30/08	10:47	SYST	5.0	10	-0.06	-0.6%	12.44	+74.4%	FAIL
06/30/08	11:53	INST	5.0	10	0.03	+0.3%	5.16	+1.6%	PASS
06/30/08	15:19	SYST	5.0	10	0.64	+6.4%	5.36	+3.6%	PASS
07/01/08	07:43	SYST	5.0	10	0.37	+3.7%	3.16	-18.4%	FAIL
07/01/08	12:00	SYST	5.0	10	0.79	+7.9%	5.97	+9.7%	PASS
07/01/08	13:45	SYST	5.0	10	0.09	+0.9%	4.97	-0.3%	PASS
07/02/08	07:43	SYST	5.0	10	0.00	+0.0%	4.93	-0.7%	PASS
07/03/08	07:43	SYST	5.0	10	0.02	+0.2%	5.18	+1.8%	PASS
07/04/08	07:43	SYST	5.0	10	0.01	+0.1%	5.19	+1.9%	PASS
07/05/08	07:43	SYST	5.0	10	0.03	+0.3%	5.19	+1.9%	PASS
07/06/08	07:43	SYST	5.0	10	0.04	+0.4%	5.20	+1.2%	PASS
07/07/08	07:43	SYST	5.0	10	0.04	+0.4%	5.22	+2.2%	PASS
07/08/08	07:43	SYST	5.0	10	0.00	+0.0%	4.95	-0.5%	PASS
07/09/08	07:43	SYST	5.0	10	0.01	+0.1%	5.02	+0.2%	PASS
07/10/08	07:43	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
07/11/08	07:43	SYST	5.0	10	0.01	+0.1%	5.01	+0.1%	PASS
07/12/08	07:43	SYST	5.0	10	0.03	+0.3%	5.13	+1.3%	PASS
07/13/08	07:43	SYST	5.0	10	0.02	+0.2%	5.02	+0.2%	PASS
07/14/08	07:43	SYST	5.0	10	0.03	+0.3%	5.11	+1.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/15/08	07:43	SYST	5.0	10	0.05	+0.5%	5.00	+0.0%	PASS
07/16/08	07:43	SYST	5.0	10	0.01	+0.1%	5.22	+2.2%	PASS
07/17/08	07:43	SYST	5.0	10	0.02	+0.2%	5.22	+2.2%	PASS
07/18/08	07:43	SYST	5.0	10	-0.04	-0.4%	4.90	-1.0%	PASS
07/19/08	07:43	SYST	5.0	10	-0.01	-0.1%	4.90	-1.0%	PASS
07/20/08	07:43	SYST	5.0	10	0.02	+0.2%	4.91	-0.9%	PASS
07/21/08	07:43	SYST	5.0	10	0.01	+0.1%	4.92	-0.8%	PASS
07/22/08	07:43	SYST	5.0	10	0.02	+0.2%	5.02	+0.2%	PASS
07/23/08	07:43	SYST	5.0	10	0.04	+0.4%	5.13	+1.3%	PASS
07/24/08	07:43	SYST	5.0	10	0.02	+0.2%	5.06	+0.6%	PASS
07/25/08	07:41	SYST	5.0	10	0.02	+0.2%	5.06	+0.6%	PASS
07/26/08	07:41	SYST	5.0	10	-0.02	-0.2%	5.05	+0.5%	PASS
07/27/08	07:41	SYST	5.0	10	-0.02	-0.2%	5.08	+0.8%	PASS
07/28/08	07:41	SYST	5.0	10	-0.01	-0.1%	5.15	+1.5%	PASS
07/29/08	07:41	SYST	5.0	10	0.01	+0.1%	5.11	+1.1%	PASS
07/30/08	07:41	SYST	5.0	10	0.01	+0.1%	5.00	+0.0%	PASS
07/31/08	07:41	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
08/01/08	07:41	SYST	5.0	10	-0.01	-0.1%	5.03	+0.3%	PASS
08/02/08	07:41	SYST	5.0	10	0.01	+0.1%	5.15	+1.5%	PASS
08/03/08	07:41	SYST	5.0	10	0.02	+0.2%	5.20	+2.0%	PASS
08/04/08	07:41	SYST	5.0	10	0.03	+0.3%	5.24	+2.4%	PASS
08/05/08	07:41	SYST	5.0	10	0.00	+0.0%	4.90	-1.0%	PASS
08/06/08	07:41	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
08/07/08	07:41	SYST	5.0	10	0.04	+0.4%	5.08	+0.8%	PASS
08/08/08	07:41	SYST	5.0	10	0.04	+0.4%	5.03	+0.3%	PASS
08/09/08	07:41	SYST	5.0	10	0.03	+0.3%	5.06	+0.6%	PASS
08/10/08	07:41	SYST	5.0	10	0.05	+0.5%	5.12	+1.2%	PASS
08/11/08	07:41	SYST	5.0	10	0.06	+0.6%	5.14	+1.4%	PASS
08/12/08	07:41	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
08/13/08	07:41	SYST	5.0	10	0.05	+0.5%	5.07	+0.7%	PASS
08/14/08	07:41	SYST	5.0	10	0.06	+0.6%	5.12	+1.2%	PASS
08/15/08	07:41	SYST	5.0	10	-0.04	-0.4%	4.32	-6.8%	PASS
08/16/08	07:41	SYST	5.0	10	-0.01	-0.1%	4.96	-0.4%	PASS
08/17/08	07:41	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/18/08	07:41	SYST	5.0	10	0.02	+0.2%	4.99	-0.1%	PASS
08/19/08	07:41	SYST	5.0	10	0.03	+0.3%	5.02	+0.2%	PASS
08/20/08	07:41	SYST	5.0	10	0.04	+0.4%	5.01	+0.1%	PASS
08/21/08	07:41	SYST	5.0	10	0.07	+0.7%	5.00	+0.0%	PASS
08/22/08	07:41	SYST	5.0	10	-0.01	-0.1%	5.03	+0.3%	PASS
08/23/08	07:41	SYST	5.0	10	0.00	+0.0%	5.06	+0.6%	PASS
08/24/08	07:41	SYST	5.0	10	0.01	+0.1%	5.08	+0.8%	PASS
08/25/08	07:41	SYST	5.0	10	0.04	+0.4%	5.15	+1.5%	PASS
08/26/08	07:41	SYST	5.0	10	0.02	+0.2%	4.97	-0.3%	PASS
08/27/08	07:41	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
08/28/08	07:41	SYST	5.0	10	0.02	+0.2%	4.95	-0.5%	PASS
08/29/08	07:41	SYST	5.0	10	0.04	+0.4%	5.00	+0.0%	PASS
08/30/08	07:41	SYST	5.0	10	0.04	+0.4%	5.02	+0.2%	PASS
08/31/08	07:41	SYST	5.0	10	0.05	+0.5%	4.99	-0.1%	PASS
09/01/08	07:41	SYST	5.0	10	0.06	+0.6%	5.09	+0.9%	PASS
09/02/08	07:41	SYST	5.0	10	0.06	+0.6%	5.08	+0.8%	PASS
09/03/08	07:43	SYST	5.0	10	0.20	+2.0%	4.14	-8.6%	PASS
09/04/08	07:43	SYST	5.0	10	0.01	+0.1%	5.02	+0.2%	PASS
09/05/08	07:43	SYST	5.0	10	-0.14	-1.4%	4.83	-1.7%	PASS
09/06/08	07:43	SYST	5.0	10	-0.09	-0.9%	5.17	+1.7%	PASS
09/07/08	07:43	SYST	5.0	10	-0.05	-0.5%	5.53	+5.3%	PASS
09/08/08	07:43	SYST	5.0	10	-0.12	-1.2%	5.59	+5.9%	PASS
09/09/08	07:43	SYST	5.0	10	0.08	+0.8%	4.99	-0.1%	PASS
09/10/08	07:43	SYST	5.0	10	0.01	+0.1%	5.06	+0.6%	PASS
09/11/08	07:43	SYST	5.0	10	0.17	+1.7%	5.13	+1.3%	PASS
09/12/08	07:43	SYST	5.0	10	0.16	+1.6%	5.11	+1.1%	PASS
09/12/08	10:03	SYST	5.0	10	0.02	+0.2%	5.07	+0.7%	PASS
09/13/08	07:43	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
09/14/08	07:43	SYST	5.0	10	0.00	+0.0%	4.96	-0.4%	PASS
09/15/08	07:43	SYST	5.0	10	0.01	+0.1%	5.06	+0.6%	PASS
09/16/08	07:43	SYST	5.0	10	0.04	+0.4%	5.08	+0.8%	PASS
09/17/08	07:43	SYST	5.0	10	0.04	+0.4%	5.11	+1.1%	PASS
09/18/08	14:59	SYST	5.0	10	0.06	+0.6%	5.19	+1.9%	PASS
09/19/08	07:43	SYST	5.0	10	0.00	+0.0%	4.93	-0.7%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
09/20/08	07:43	SYST	5.0	10	0.02	+0.2%	4.99	-0.1%	PASS
09/21/08	07:43	SYST	5.0	10	0.01	+0.1%	5.06	+0.6%	PASS
09/22/08	07:43	SYST	5.0	10	0.05	+0.5%	5.07	+0.7%	PASS
09/23/08	07:43	SYST	5.0	10	0.06	+0.6%	5.06	+0.6%	PASS
09/24/08	07:43	SYST	5.0	10	0.01	+0.1%	4.95	-0.5%	PASS
09/25/08	07:43	SYST	5.0	10	-0.01	-0.1%	5.03	+0.3%	PASS
09/26/08	07:43	SYST	5.0	10	-0.08	-0.8%	4.96	-0.4%	PASS
09/27/08	07:43	SYST	5.0	10	-0.01	-0.1%	5.02	+0.2%	PASS
09/28/08	07:43	SYST	5.0	10	0.01	+0.1%	5.08	+0.8%	PASS
09/29/08	07:43	SYST	5.0	10	0.02	+0.2%	5.07	+0.7%	PASS
09/30/08	07:43	SYST	5.0	10	0.05	+0.5%	5.06	+0.6%	PASS
10/01/08	07:43	SYST	5.0	10	0.04	+0.4%	5.05	+0.5%	PASS
10/02/08	07:43	SYST	5.0	10	0.04	+0.4%	5.06	+0.6%	PASS
10/03/08	07:43	SYST	5.0	10	0.07	+0.7%	5.09	+0.9%	PASS
10/04/08	07:43	SYST	5.0	10	0.01	+0.1%	5.04	+0.4%	PASS
10/05/08	07:43	SYST	5.0	10	0.01	+0.1%	5.07	+0.7%	PASS
10/06/08	07:43	SYST	5.0	10	0.02	+0.2%	5.13	+1.3%	PASS
10/07/08	07:43	SYST	5.0	10	0.03	+0.3%	5.11	+1.1%	PASS
10/08/08	07:43	SYST	5.0	10	0.01	+0.1%	4.98	-0.2%	PASS
10/09/08	07:43	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
10/10/08	07:43	SYST	5.0	10	0.03	+0.3%	5.02	+0.2%	PASS
10/11/08	07:43	SYST	5.0	10	0.04	+0.4%	5.07	+0.7%	PASS
10/12/08	07:43	SYST	5.0	10	0.07	+0.7%	5.11	+1.1%	PASS
10/13/08	07:43	SYST	5.0	10	0.08	+0.8%	5.14	+1.4%	PASS
10/14/08	07:43	SYST	5.0	10	-0.01	-0.1%	4.96	-0.4%	PASS
10/15/08	07:43	SYST	5.0	10	0.00	+0.0%	4.96	-0.4%	PASS
10/16/08	07:43	SYST	5.0	10	0.01	+0.1%	4.96	-0.4%	PASS
10/17/08	07:43	SYST	5.0	10	0.03	+0.3%	4.98	-0.2%	PASS
10/18/08	07:43	SYST	5.0	10	-0.03	-0.3%	5.01	+0.1%	PASS
10/19/08	07:43	SYST	5.0	10	-0.03	-0.3%	4.96	-0.4%	PASS
10/20/08	07:43	SYST	5.0	10	0.00	+0.0%	5.03	+0.3%	PASS
10/21/08	07:43	SYST	5.0	10	0.00	+0.0%	5.05	+0.5%	PASS
10/22/08	07:43	SYST	5.0	10	0.00	+0.0%	5.11	+1.1%	PASS
10/23/08	07:43	SYST	5.0	10	0.05	+0.5%	5.11	+1.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
10/24/08	07:43	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
10/25/08	07:43	SYST	5.0	10	-0.01	-0.1%	4.91	-0.9%	PASS
10/26/08	07:43	SYST	5.0	10	0.00	+0.0%	4.88	-1.2%	PASS
10/27/08	14:11	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
10/27/08	20:10	SYST	5.0	10	-0.02	-0.2%	5.08	+0.8%	PASS
10/28/08	02:10	SYST	5.0	10	0.00	+0.0%	5.10	+1.0%	PASS
10/28/08	07:44	SYST	5.0	10	0.01	+0.1%	5.47	+4.7%	PASS
10/28/08	08:10	SYST	5.0	10	0.03	+0.3%	5.21	+2.1%	PASS
10/28/08	14:10	SYST	5.0	10	0.00	+0.0%	4.80	-2.0%	PASS
10/28/08	20:10	SYST	5.0	10	-0.03	-0.3%	4.76	-2.4%	PASS
10/29/08	02:10	SYST	5.0	10	-0.04	-0.4%	4.81	-1.9%	PASS
10/29/08	07:44	SYST	5.0	10	0.00	+0.0%	4.82	-1.8%	PASS
10/29/08	08:10	SYST	5.0	10	0.00	+0.0%	4.81	-1.9%	PASS
10/30/08	07:43	SYST	5.0	10	-0.04	-0.4%	4.95	-0.5%	PASS
10/31/08	07:43	SYST	5.0	10	0.00	+0.0%	5.08	+0.8%	PASS
11/01/08	07:43	SYST	5.0	10	-0.08	-0.8%	4.93	-0.7%	PASS
11/02/08	07:43	SYST	5.0	10	-0.07	-0.7%	4.91	-0.9%	PASS
11/03/08	07:43	SYST	5.0	10	-0.10	-1.0%	4.94	-0.6%	PASS
11/04/08	07:43	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS
11/05/08	07:43	SYST	5.0	10	0.06	+0.6%	5.06	+0.6%	PASS
11/06/08	07:44	SYST	5.0	10	0.07	+0.7%	5.04	+0.4%	PASS
11/07/08	07:44	SYST	5.0	10	0.08	+0.8%	4.98	-0.2%	PASS
11/08/08	07:44	SYST	5.0	10	0.09	+0.9%	4.99	-0.1%	PASS
11/09/08	07:44	SYST	5.0	10	0.08	+0.8%	5.03	+0.3%	PASS
11/10/08	07:44	SYST	5.0	10	0.11	+1.1%	5.16	+1.6%	PASS
11/11/08	12:29	SYST	5.0	10	0.03	+0.3%	5.08	+0.8%	PASS
11/12/08	07:44	SYST	5.0	10	0.03	+0.3%	5.03	+0.3%	PASS
11/13/08	07:44	SYST	5.0	10	0.03	+0.3%	4.94	-0.6%	PASS
11/14/08	07:44	SYST	5.0	10	-0.01	-0.1%	4.60	-4.0%	PASS
11/15/08	07:44	SYST	5.0	10	-0.01	-0.1%	5.08	+0.8%	PASS
11/16/08	07:44	SYST	5.0	10	0.02	+0.2%	5.08	+0.8%	PASS
11/17/08	07:44	SYST	5.0	10	0.02	+0.2%	5.16	+1.6%	PASS
11/18/08	07:44	SYST	5.0	10	0.19	+1.9%	5.13	+1.3%	PASS
11/19/08	07:44	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
11/20/08	07:44	SYST	5.0	10	0.00	+0.0%	5.14	+1.4%	PASS
11/21/08	07:44	SYST	5.0	10	0.00	+0.0%	5.29	+2.9%	PASS
11/22/08	07:44	SYST	5.0	10	0.11	+1.1%	5.18	+1.8%	PASS
11/23/08	07:44	SYST	5.0	10	0.16	+1.6%	5.20	+2.0%	PASS
11/24/08	07:44	SYST	5.0	10	0.23	+2.3%	5.25	+2.5%	PASS
11/25/08	07:44	SYST	5.0	10	0.01	+0.1%	5.04	+0.4%	PASS
11/26/08	07:44	SYST	5.0	10	-0.01	-0.1%	5.01	+0.1%	PASS
11/27/08	07:44	SYST	5.0	10	0.01	+0.1%	5.04	+0.4%	PASS
11/28/08	07:44	SYST	5.0	10	0.14	+1.4%	4.85	-1.5%	PASS
11/29/08	07:44	SYST	5.0	10	0.16	+1.6%	4.88	-1.2%	PASS
11/30/08	07:44	SYST	5.0	10	0.18	+1.8%	4.92	-0.8%	PASS
12/01/08	07:44	SYST	5.0	10	0.17	+1.7%	4.84	-1.6%	PASS
12/02/08	07:44	SYST	5.0	10	0.00	+0.0%	5.01	+0.1%	PASS
12/03/08	07:44	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
12/04/08	07:44	SYST	5.0	10	0.02	+0.2%	5.08	+0.8%	PASS
12/05/08	07:44	SYST	5.0	10	0.02	+0.2%	5.05	+0.5%	PASS
12/06/08	07:44	SYST	5.0	10	0.05	+0.5%	4.98	-0.2%	PASS
12/07/08	07:44	SYST	5.0	10	0.05	+0.5%	5.14	+1.4%	PASS
12/08/08	07:44	SYST	5.0	10	0.06	+0.6%	5.07	+0.7%	PASS
12/09/08	07:44	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
12/10/08	07:44	SYST	5.0	10	0.07	+0.7%	5.27	+2.7%	PASS
12/11/08	07:44	SYST	5.0	10	-0.01	-0.1%	4.92	-0.8%	PASS
12/12/08	07:44	SYST	5.0	10	0.01	+0.1%	4.98	-0.2%	PASS
12/13/08	07:44	SYST	5.0	10	0.03	+0.3%	4.98	-0.2%	PASS
12/14/08	07:44	SYST	5.0	10	0.05	+0.5%	4.98	-0.2%	PASS
12/15/08	07:44	SYST	5.0	10	0.03	+0.3%	4.99	-0.1%	PASS
12/15/08	14:11	SYST	5.0	10	0.15	+1.5%	5.06	+0.6%	PASS
12/16/08	07:44	SYST	5.0	10	0.18	+1.8%	5.19	+1.9%	PASS
12/17/08	07:44	SYST	5.0	10	-0.11	-1.1%	4.86	-1.4%	PASS
12/18/08	07:44	SYST	5.0	10	-1.12	-11.2%	3.69	-13.1%	FAIL
12/18/08	11:15	INST	5.0	10	0.00	+0.0%	5.03	+0.3%	PASS
12/18/08	14:52	SYST	5.0	10	-0.05	-0.5%	5.10	+1.0%	PASS
12/19/08	07:34	SYST	5.0	10	-0.07	-0.7%	5.23	+2.3%	PASS
12/19/08	13:44	SYST	5.0	10	0.03	+0.3%	4.70	-3.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
12/20/08	07:34	SYST	5.0	10	0.08	+0.8%	4.75	-2.5%	PASS
12/21/08	07:34	SYST	5.0	10	0.04	+0.4%	4.77	-2.3%	PASS
12/22/08	07:34	SYST	5.0	10	0.04	+0.4%	4.85	-1.5%	PASS
12/23/08	07:34	SYST	5.0	10	0.03	+0.3%	5.06	+0.6%	PASS
12/24/08	07:34	SYST	5.0	10	0.03	+0.3%	4.89	-1.1%	PASS
12/25/08	07:34	SYST	5.0	10	0.04	+0.4%	5.03	+0.3%	PASS
12/26/08	07:34	SYST	5.0	10	0.03	+0.3%	4.97	-0.3%	PASS
12/27/08	07:34	SYST	5.0	10	0.05	+0.5%	5.08	+0.8%	PASS
12/28/08	07:34	SYST	5.0	10	0.06	+0.6%	4.94	-0.6%	PASS
12/29/08	No Calibration Check – Blowback Mode – Probe Temperature Failure								
12/30/08	07:34	SYST	5.0	10	0.08	+0.8%	4.95	-0.5%	PASS
12/31/08	07:34	SYST	5.0	10	0.06	+0.6%	5.05	+0.5%	PASS
01/01/09	07:34	SYST	5.0	10	0.08	+0.8%	4.91	-0.9%	PASS
01/02/09	07:34	SYST	5.0	10	0.08	+0.8%	4.77	-2.3%	PASS
01/03/09	07:34	SYST	5.0	10	0.01	+0.1%	5.09	+0.9%	PASS
01/04/09	07:34	SYST	5.0	10	0.04	+0.4%	5.03	+0.3%	PASS
01/05/09	07:34	SYST	5.0	10	0.03	+0.3%	5.06	+0.6%	PASS
01/05/09	19:07	SYST	5.0	10	0.03	+0.3%	4.82	-1.8%	PASS
01/06/09	17:53	SYST	5.0	10	0.50	+5.0%	2.46	-25.4%	FAIL
01/07/09	13:00	SYST	5.0	10	0.47	+4.7%	2.68	-23.2%	FAIL
01/07/09	18:19	SYST	5.0	10	-0.05	-0.5%	4.93	-0.7%	PASS
01/08/09	06:44	SYST	5.0	10	-0.21	-2.1%	4.83	-1.7%	PASS
01/08/09	07:34	SYST	5.0	10	-0.16	-1.6%	4.72	-2.8%	PASS
01/08/09	11:20	SYST	5.0	10	-0.63	-6.3%	10.92	+59.2%	FAIL
01/08/09	16:08	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
01/09/09	06:44	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS
01/09/09	07:34	SYST	5.0	10	0.00	+0.0%	4.98	-0.2%	PASS
01/10/09	06:44	SYST	5.0	10	0.00	+0.0%	4.93	-0.7%	PASS
01/10/09	07:34	SYST	5.0	10	0.02	+0.2%	4.86	-1.4%	PASS
01/11/09	06:44	SYST	5.0	10	0.01	+0.1%	4.80	-2.0%	PASS
01/11/09	07:34	SYST	5.0	10	0.04	+0.4%	4.77	-2.3%	PASS
01/12/09	06:44	SYST	5.0	10	0.03	+0.3%	4.78	-2.2%	PASS
01/12/09	07:34	SYST	5.0	10	0.06	+0.6%	4.72	-2.8%	PASS
01/13/09	06:44	SYST	5.0	10	-0.01	-0.1%	5.02	+0.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
01/13/09	07:34	SYST	5.0	10	0.01	+0.1%	4.92	-0.8%	PASS
01/14/09	06:44	SYST	5.0	10	0.00	+0.0%	4.95	-0.5%	PASS
01/14/09	07:34	SYST	5.0	10	0.02	+0.2%	4.86	-1.4%	PASS
01/15/09	No Calibration Check – Blowback Mode – Probe Temperature Failure								
01/16/09	06:44	SYST	5.0	10	0.01	+0.1%	4.80	-2.0%	PASS
01/16/09	07:34	SYST	5.0	10	0.03	+0.3%	4.71	-2.9%	PASS
01/17/09	06:44	SYST	5.0	10	-0.01	-0.1%	5.04	+0.4%	PASS
01/17/09	07:34	SYST	5.0	10	0.00	+0.0%	4.86	-1.4%	PASS
01/18/09	06:44	SYST	5.0	10	-0.03	-0.3%	4.99	-0.1%	PASS
01/18/09	07:34	SYST	5.0	10	-0.02	-0.2%	4.89	-1.1%	PASS
01/19/09	06:44	SYST	5.0	10	-0.01	-0.1%	4.95	-0.5%	PASS
01/19/09	07:34	SYST	5.0	10	0.01	+0.1%	4.87	-1.3%	PASS
01/20/09	06:44	SYST	5.0	10	0.02	+0.2%	4.94	-0.6%	PASS
01/20/09	07:34	SYST	5.0	10	0.03	+0.3%	4.92	-0.8%	PASS
01/21/09	06:44	SYST	5.0	10	0.02	+0.2%	4.91	-0.9%	PASS
01/21/09	07:34	SYST	5.0	10	0.04	+0.4%	4.85	-1.5%	PASS
01/22/09	06:44	SYST	5.0	10	0.05	+0.5%	5.00	+0.0%	PASS
01/22/09	07:34	SYST	5.0	10	0.06	+0.6%	4.90	-1.0%	PASS
01/23/09	06:44	SYST	5.0	10	0.04	+0.4%	4.88	-1.2%	PASS
01/23/09	07:34	SYST	5.0	10	0.04	+0.4%	4.77	-2.3%	PASS
01/24/09	06:44	SYST	5.0	10	-0.01	-0.1%	5.20	+2.0%	PASS
01/24/09	07:34	SYST	5.0	10	0.00	+0.0%	5.09	+0.9%	PASS
01/25/09	06:44	SYST	5.0	10	0.00	+0.0%	5.22	+2.2%	PASS
01/25/09	07:34	SYST	5.0	10	0.01	+0.1%	5.11	+1.1%	PASS
01/26/09	06:44	SYST	5.0	10	0.03	+0.3%	5.29	+2.9%	PASS
01/26/09	07:34	SYST	5.0	10	0.05	+0.5%	5.13	+1.3%	PASS
01/27/09	06:44	SYST	5.0	10	0.05	+0.5%	5.30	+3.0%	PASS
01/27/09	07:34	SYST	5.0	10	0.07	+0.7%	5.14	+1.4%	PASS
01/28/09	07:34	SYST	5.0	10	-0.09	-0.9%	4.92	-0.8%	PASS
01/29/09	07:34	SYST	5.0	10	-0.05	-0.5%	4.83	-1.7%	PASS
01/30/09	07:34	SYST	5.0	10	-0.10	-1.0%	4.80	-2.0%	PASS
01/31/09	07:34	SYST	5.0	10	-0.01	-0.1%	4.89	-1.1%	PASS
02/01/09	07:34	SYST	5.0	10	0.05	+0.5%	4.95	-0.5%	PASS
02/02/09	07:34	SYST	5.0	10	0.06	+0.6%	4.99	-0.1%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/03/09	07:34	SYST	5.0	10	0.07	+0.7%	5.02	+0.2%	PASS
02/04/09	07:34	SYST	5.0	10	0.11	+1.1%	5.09	+0.9%	PASS
02/05/09	07:34	SYST	5.0	10	0.03	+0.3%	4.98	-0.2%	PASS
02/06/09	07:34	SYST	5.0	10	0.06	+0.6%	5.01	+0.1%	PASS
02/07/09	07:34	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
02/08/09	07:34	SYST	5.0	10	0.02	+0.2%	5.08	+0.8%	PASS
02/09/09	07:34	SYST	5.0	10	0.14	+1.4%	5.09	+0.9%	PASS
02/10/09	07:34	SYST	5.0	10	-0.05	-0.5%	4.92	-0.8%	PASS
02/10/09	15:27	INST	5.0	10	0.02	+0.2%	4.74	-2.6%	PASS
02/11/09	07:34	SYST	5.0	10	0.13	+1.3%	3.22	-17.8%	FAIL
02/11/09	11:30	SYST	5.0	10	-0.20	-2.0%	3.05	-19.5%	FAIL
02/11/09	14:46	SYST	5.0	10	0.79	+7.9%	5.36	+3.6%	PASS
02/12/09	07:34	SYST	5.0	10	1.29	+12.9%	5.83	+8.3%	FAIL
02/12/09	19:08	SYST	5.0	10	-0.11	-1.1%	4.98	-0.2%	PASS
02/13/09	07:34	SYST	5.0	10	0.69	+6.9%	5.68	+6.8%	PASS
02/14/09	07:34	SYST	5.0	10	-0.50	-5.0%	4.70	-3.0%	PASS
02/15/09	07:34	SYST	5.0	10	-0.80	-8.0%	4.55	-4.5%	PASS
02/16/09	07:34	SYST	5.0	10	-0.04	-0.4%	5.23	+2.3%	PASS
02/17/09	07:34	SYST	5.0	10	-0.53	-5.3%	4.40	-6.0%	PASS
02/17/09	12:35	SYST	11.0	20	0.11	+0.6%	11.66	+3.3%	PASS
02/17/09	13:07	SYST	5.0	10	-0.15	-1.5%	4.91	-0.9%	PASS
02/18/09	07:34	SYST	5.0	10	-0.45	-4.5%	4.68	-3.2%	PASS
02/18/09	10:45	SYST	5.0	10	-0.53	-5.3%	4.64	-3.6%	PASS
02/18/09	17:15	SYST	5.0	10	0.34	+3.4%	5.09	+0.9%	PASS
02/19/09	07:34	SYST	5.0	10	0.40	+4.0%	5.21	+2.1%	PASS
02/19/09	14:15	SYST	5.0	10	0.11	+1.1%	5.09	+0.9%	PASS
02/20/09	05:35	SYST	5.0	10	0.03	+0.3%	5.03	+0.3%	PASS
02/20/09	07:34	SYST	5.0	10	0.04	+0.4%	4.89	-1.1%	PASS
02/21/09	05:35	SYST	5.0	10	0.15	+1.5%	5.13	+1.3%	PASS
02/21/09	07:34	SYST	5.0	10	0.23	+2.3%	5.06	+0.6%	PASS
02/22/09	05:35	SYST	5.0	10	0.22	+2.2%	5.08	+0.8%	PASS
02/23/09	05:35	SYST	5.0	10	0.02	+0.2%	5.12	+1.2%	PASS
02/24/09	05:05	SYST	5.0	10	-0.07	-0.7%	5.17	+1.7%	PASS
02/25/09	05:05	SYST	5.0	10	0.07	+0.7%	5.10	+1.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
02/26/09	05:05	SYST	5.0	10	0.00	+0.0%	5.08	+0.8%	PASS
02/27/09	05:05	SYST	5.0	10	-0.04	-0.4%	5.00	+0.0%	PASS
02/28/09	05:05	SYST	5.0	10	0.27	+2.7%	5.36	+3.6%	PASS
03/01/09	05:46	SYST	5.0	10	-0.21	-2.1%	4.84	-1.6%	PASS
03/02/09	05:05	SYST	5.0	10	1.76	+17.6%	6.39	+13.9%	FAIL
03/03/09	05:05	SYST	5.0	10	-0.94	-9.4%	3.42	-15.8%	FAIL
03/03/09	19:25	SYST	5.0	10	-0.09	-0.9%	5.05	+0.5%	PASS
03/04/09	07:36	SYST	5.0	10	-0.07	-0.7%	5.21	+2.1%	PASS
03/05/09	07:36	SYST	5.0	10	-0.19	-1.9%	5.24	+2.4%	PASS
03/06/09	07:36	SYST	5.0	10	0.03	+0.3%	5.49	+4.9%	PASS
03/07/09	07:36	SYST	5.0	10	-0.06	-0.6%	5.36	+3.6%	PASS
03/08/09	07:36	SYST	5.0	10	0.02	+0.2%	5.40	+4.0%	PASS
03/09/09	07:36	SYST	5.0	10	0.11	+1.1%	5.49	+4.9%	PASS
03/10/09	07:36	SYST	0.0	10	-0.03	-0.3%	-0.11	-1.1%	FAIL
03/11/09	07:36	SYST	0.0	10	-0.02	-0.2%	-0.07	-0.7%	FAIL
03/11/09	18:03	SYST	5.0	10	-0.08	-0.8%	5.05	+0.5%	PASS
03/12/09	07:36	SYST	5.0	10	-0.02	-0.2%	5.11	+1.1%	PASS
03/13/09	07:36	SYST	5.0	10	0.08	+0.8%	5.20	+2.0%	PASS
03/14/09	07:36	SYST	5.0	10	-0.03	-0.3%	4.90	-1.0%	PASS
03/15/09	07:36	SYST	5.0	10	-0.04	-0.4%	4.92	-0.8%	PASS
03/16/09	07:36	SYST	5.0	10	0.00	+0.0%	5.11	+1.1%	PASS
03/17/09	07:36	SYST	5.0	10	0.16	+1.6%	5.11	+1.1%	PASS
03/18/09	07:36	SYST	5.0	10	0.04	+0.4%	5.01	+0.1%	PASS
03/19/09	07:36	SYST	5.0	10	-0.10	-1.0%	5.01	+0.1%	PASS
03/20/09	07:36	SYST	5.0	10	-0.06	-0.6%	4.98	-0.2%	PASS
03/21/09	07:36	SYST	5.0	10	0.01	+0.1%	5.09	+0.9%	PASS
03/22/09	07:36	SYST	5.0	10	-0.09	-0.9%	5.00	+0.0%	PASS
03/23/09	07:36	SYST	5.0	10	0.10	+1.0%	5.16	+1.6%	PASS
03/24/09	07:36	SYST	5.0	10	-0.22	-2.2%	4.81	-1.9%	PASS
03/25/09	07:36	SYST	5.0	10	-0.02	-0.2%	4.95	-0.5%	PASS
03/26/09	07:36	SYST	5.0	10	0.00	+0.0%	5.02	+0.2%	PASS
03/27/09	07:36	SYST	5.0	10	0.01	+0.1%	5.01	+0.1%	PASS
03/28/09	07:36	SYST	5.0	10	0.05	+0.5%	5.08	+0.8%	PASS
03/29/09	07:36	SYST	5.0	10	-0.01	-0.1%	4.95	-0.5%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
03/30/09	07:36	SYST	5.0	10	-0.10	-1.0%	4.90	-1.0%	PASS
03/31/09	07:36	SYST	5.0	10	1.17	+11.7%	5.82	+8.2%	FAIL
03/31/09	21:31	SYST	5.0	10	0.01	+0.1%	4.88	-1.2%	PASS
04/01/09	07:36	SYST	5.0	10	0.00	+0.0%	4.86	-1.4%	PASS
04/02/09	07:36	SYST	5.0	10	0.10	+1.0%	5.21	+2.1%	PASS
04/03/09	07:36	SYST	5.0	10	0.15	+1.5%	5.23	+2.3%	PASS
04/04/09	07:36	SYST	5.0	10	-0.02	-0.2%	5.15	+1.5%	PASS
04/05/09	07:36	SYST	5.0	10	-0.07	-0.7%	5.18	+1.8%	PASS
04/06/09	07:36	SYST	5.0	10	0.11	+1.1%	5.26	+2.6%	PASS
04/07/09	07:36	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
04/08/09	07:36	SYST	5.0	10	0.03	+0.3%	5.09	+0.9%	PASS
04/09/09	07:36	SYST	5.0	10	0.00	+0.0%	5.13	+1.3%	PASS
04/10/09	07:36	SYST	5.0	10	0.03	+0.3%	5.21	+2.1%	PASS
04/11/09	07:36	SYST	5.0	10	-0.08	-0.8%	4.96	-0.4%	PASS
04/12/09	07:36	SYST	5.0	10	-0.02	-0.2%	5.06	+0.6%	PASS
04/13/09	07:36	SYST	5.0	10	0.06	+0.6%	5.10	+1.0%	PASS
04/14/09	07:36	SYST	5.0	10	0.00	+0.0%	4.99	-0.1%	PASS
04/15/09	07:36	SYST	5.0	10	0.07	+0.7%	5.00	+0.0%	PASS
04/16/09	07:36	SYST	5.0	10	0.15	+1.5%	4.97	-0.3%	PASS
04/16/09	19:36	SYST	5.0	10	0.07	+0.7%	5.06	+0.6%	PASS
04/17/09	07:36	SYST	5.0	10	0.17	+1.7%	5.03	+0.3%	PASS
04/18/09	07:36	SYST	5.0	10	-0.07	-0.7%	4.86	-1.4%	PASS
04/19/09	07:36	SYST	5.0	10	-0.14	-1.4%	4.85	-1.5%	PASS
04/20/09	07:36	SYST	5.0	10	-0.07	-0.7%	4.96	-0.4%	PASS
04/21/09	07:36	SYST	5.0	10	-0.10	-1.0%	4.95	-0.5%	PASS
04/22/09	07:36	SYST	5.0	10	-0.15	-1.5%	4.92	-0.8%	PASS
04/23/09	07:36	SYST	5.0	10	0.04	+0.4%	5.10	+1.0%	PASS
04/24/09	07:36	SYST	5.0	10	-0.02	-0.2%	5.03	+0.3%	PASS
04/25/09	07:36	SYST	5.0	10	0.08	+0.8%	5.11	+1.1%	PASS
04/26/09	07:36	SYST	5.0	10	-0.10	-1.0%	4.94	-0.6%	PASS
04/27/09	07:36	SYST	5.0	10	-0.05	-0.5%	4.98	-0.2%	PASS
04/28/09	07:36	SYST	5.0	10	0.08	+0.8%	5.21	+2.1%	PASS
04/29/09	07:36	SYST	5.0	10	0.17	+1.7%	5.29	+2.9%	PASS
04/30/09	07:36	SYST	5.0	10	0.01	+0.1%	5.00	+0.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
05/01/09	07:36	SYST	5.0	10	-0.04	-0.4%	4.90	-1.0%	PASS
05/02/09	07:36	SYST	5.0	10	-0.28	-2.8%	4.85	-1.5%	PASS
05/03/09	07:36	SYST	5.0	10	-0.18	-1.8%	4.83	-1.7%	PASS
05/04/09	07:36	SYST	5.0	10	-0.06	-0.6%	5.03	+0.3%	PASS
05/05/09	07:36	SYST	5.0	10	-0.02	-0.2%	4.99	-0.1%	PASS
05/06/09	07:36	SYST	5.0	10	-0.08	-0.8%	4.91	-0.9%	PASS
05/07/09	07:36	SYST	5.0	10	-0.06	-0.6%	5.00	+0.0%	PASS
05/08/09	07:36	SYST	5.0	10	-0.26	-2.6%	4.77	-2.3%	PASS
05/09/09	07:36	SYST	5.0	10	-0.09	-0.9%	4.99	-0.1%	PASS
05/10/09	07:36	SYST	5.0	10	-0.20	-2.0%	4.93	-0.7%	PASS
05/11/09	07:36	SYST	5.0	10	-0.05	-0.5%	5.10	+1.0%	PASS
05/12/09	07:36	SYST	5.0	10	-0.04	-0.4%	4.96	-0.4%	PASS
05/13/09	07:36	SYST	5.0	10	0.02	+0.2%	4.89	-1.1%	PASS
05/14/09	07:36	SYST	5.0	10	0.04	+0.4%	4.99	-0.1%	PASS
05/15/09	07:36	SYST	5.0	10	0.03	+0.3%	5.00	+0.0%	PASS
05/16/09	07:36	SYST	5.0	10	-0.07	-0.7%	4.99	-0.1%	PASS
05/17/09	07:36	SYST	5.0	10	-0.06	-0.6%	5.00	+0.0%	PASS
05/18/09	07:36	SYST	5.0	10	-0.05	-0.5%	5.09	+0.9%	PASS
05/19/09	07:36	SYST	5.0	10	-0.03	-0.3%	5.11	+1.1%	PASS
05/20/09	07:36	SYST	5.0	10	-0.03	-0.3%	4.91	-0.9%	PASS
05/21/09	07:36	SYST	5.0	10	0.02	+0.2%	5.01	+0.1%	PASS
05/22/09	07:36	SYST	5.0	10	-0.02	-0.2%	4.92	-0.8%	PASS
05/23/09	07:36	SYST	5.0	10	-0.08	-0.8%	4.84	-1.6%	PASS
05/24/09	07:36	SYST	5.0	10	-0.04	-0.4%	4.97	-0.3%	PASS
05/25/09	07:36	SYST	5.0	10	-0.06	-0.6%	4.92	-0.8%	PASS
05/26/09	07:36	SYST	5.0	10	0.12	+1.2%	5.13	+1.3%	PASS
05/27/09	07:36	SYST	5.0	10	0.02	+0.2%	5.13	+1.3%	PASS
05/28/09	07:36	SYST	5.0	10	-0.03	-0.3%	4.86	-1.4%	PASS
05/29/09	07:36	SYST	5.0	10	0.06	+0.6%	5.00	+0.0%	PASS
05/30/09	07:36	SYST	5.0	10	0.01	+0.1%	4.96	-0.4%	PASS
05/31/09	07:36	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
06/01/09	07:36	SYST	5.0	10	0.06	+0.6%	5.04	+0.4%	PASS
06/02/09	07:36	SYST	5.0	10	0.02	+0.2%	4.96	-0.4%	PASS
06/03/09	07:36	SYST	5.0	10	0.06	+0.6%	5.12	+1.2%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
06/04/09	07:36	SYST	5.0	10	0.15	1.5%	5.16	1.6%	PASS
06/05/09	07:36	SYST	5.0	10	0.06	+0.6%	5.02	+0.2%	PASS
06/06/09	07:36	SYST	5.0	10	-0.02	-0.2%	4.98	-0.2%	PASS
06/07/09	07:36	SYST	5.0	10	-0.09	-0.9%	4.87	-1.3%	PASS
06/08/09	07:36	SYST	5.0	10	-0.08	-0.8%	4.88	-1.2%	PASS
06/09/09	07:36	SYST	5.0	10	0.04	+0.4%	5.09	+0.9%	PASS
06/10/09	07:36	SYST	5.0	10	0.12	+1.2%	5.21	+2.1%	PASS
06/11/09	07:36	SYST	5.0	10	0.02	+0.2%	5.06	+0.6%	PASS
06/12/09	07:36	SYST	5.0	10	0.03	+0.3%	5.04	+0.4%	PASS
06/13/09	07:36	SYST	5.0	10	0.02	+0.2%	5.03	+0.3%	PASS
06/14/09	07:36	SYST	5.0	10	0.03	+0.3%	4.99	-0.1%	PASS
06/15/09	07:36	SYST	5.0	10	0.05	+0.5%	5.09	+0.9%	PASS
06/16/09	07:35	SYST	5.0	10	0.06	+0.6%	5.00	+0.0%	PASS
06/17/09	07:35	SYST	5.0	10	0.04	+0.4%	4.94	-0.6%	PASS
06/18/09	07:35	SYST	5.0	10	0.03	+0.3%	4.96	-0.4%	PASS
06/19/09	07:35	SYST	5.0	10	0.04	+0.4%	4.98	-0.2%	PASS
06/20/09	07:35	SYST	5.0	10	0.01	+0.1%	4.96	-0.4%	PASS
06/21/09	07:35	SYST	5.0	10	0.01	+0.1%	5.04	+0.4%	PASS
06/22/09	07:35	SYST	5.0	10	0.09	+0.9%	5.17	+1.7%	PASS
06/23/09	07:35	SYST	5.0	10	0.08	+0.8%	5.21	+2.1%	PASS
06/24/09	07:35	SYST	5.0	10	0.00	+0.0%	4.94	-0.6%	PASS
06/25/09	07:35	SYST	5.0	10	0.07	+0.7%	4.98	-0.2%	PASS
06/26/09	07:35	SYST	5.0	10	-0.01	-0.1%	5.01	+0.1%	PASS
06/27/09	07:35	SYST	5.0	10	-0.04	-0.4%	4.98	-0.2%	PASS
06/28/09	07:35	SYST	5.0	10	-0.03	-0.3%	4.96	-0.4%	PASS
06/29/09	07:35	SYST	5.0	10	-0.03	-0.3%	4.99	-0.1%	PASS
06/30/09	07:35	SYST	5.0	10	-0.04	-0.4%	4.95	-0.5%	PASS
07/01/09	07:35	SYST	5.0	10	-0.05	-0.5%	4.97	-0.3%	PASS
07/02/09	07:35	SYST	5.0	10	0.09	+0.9%	5.15	+1.5%	PASS
07/03/09	07:35	SYST	5.0	10	0.05	+0.5%	5.20	+2.0%	PASS
07/04/09	07:35	SYST	5.0	10	0.06	+0.6%	5.18	+1.8%	PASS
07/05/09	07:35	SYST	5.0	10	0.06	+0.6%	5.17	+1.7%	PASS
07/06/09	07:35	SYST	5.0	10	0.07	+0.7%	5.20	+2.0%	PASS
07/07/09	07:35	SYST	5.0	10	0.04	+0.4%	5.03	+0.3%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/08/09	07:35	SYST	5.0	10	0.05	+0.5%	5.06	+0.6%	PASS
07/09/09	07:35	SYST	5.0	10	0.07	+0.7%	5.14	+1.4%	PASS
07/10/09	07:35	SYST	5.0	10	0.04	+0.4%	5.15	+1.5%	PASS
07/11/09	07:35	SYST	5.0	10	-0.02	-0.2%	4.93	-0.7%	PASS
07/12/09	07:35	SYST	5.0	10	-0.03	-0.3%	4.94	-0.6%	PASS
07/13/09	07:35	SYST	5.0	10	0.01	-0.1%	5.00	0.0%	PASS
07/14/09	No Calibration Check – Maintenance Activities – Probe Cleaning								
07/15/09	No Calibration Check – Maintenance Activities – Probe Cleaning								
07/16/09	No Calibration Check – Maintenance Activities – Probe Cleaning								
07/17/09	04:00	SYST	10.0	10	-0.36	-3.6%	9.34	-6.6%	PASS
07/17/09	07:35	SYST	10.0	10	-0.33	-3.3%	8.79	-12.1%	FAIL
07/17/09	12:28	SYST	10.0	10	-0.16	-1.6%	9.98	-0.2%	PASS
07/17/09	13:02	SYST	5.0	10	0.15	+1.5%	4.74	-2.6%	PASS
07/18/09	07:35	SYST	5.0	10	-0.62	-6.2%	4.18	-8.2%	PASS
07/18/09	12:28	SYST	5.0	10	-0.60	-6.0%	4.52	-4.8%	PASS
07/19/09	07:35	SYST	5.0	10	-0.61	-6.1%	4.09	-9.1%	PASS
07/19/09	12:28	SYST	5.0	10	-0.59	-5.9%	4.58	-4.2%	PASS
07/20/09	07:35	SYST	5.0	10	-0.55	-5.5%	4.11	-8.9%	PASS
07/20/09	12:28	SYST	5.0	10	-0.57	-5.7%	4.56	-4.4%	PASS
07/21/09	07:35	SYST	5.0	10	0.01	+0.1%	5.06	+0.6%	PASS
07/21/09	12:28	SYST	5.0	10	0.00	+0.0%	5.42	+4.2%	PASS
07/22/09	07:35	SYST	5.0	10	-0.02	-0.2%	5.06	+0.6%	PASS
07/22/09	12:28	SYST	5.0	10	-0.01	-0.1%	5.55	+5.5%	PASS
07/23/09	07:35	SYST	5.0	10	-0.01	-0.1%	4.46	-5.4%	PASS
07/23/09	12:28	SYST	5.0	10	-0.01	-0.1%	5.48	+4.8%	PASS
07/24/09	07:35	SYST	5.0	10	0.01	+0.1%	5.00	+0.0%	PASS
07/24/09	12:28	SYST	5.0	10	0.05	+0.5%	5.46	+4.6%	PASS
07/25/09	07:35	SYST	5.0	10	-0.04	-0.4%	4.95	-0.5%	PASS
07/25/09	12:28	SYST	5.0	10	-0.02	-0.2%	5.53	+5.3%	PASS
07/26/09	07:35	SYST	5.0	10	-0.06	-0.6%	5.08	+0.8%	PASS
07/26/09	12:28	SYST	5.0	10	0.00	+0.0%	5.47	+4.7%	PASS
07/27/09	07:35	SYST	5.0	10	0.02	+0.2%	5.19	+1.9%	PASS
07/27/09	12:28	SYST	5.0	10	0.02	+0.2%	5.72	+7.2%	PASS
07/28/09	07:35	SYST	5.0	10	-0.03	-0.3%	5.10	+1.0%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
07/29/09	07:35	SYST	5.0	10	-0.07	-0.7%	4.93	-0.7%	PASS
07/29/09	12:28	SYST	5.0	10	-0.03	-0.3%	5.21	+2.1%	PASS
07/30/09	07:35	SYST	5.0	10	-0.02	-0.2%	5.05	+0.5%	PASS
07/30/09	12:28	SYST	5.0	10	-0.03	-0.3%	5.48	+4.8%	PASS
07/31/09	07:35	SYST	5.0	10	0.00	+0.0%	4.73	-2.7%	PASS
07/31/09	12:28	SYST	5.0	10	-0.01	-0.1%	4.84	-1.6%	PASS
08/01/09	07:35	SYST	5.0	10	0.00	+0.0%	4.77	-2.3%	PASS
08/01/09	12:28	SYST	5.0	10	0.00	+0.0%	5.02	+0.2%	PASS
08/02/09	07:35	SYST	5.0	10	-0.02	-0.2%	4.60	-4.0%	PASS
08/02/09	12:28	SYST	5.0	10	0.00	+0.0%	4.96	-0.4%	PASS
08/03/09	07:35	SYST	5.0	10	-0.01	-0.1%	4.67	-3.3%	PASS
08/03/09	12:28	SYST	5.0	10	0.03	+0.3%	5.22	+2.2%	PASS
08/04/09	07:35	SYST	5.0	10	0.02	+0.2%	4.95	-0.5%	PASS
08/04/09	12:28	SYST	5.0	10	0.02	+0.2%	4.98	-0.2%	PASS
08/05/09	07:35	SYST	5.0	10	0.02	+0.2%	5.00	+0.0%	PASS
08/05/09	12:28	SYST	5.0	10	0.00	+0.0%	5.23	+2.3%	PASS
08/06/09	07:35	SYST	5.0	10	0.02	+0.2%	5.02	+0.2%	PASS
08/06/09	12:28	SYST	5.0	10	0.01	+0.1%	5.33	+3.3%	PASS
08/07/09	07:35	SYST	5.0	10	0.00	+0.0%	5.07	+0.7%	PASS
08/08/09	07:35	SYST	5.0	10	0.03	+0.3%	5.06	+0.6%	PASS
08/09/09	07:35	SYST	5.0	10	-0.01	-0.1%	5.07	+0.7%	PASS
08/10/09	07:35	SYST	5.0	10	0.03	+0.3%	5.03	+0.3%	PASS
08/11/09	07:35	SYST	5.0	10	0.04	+0.4%	5.03	+0.3%	PASS
08/12/09	07:35	SYST	5.0	10	0.00	+0.0%	4.95	-0.5%	PASS
08/13/09	07:35	SYST	5.0	10	0.02	+0.2%	5.22	+2.2%	PASS
08/14/09	07:35	SYST	5.0	10	0.03	+0.3%	5.10	+1.0%	PASS
08/15/09	07:35	SYST	5.0	10	0.06	+0.6%	5.15	+1.5%	PASS
08/16/09	07:35	SYST	5.0	10	0.01	+0.1%	5.06	+0.6%	PASS
08/17/09	07:35	SYST	5.0	10	-0.05	-0.5%	5.01	+0.1%	PASS
08/18/09	07:35	SYST	5.0	10	0.08	+0.8%	5.04	+0.4%	PASS
08/19/09	07:35	SYST	5.0	10	0.08	+0.8%	4.94	-0.6%	PASS
08/20/09	07:35	SYST	5.0	10	0.10	+1.0%	4.94	-0.6%	PASS
08/21/09	07:35	SYST	5.0	10	-0.03	-0.3%	5.17	+1.7%	PASS
08/22/09	07:35	SYST	5.0	10	-0.14	-1.4%	5.06	+0.6%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
08/23/09	07:35	SYST	5.0	10	-0.12	-1.2%	5.07	+0.7%	PASS
08/24/09	07:35	SYST	5.0	10	-0.11	-1.1%	5.32	+3.2%	PASS
08/25/09	07:35	SYST	5.0	10	-0.04	-0.4%	4.98	-0.2%	PASS
08/26/09	07:35	SYST	5.0	10	-0.04	-0.4%	5.17	+1.7%	PASS
08/27/09	07:35	SYST	5.0	10	-0.04	-0.4%	5.09	+0.9%	PASS
08/28/09	No Calibration Check – Blowback Mode – Baghouse Offline								
08/29/09	No Calibration Check – Blowback Mode – Baghouse Offline								
08/30/09	No Calibration Check – Blowback Mode – Baghouse Offline								
08/31/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/01/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/02/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/03/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/04/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/05/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/06/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/07/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/08/09	No Calibration Check – Blowback Mode – Baghouse Offline								
09/09/09	10:25	SYST	5.0	10	0.00	+0.0%	4.96	-0.4%	PASS
09/10/09	07:35	SYST	5.0	10	-0.02	-0.2%	4.88	-1.2%	PASS
09/11/09	07:35	SYST	5.0	10	-0.05	-0.5%	4.89	-1.1%	PASS
09/12/09	07:35	SYST	5.0	10	-0.17	-1.7%	4.82	-1.8%	PASS
09/13/09	07:35	SYST	5.0	10	-0.20	-2.0%	4.69	-3.1%	PASS
09/14/09	07:35	SYST	5.0	10	-0.11	-1.1%	4.77	-2.3%	PASS
09/15/09	07:35	SYST	5.0	10	-0.03	-0.3%	4.88	-1.2%	PASS
09/15/09	14:50	SYST	5.0	10	0.06	+0.6%	4.79	-2.1%	PASS
09/16/09	07:35	SYST	5.0	10	-0.04	-0.4%	4.69	-3.1%	PASS
09/17/09	07:35	SYST	5.0	10	0.02	+0.2%	5.05	+0.5%	PASS
09/18/09	07:35	SYST	5.0	10	0.07	+0.7%	5.15	+1.5%	PASS
09/19/09	07:35	SYST	5.0	10	-0.07	-0.7%	5.13	+1.3%	PASS
09/20/09	07:35	SYST	5.0	10	0.21	+2.1%	5.48	+4.8%	PASS
09/21/09	07:35	SYST	5.0	10	0.57	+5.7%	5.85	+8.5%	PASS
09/22/09	07:35	SYST	5.0	10	0.12	+1.2%	5.20	+2.0%	PASS
09/23/09	07:35	SYST	5.0	10	0.18	+1.8%	5.15	+1.5%	PASS
09/24/09	07:35	SYST	5.0	10	0.15	+1.5%	5.29	+2.9%	PASS

Date	Time	Type	Level	Span	Zero Response		Cal Response		Result
09/25/09	07:35	SYST	5.0	10	0.30	+3.0%	5.51	+5.1%	PASS
09/26/09	07:35	SYST	5.0	10	0.39	+3.9%	5.56	+5.6%	PASS
09/27/09	07:35	SYST	5.0	10	0.54	+5.4%	5.49	+4.9%	PASS
09/28/09	07:35	SYST	5.0	10	0.76	+7.6%	5.63	+6.3%	PASS
09/29/09	07:35	SYST	5.0	10	0.06	+0.6%	5.24	+2.4%	PASS
09/30/09	07:35	SYST	5.0	10	-0.09	-0.9%	4.95	-0.5%	PASS

Appendix P. Outlet CEMS Monthly Maintenance Records

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _January 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _0_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
1/1/08 14:02		Updated calibration factors
1/4/08 17:50		Updated calibration factors
1/7/08 16:05		Updated calibration factors
1/15/08 13:53		Updated calibration factors
1/17/08 16:22		Updated calibration factors
1/21/08 16:55		Updated calibration factors
1/28/08 16:52		Updated calibration factors
1/31/08 12:46		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _February 2008_
Number of Operating Hours in the month _696_
Number of Downtime Hours in the month _0_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
02/21/08 13:22		Updated calibration factors
02/22/08 17:37		Updated calibration factors
02/25/08 18:15		Updated calibration factors
02/28/08 12:22		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _March 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _90_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
03/06/08 13:32		Updated calibration factors
03/11/08 15:47		Passed linearity check
03/11/08 16:28	03/12/08 07:56 (16 hrs)	Manual recalibration Passed calibration check on 3/12
03/17/08 13:25		Updated calibration factors
03/19/08 12:00		Updated calibration factors
03/21/08 10:48		Updated calibration factors
03/24/08 15:40		Updated calibration factors
03/25/08 09:48	03/28/08 12:13 (74 hrs)	Communication error Data not collected / data missing

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Inlet)_ Month & Year _April 2008_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _25_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
04/08/08 13:36		Updated calibration factors
04/10/08 11:04		Updated calibration factors
04/11/08 08:01	04/11/08 15:46 (8 hr)	Failed calibration check Calibrator communication error Passed calibration check on 4/11
04/14/08 17:08		Updated calibration factors
04/16/08 15:06	04/17/08 08:01 (17 hrs)	PMT voltage adjustment Manual recalibration Passed calibration check on 4/17
04/17/08 12:06		Updated calibration factors
04/23/08 15:12		Updated calibration factors
04/30/08 10:00		Passed linearity check
04/30/08 15:21		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Inlet)_ Month & Year _May 2008_
Number of Operating Hours in the month _457_
Number of Downtime Hours in the month _158_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	End Time and Date, and number of hours	Cause and Follow up action
05/01/08 13:08		Updated calibration factors
05/06/08 12:20		Updated calibration factors
05/07/08 11:47	05/14/08 00:10 (156 hrs)	Error in analyzer data file Data not collected / corrupt
05/14/08 14:37	05/14/08 15:31 (2 hrs)	Manual recalibration Passed calibration check
05/19/08 13:10		Updated calibration factors

Name of technician filling report _EZ_

Comments:
Unit 7-9 Outlet Duct bypassed from 5/18/08 02:48 to 5/30/08 0:42 for 287 operating hours.

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Inlet)_ Month & Year _June 2008_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _75_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
06/02/08 14:51		Updated calibration factors
06/05/08 12:05		Updated calibration factors
06/06/08 10:36		Updated calibration factors
06/09/08 11:47		Updated calibration factors
06/11/08 10:21		Updated calibration factors
06/17/08 10:32		Updated calibration factors
06/27/09 13:31	06/30/08 15:39 (75 hrs)	Mercury lamp replacement Failed calibration checks Manual recalibrations Passed calibration check on 6/30

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _July 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _6_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
07/01/08 8:02	07/01/08 13:44 (6 hr)	Failed calibration check Recalibrated and passed check
07/02/08 10:18		Updated calibration factors
07/07/08 11:01		Updated calibration factors
07/15/08 9:42		Updated calibration factors
07/17/08 9:37		Updated calibration factors
07/21/08 10:52		Updated calibration factors
07/25/08 10:54		Updated calibration factors
07/29/08 9:40		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _August 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _3_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
08/04/08 10:42		Updated calibration factors
08/04/08 16:26		Linearity check
08/11/08 15:50		Updated calibration factors
08/14/08 12:51		Updated calibration factors
08/15/08 11:35		Updated calibration factors
08/21/08 11:12		Updated calibration factors
08/25/08 13:39		Updated calibration factors
08/31/08 21:17	8/31/09 23:59 (3 hr)	Eductor transducer failed OOC to End of Month

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _September 2008_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _272_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
09/01/08 0:00	09/12/08 8:02 (272 hr)	OOC at Start of Month Eductor Regulator Broken Mercury Lamp Replaced 9/2 Eductor Regulator Replaced 9/11 Passed calibration check 9/12
09/12/08 9:34		Updated calibration factors
09/18/08 17:16		Updated calibration factors
09/23/08 17:17		Updated calibration factors
09/26/08 12:17		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _October 2008_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _2_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
10/03/08 16:31		Updated calibration factors
10/07/08 16:29		Updated calibration factors
10/13/08 16:48		Updated calibration factors
10/23/08 9:50		Updated calibration factors
10/26/08 16:06		Updated calibration factors
10/27/08 12:51	10/27/08 14:39 (2 hr)	PMT Voltage Adjustment Recalibrated and pass check
10/28/08 12:08		Updated calibration factors
10/29/08 10:26		Updated calibration factors
10/31/08 11:19		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _November 2008_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _0_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
11/03/08 14:05		Updated calibration factors
11/10/08 15:39		Updated calibration factors
11/14/08 11:44		Updated calibration factors
11/17/08 15:33		Updated calibration factors
11/18/08 11:44		Updated calibration factors
11/20/08 14:30		Linearity Check
11/21/08 11:35		Updated calibration factors
11/24/08 15:01		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _December 2008_
Number of Operating Hours in the month _528_
Number of Downtime Hours in the month _25_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
12/10/08 17:15		Updated calibration factors
12/15/08 5:45		Updated calibration factors
12/16/08 16:10		Updated calibration factors
12/17/08 14:37	12/18/08 15:21 (25 hr)	Mercury lamp replacement Failed calibration check 12/18 Recalibrated and passed check
12/19/08 13:40		Updated calibration factors
12/22/08 12:30		Updated calibration factors

Name of technician filling report _EZ_

Comments:
Unit 7-9 Outlet Duct bypassed from 12/1/08 0:00 to 12/10/08 0:00 for 216 hours

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _January 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _54_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
01/02/09 9:25		Updated calibration factors
01/05/09 19:07	01/07/09 18:48 (48 hr)	Converter core replaced / burn-in Recalibrated and pass check
01/08/09 11:40	01/08/09 16:39 (6 hr)	Failed calibration check Repair leak in system Recalibrated and pass check
01/12/09 15:03		Updated calibration factors
01/16/09 13:45		Updated calibration factors
01/23/09 12:26		Updated calibration factors
01/26/09 20:06		Updated calibration factors
01/27/09 13:16		Updated calibration factors
01/30/09 9:24		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _February 2009_
Number of Operating Hours in the month _672_
Number of Downtime Hours in the month _41_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
02/04/09 14:19		Updated calibration factors
02/09/09 19:24		Updated calibration factors
02/10/09 12:36	02/11/09 15:15 (26 hr)	Eductor turned off Eductor turned on Calibration check passed
02/12/09 7:53	02/12/09 19:38 (12 hr)	Failed calibration check Recalibration and pass check
02/12/09 20:41		Updated calibration factors
02/13/09 10:31		Updated calibration factors
02/16/09 8:25		Updated calibration factors
02/17/09 12:22	02/17/09 13:04 (1 hr)	Manual recalibration Passed calibration check
02/18/09 16:31	02/18/09 17:44 (2 hr)	Manual recalibration Passed calibration check
02/20/09 6:34		Updated calibration factors
02/22/09 6:22		Updated calibration factors
02/24/09 5:50		Updated calibration factors
02/28/09 5:44		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _March 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _87_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
03/02/09 5:34	03/03/09 19:54 (38 hr)	Mercury lamp replaced Recalibration and pass check
03/04/09 13:32		Updated calibration factors
03/05/09 15:35		Updated calibration factors
03/09/09 22:27		Updated calibration factors
03/10/09 7:55	03/11/09 18:32 (35 hr)	Failed calibration check Communication error to Calibrator Communication restored Recalibration and pass check
03/13/09 10:47		Updated calibration factors
03/13/09 14:05		Linearity check
03/17/09 19:40		Updated calibration factors
03/23/09 15:27		Updated calibration factors
03/24/09 12:25		Updated calibration factors
03/31/09 7:55	3/31/09 21:50 (14 hr)	Failed calibration check Recalibrated and pass check

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _April 2009_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _5_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
04/01/09 14:50		Updated calibration factors
04/06/09 16:57		Updated calibration factors
04/10/09 9:39		Updated calibration factors
04/16/09 10:59		Updated calibration factors
04/16/09 15:32	04/16 20:05 (5 hr)	PMT voltage adjusted Instrument recalibration System recalibration Passed calibration check
04/17/09 10:28		Updated calibration factors
04/22/09 8:29		Updated calibration factors
04/29/09 10:13		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _May 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _0_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
05/11/09 15:22		Updated calibration factors
05/14/09 13:20		Updated calibration factors
05/15/09 10:27		Updated calibration factors
05/19/09 12:37		Updated calibration factors
05/27/09 12:44		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _June 2009_
Number of Operating Hours in the month _720_
Number of Downtime Hours in the month _0_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
06/01/09 15:04		Updated calibration factors
06/08/09 21:33		Updated calibration factors
06/12/09 12:01		Passed linearity check
06/23/09 15:34		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _July 2009_
Number of Operating Hours in the month _744_
Number of Downtime Hours in the month _98_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
07/6/09 13:35		Updated calibration factors
07/10/09 10:44		Updated calibration factors
07/13/09 14:33	07/16/09 15:23 (74 hours)	Maintenance activities No calibration check 7/14, 7/15 Outlet mercury probe cleaning Failed calibration check on 7/16 PMT voltage adjustment on 7/16 Passed calibration check on 7/16
07/17/09 7:54	07/17/09 12:57 (5 hr)	Failed calibration check Passed calibration check
07/17/09 13:31		Updated calibration factors
07/20/09 18:00		Updated calibration factors
07/22/09 15:34		Updated calibration factors
07/23/09 11:48		Updated calibration factors
07/27/09 22:06		Updated calibration factors
07/28/09 12:57	07/29/09 7:54 (19 hr)	Manual recalibration on 7/28 Passed calibration check
07/30/09 13:42		Updated calibration factors

Name of technician filling report _EZ_

Comments:

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _August 2009_
Number of Operating Hours in the month _577_
Number of Downtime Hours in the month _0_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
8/4/09 13:15		Updated calibration factors
8/6/09 10:10		Updated calibration factors
8/7/09 12:20		Updated calibration factors
8/12/09 15:50		Updated calibration factors
8/14/09 12:14		Updated calibration factors
8/20/09 13:04		Updated calibration factors
8/24/09 12:17		Updated calibration factors
8/25/09 1:30	8/31/09 23:59 (0 hr) (BH bypass)	Baghouse bypassed start 8/25 Maintenance activities Analyzer mercury lamp replacement Start PMT voltage adjust on 8/31

Name of technician filling report _EZ_

Comments:
Unit 7-9 Baghouse bypassed from 8/25 1:30 to 8/31 23:59 for 167 hours.

Monthly PM and Hg CEM Systems Performance Report

Plant _PIPP_ Stack _Unit 7–9 (Outlet)_ Month & Year _September 2009_
Number of Operating Hours in the month _574_
Number of Downtime Hours in the month _49_

Downtime, Calibration Failures, Quarterly Failures, or any Unusual Operating Events

Start Time and Date	**End Time and Date, and number of hours**	**Cause and Follow up action**
9/1/09 0:00	9/7/09 2:00 (0 hr)	Baghouse bypass end
9/7/09 10:00 (grace)	9/9/04 10:25 (49 hr)	BH online (+8 hrs grace) Manual recalibrations on 9/8, 9/9 Passed calibration check on 9/9
9/14/09 14:07		Updated calibration factors
9/15/09 14:39		Updated calibration factors
9/16/09 10:43		Updated calibration factors
9/16/09 11:31		Passed linearity check
9/21/09 10:53		Updated calibration factors
9/22/09 10:53		Updated calibration factors
9/23/09 11:48		Updated calibration factors
9/28/09 20:05		Updated calibration factors

Name of technician filling report _EZ_

Comments:
Unit 7-9 Baghouse bypassed from 9/1 0:00 to 9/7 2:00 for 146 hours.

Appendix Q. 40 CFR Part 75

APPENDIX A TO PART 75—SPECIFICATIONS AND TEST PROCEDURES

1. INSTALLATION AND MEASUREMENT LOCATION

1.1 Gas and Hg Monitors

Following the procedures in section 8.1.1 of Performance Specification 2 in appendix B to part 60 of this chapter, install the pollutant concentration monitor or monitoring system at a location where the pollutant concentration and emission rate measurements are directly representative of the total emissions from the affected unit. Select a representative measurement point or path for the monitor probe(s) (or for the path from the transmitter to the receiver) such that the SO_2, CO_2, O_2, and NO_X concentration monitoring system or NO_X-diluent CEMS (NO_X pollutant concentration monitor and diluent gas monitor), Hg concentration monitoring system, or sorbent trap monitoring system will pass the relative accuracy test (see section 6 of this appendix).

It is recommended that monitor measurements be made at locations where the exhaust gas temperature is above the dewpoint temperature. If the cause of failure to meet the relative accuracy tests is determined to be the measurement location, relocate the monitor probe(s).

1.1.1 Point Monitors

Locate the measurement point (1) within the centroidal area of the stack or duct cross section, or (2) no less than 1.0 meter from the stack or duct wall.

1.1.2 Path Monitors

Locate the measurement path (1) totally within the inner area bounded by a line 1.0 meter from the stack or duct wall, or (2) such that at least 70.0 percent of the path is within the inner 50.0 percent of the stack or duct cross-sectional area, or (3) such that the path is centrally located within any part of the centroidal area.

1.2 Flow Monitors

Install the flow monitor in a location that provides representative volumetric flow over all operating conditions. Such a location is one that provides an average velocity of the flue gas flow over the stack or duct cross section, provides a representative SO_2 emission rate (in lb/hr), and is representative of the pollutant concentration monitor location. Where the moisture content of the flue gas affects volumetric flow measurements, use the procedures in both Reference Methods 1 and 4 of appendix A to part 60 of this chapter to establish a proper location for the flow monitor. The EPA recommends (but does not require) performing a flow profile study following the procedures in 40 CFR part 60, appendix A, method, 1, sections 11.5 or 11.4 for each of the three operating or load levels indicated in section 6.5.2.1 of this appendix to determine the acceptability of the potential flow monitor location and to determine the number and location of flow sampling points required to obtain a representative flow value. The procedure in 40 CFR part 60, appendix A, Test Method 1, section 11.5 may be used even if the flow measurement location is greater than or equal to 2 equivalent stack or duct diameters downstream or greater than or equal to ½ duct diameter upstream from a flow disturbance. If a flow profile study shows that cyclonic (or swirling) or stratified flow conditions exist at the potential flow monitor location that are likely to prevent the monitor from meeting the performance specifications of this part, then EPA recommends either (1) selecting another location where there is no cyclonic (or swirling) or stratified flow condition, or (2) eliminating the cyclonic (or swirling) or stratified flow condition by straightening the flow, e.g., by installing straightening vanes. EPA also recommends selecting flow monitor locations to minimize the effects of condensation, coating, erosion, or other conditions that could adversely affect flow monitor performance.

1.2.1 Acceptability of Monitor Location

The installation of a flow monitor is acceptable if either (1) the location satisfies the minimum siting criteria of method 1 in appendix A to part 60 of this chapter (i.e., the location is greater than or equal to eight stack or duct diameters downstream and two diameters upstream from a flow disturbance; or, if necessary, two stack or duct diameters downstream and one-half stack or duct diameter upstream from a flow disturbance), or (2) the results of a flow profile study, if performed, are acceptable (i.e., there are no cyclonic (or swirling) or stratified flow conditions), and the flow monitor also satisfies the performance specifications of this part. If the flow monitor is installed in a location that does not satisfy these physical criteria, but nevertheless the monitor achieves the performance specifications of this part, then the location is acceptable, notwithstanding the requirements of this section.

1.2.2 Alternative Monitoring Location

Whenever the owner or operator successfully demonstrates that modifications to the exhaust duct or stack (such as installation of straightening vanes, modifications of ductwork, and the like) are necessary for the flow monitor to meet the performance specifications, the Administrator may approve an interim alternative flow monitoring methodology and an extension to the required certification date for the flow monitor.

Where no location exists that satisfies the physical siting criteria in section 1.2.1, where

the results of flow profile studies performed at two or more alternative flow monitor locations are unacceptable, or where installation of a flow monitor in either the stack or the ducts is demonstrated to be technically infeasible, the owner or operator may petition the Administrator for an alternative method for monitoring flow.

2. EQUIPMENT SPECIFICATIONS

2.1 Instrument Span and Range

In implementing sections 2.1.1 through 2.1.6 of this appendix, set the measurement range for each parameter (SO_2, NO_X, CO_2, O_2, or flow rate) high enough to prevent full-scale exceedances from occurring, yet low enough to ensure good measurement accuracy and to maintain a high signal-to-noise ratio. To meet these objectives, select the range such that the majority of the readings obtained during typical unit operation are kept, to the extent practicable, between 20.0 and 80.0 percent of the full-scale range of the instrument. These guidelines do not apply to: (1) SO_2 readings obtained during the combustion of very low sulfur fuel (as defined in §72.2 of this chapter); (2) SO_2 or NO_X readings recorded on the high measurement range, for units with SO_2 or NO_X emission controls and two span values, unless the emission controls are operated seasonally (for example, only during the ozone season); or (3) SO_2 or NO_X readings less than 20.0 percent of full-scale on the low measurement range for a dual span unit, provided that the maximum expected concentration (MEC), low-scale span value, and low-scale range settings have been determined according to sections 2.1.1.2, 2.1.1.4(a), (b), and (g) of this appendix (for SO_2), or according to sections 2.1.2.2, 2.1.2.4(a) and (f) of this appendix (for NO_X).

2.1.1 SO_2 Pollutant Concentration Monitors

Determine, as indicated in sections 2.1.1.1 through 2.1.1.5 of this appendix the span value(s) and range(s) for an SO_2 pollutant concentration monitor so that all potential and expected concentrations can be accurately measured and recorded. Note that if a unit exclusively combusts fuels that are very low sulfur fuels (as defined in §72.2 of this chapter), the SO_2 monitor span requirements in §75.11(e)(3)(iv) apply in lieu of the requirements of this section.

2.1.1.1 Maximum Potential Concentration

(a) Make an initial determination of the maximum potential concentration (MPC) of SO_2 by using Equation A–1a or A–1b. Base the MPC calculation on the maximum percent sulfur and the minimum gross calorific value (GCV) for the highest-sulfur fuel to be burned. The maximum sulfur content and minimum GCV shall be determined from all available fuel sampling and analysis data for that fuel from the previous 12 months (minimum), excluding clearly anomalous fuel sampling values. If both the fuel sulfur content and the GCV are routinely determined from each fuel sample, the owner or operator may, as an alternative to using the highest individual percent sulfur and lowest individual GCV values in the MPC calculation, pair the sulfur content and GCV values from each sample analysis and calculate the ratio of percent sulfur to GCV (*i.e.*, %S/GCV) for each pair of values. If this option is selected, the MPC shall be calculated using the highest %S/GCV ratio in Equation A–1a or A–1b. If the designated representative certifies that the highest-sulfur fuel is never burned alone in the unit during normal operation but is always blended or co-fired with other fuel(s), the MPC may be calculated using a best estimate of the highest sulfur content and lowest gross calorific value expected for the blend or fuel mixture and inserting these values into Equation A–1a or A–1b. Derive the best estimate of the highest percent sulfur and lowest GCV for a blend or fuel mixture from weighted-average values based upon the historical composition of the blend or mixture in the previous 12 (or more) months. If insufficient representative fuel sampling data are available to determine the maximum sulfur content and minimum GCV, use values from contract(s) for the fuel(s) that will be combusted by the unit in the MPC calculation.

$$\text{MPC (or MEC)} = 11.32 \times 10^6 \left(\frac{\%S}{GCV}\right)\left(\frac{20.9 - \%O_{2w}}{20.9}\right) \qquad \text{(Eq. A-1a)}$$

or

$$\text{MPC (or MEC)} = 66.93 \times 10^6 \left(\frac{\%S}{GCV}\right)\left(\frac{\%CO_{2w}}{100}\right) \qquad \text{(Eq. A-1b)}$$

Where,

MPC = Maximum potential concentration (ppm, wet basis). (To convert to dry basis, divide the MPC by 0.9.)

MEC = Maximum expected concentration (ppm, wet basis). (To convert to dry basis, divide the MEC by 0.9).

%S = Maximum sulfur content of fuel to be fired, wet basis, weight percent, as determined according to the applicable method in paragraph (c) of section 2.1.1.1.

$\%O_{2w}$ = Minimum oxygen concentration, percent wet basis, under typical operating conditions.

$\%CO_{2w}$ = Maximum carbon dioxide concentration, percent wet basis, under typical operating conditions.

GCV = Minimum gross calorific value of the fuel or blend to be combusted, based on historical fuel sampling and analysis data or, if applicable, based on the fuel contract specifications (Btu/lb). If based on fuel sampling and analysis, the GCV shall be determined according to the applicable method in paragraph (c) of section 2.1.1.1.

11.32×10^6 = Oxygen-based conversion factor in Btu/lb (ppm)/%.

66.93×10^6 = Carbon dioxide-based conversion factor in Btu/lb (ppm)/%.

NOTE: All percent values to be inserted in the equations of this section are to be expressed as a percentage, not a fractional value (e.g., 3, not .03).

(b) Alternatively, if a certified SO_2 CEMS is already installed, the owner or operator may make the initial MPC determination based upon quality-assured historical data recorded by the CEMS. For the purposes of this section, 2.1.1.1, a ''certified'' CEMS means a CEM system that has met the applicable certification requirements of either: This part, or part 60 of this chapter, or a State CEM program, or the source operating permit. If this option is chosen, the MPC shall be the maximum SO_2 concentration observed during the previous 720 (or more) quality-assured monitor operating hours when combusting the highest-sulfur fuel (or highest-sulfur blend if fuels are always blended or co-fired) that is to be combusted in the unit or units monitored by the SO_2 monitor. For units with SO_2 emission controls, the certified SO_2 monitor used to determine the MPC must be located at or before the control device inlet. Report the MPC and the method of determination in the monitoring plan required under §75.53. Note that the initial MPC value is subject to periodic review under section 2.1.1.5 of this appendix. If an MPC value is found to be either inappropriately high or low, the MPC shall be adjusted in accordance with section 2.1.1.5, and corresponding span and range adjustments shall be made, if necessary.

(c) When performing fuel sampling to determine the MPC, use ASTM Methods: ASTM D3177–02 (Reapproved 2007), Standard Test Methods for Total Sulfur in the Analysis Sample of Coal and Coke; ASTM D4239–02, Standard Test Methods for Sulfur in the Analysis Sample of Coal and Coke Using High-Temperature Tube Furnace Combustion Methods; ASTM D4294–98, Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-ray Fluorescence Spectrometry; ASTM D1552–01, Standard Test Method for Sulfur in Petroleum Products (High-Temperature Method); ASTM D129–00, Standard Test Method for Sulfur in Petroleum Products (General Bomb Method); ASTM D2622–98, Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry, for sulfur content of solid or liquid fuels; ASTM D3176–89 (Reapproved 2002), Standard Practice for Ultimate Analysis of Coal and Coke; ASTM D240–00, Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter; or ASTM D5865–01a, Standard Test Method for Gross Calorific Value of Coal and Coke (all incorporated by reference under §75.6 of this part).

2.1.1.2 Maximum Expected Concentration

(a) Make an initial determination of the maximum expected concentration (MEC) of SO_2 whenever: (a) SO_2 emission controls are used; or (b) both high-sulfur and low-sulfur fuels (e.g., high-sulfur coal and low-sulfur coal or different grades of fuel oil) or high-sulfur and low-sulfur fuel blends are combusted as primary or backup fuels in a unit without SO_2 emission controls. For units with SO_2 emission controls, use Equation A–2 to make the initial MEC determination. When high-sulfur and low-sulfur fuels or blends are burned as primary or backup fuels in a unit without SO_2 controls, use Equation A–1a or A–1b to calculate the initial MEC value for each fuel or blend, except for: (1) the highest-sulfur fuel or blend (for which the MPC was previously calculated in section 2.1.1.1 of this appendix); (2) fuels or blends that are very low sulfur fuels (as defined in §72.2 of this chapter); or (3) fuels or blends that are used only for unit startup. Each initial MEC value shall be documented in the monitoring plan required under §75.53. Note that each initial MEC value is subject to periodic review under section 2.1.1.5 of this appendix. If an MEC value is found to be either inappropriately high or low, the MEC shall be adjusted in accordance with section 2.1.1.5, and corresponding span and range adjustments shall be made, if necessary.

(b) For each MEC determination, substitute into Equation A–1a or A–1b the highest sulfur content and minimum GCV value for that fuel or blend, based upon all available fuel sampling and analysis results from the previous 12 months (or more), or, if fuel

sampling data are unavailable, based upon fuel contract(s).

(c) Alternatively, if a certified SO_2 CEMS is already installed, the owner or operator may make the initial MEC determination(s) based upon historical monitoring data. For the purposes of this section, 2.1.1.2, a ''certified'' CEMS means a CEM system that has met the applicable certification requirements of either: This part, or part 60 of this chapter, or a State CEM program, or the source operating permit. If this option is chosen for a unit with SO_2 emission controls, the MEC shall be the maximum SO_2 concentration measured downstream of the control device outlet by the CEMS over the previous 720 (or more) quality-assured monitor operating hours with the unit and the control device both operating normally. For units that burn high- and low-sulfur fuels or blends as primary and backup fuels and have no SO_2 emission controls, the MEC for each fuel shall be the maximum SO_2 concentration measured by the CEMS over the previous 720 (or more) quality-assured monitor operating hours in which that fuel or blend was the only fuel being burned in the unit.

$$\mathrm{MEC} = \mathrm{MPC}\left(\frac{100 - \mathrm{RE}}{100}\right) \qquad \text{(Eq. A-2)}$$

Where:

MEC = Maximum expected concentration (ppm).

MPC = Maximum potential concentration (ppm), as determined by Eq. A–1a or A–1b in section 2.1.1.1 of this appendix.

RE = Expected average design removal efficiency of control equipment (%).

2.1.1.3 Span Value(s) and Range(s)

Determine the high span value and the high full-scale range of the SO_2 monitor as follows. (Note: For purposes of this part, the high span and range refer, respectively, either to the span and range of a single span unit or to the high span and range of a dual span unit.) The high span value shall be obtained by multiplying the MPC by a factor no less than 1.00 and no greater than 1.25. Round the span value upward to the next highest multiple of 100 ppm. If the SO_2 span concentration is ≤ 500 ppm, the span value may either be rounded upward to the next highest multiple of 10 ppm, or to the next highest multiple of 100 ppm. The high span value shall be used to determine concentrations of the calibration gases required for daily calibration error checks and linearity tests. Select the full-scale range of the instrument to be consistent with section 2.1 of this appendix and to be greater than or equal to the span value. Report the full-scale range setting and calculations of the MPC and span in the monitoring plan for the unit. Note that for certain applications, a second (low) SO_2 span and range may be required (see section 2.1.1.4 of this appendix). If an existing State, local, or federal requirement for span of an SO_2 pollutant concentration monitor requires or allows the use of a span value lower than that required by this section or by section 2.1.1.4 of this appendix, the State, local, or federal span value may be used if a satisfactory explanation is included in the monitoring plan, unless span and/or range adjustments become necessary in accordance with section 2.1.1.5 of this appendix. Span values higher than those required by either this section or section 2.1.1.4 of this appendix must be approved by the Administrator.

2.1.1.4 Dual Span and Range Requirements

For most units, the high span value based on the MPC, as determined under section 2.1.1.3 of this appendix will suffice to measure and record SO_2 concentrations (unless span and/or range adjustments become necessary in accordance with section 2.1.1.5 of this appendix). In some instances, however, a second (low) span value based on the MEC may be required to ensure accurate measurement of all possible or expected SO_2 concentrations. To determine whether two SO_2 span values are required, proceed as follows:

(a) For units with SO_2 emission controls, compare the MEC from section 2.1.1.2 of this appendix to the high full-scale range value from section 2.1.1.3 of this appendix. If the MEC is ≥20.0 percent of the high range value, then the high span value and range determined under section 2.1.1.3 of this appendix are sufficient. If the MEC is <20.0 percent of the high range value, then a second (low) span value is required.

(b) For units that combust high- and low-sulfur primary and backup fuels (or blends) and have no SO_2 controls, compare the high range value from section 2.1.1.3 of this appendix (for the highest-sulfur fuel or blend) to the MEC value for each of the other fuels or blends, as determined under section 2.1.1.2 of this appendix. If all of the MEC values are ≥20.0 percent of the high range value, the high span and range determined under section 2.1.1.3 of this appendix are sufficient, regardless of which fuel or blend is burned in the unit. If any MEC value is <20.0 percent of the high range value, then a second (low) span value must be used when that fuel or blend is combusted.

(c) When two SO_2 spans are required, the owner or operator may either use a single SO_2 analyzer with a dual range (i.e., low- and high-scales) or two separate SO_2 analyzers connected to a common sample probe and sample interface. Alternatively, if RATAs are performed and passed on both measurement ranges, the owner or operator may use two separate SO_2 analyzers connected to separate probes and sample interfaces. For units with SO_2 emission controls, the owner or operator may use a low range analyzer and a

default high range value, as described in paragraph (f) of this section, in lieu of maintaining and quality assuring a high-scale range. Other monitor configurations are subject to the approval of the Administrator.

(d) The owner or operator shall designate the monitoring systems and components in the monitoring plan under § 75.53 as follows: when a single probe and sample interface are used, either designate the low and high monitor ranges as separate SO_2 components of a single, primary SO_2 monitoring system; designate the low and high monitor ranges as the SO_2 components of two separate, primary SO_2 monitoring systems; designate the normal monitor range as a primary monitoring system and the other monitor range as a non-redundant backup monitoring system; or, when a single, dual-range SO_2 analyzer is used, designate the low and high ranges as a single SO_2 component of a primary SO_2 monitoring system (if this option is selected, use a special dual-range component type code, as specified by the Administrator, to satisfy the requirements of § 75.53(e)(1)(iv)(D)). When two SO_2 analyzers are connected to separate probes and sample interfaces, designate the analyzers as the SO_2 components of two separate, primary SO_2 monitoring systems. For units with SO_2 controls, if the default high range value is used, designate the low range analyzer as the SO_2 component of a primary SO_2 monitoring system. Do not designate the default high range as a monitoring system or component. Other component and system designations are subject to approval by the Administrator. Note that the component and system designations for redundant backup monitoring systems shall be the same as for primary monitoring systems.

(e) Each monitoring system designated as primary or redundant backup shall meet the initial certification and quality assurance requirements for primary monitoring systems in § 75.20(c) or § 75.20(d)(1), as applicable, and appendices A and B to this part, with one exception: relative accuracy test audits (RATAs) are required only on the normal range (for units with SO_2 emission controls, the low range is considered normal). Each monitoring system designated as a non-redundant backup shall meet the applicable quality assurance requirements in § 75.20(d)(2).

(f) For dual span units with SO_2 emission controls, the owner or operator may, as an alternative to maintaining and quality assuring a high monitor range, use a default high range value. If this option is chosen, the owner or operator shall report a default SO_2 concentration of 200 percent of the MPC for each unit operating hour in which the full-scale of the low range SO_2 analyzer is exceeded.

(g) The high span value and range shall be determined in accordance with section 2.1.1.3 of this appendix. The low span value shall be obtained by multiplying the MEC by a factor no less than 1.00 and no greater than 1.25, and rounding the result upward to the next highest multiple of 10 ppm (or 100 ppm, as appropriate). For units that burn high- and low-sulfur primary and backup fuels or blends and have no SO_2 emission controls, select, as the basis for calculating the appropriate low span value and range, the fuel-specific MEC value closest to 20.0 percent of the high full-scale range value (from paragraph (b) of this section). The low range must be greater than or equal to the low span value, and the required calibration gases must be selected based on the low span value. However, if the default high range option in paragraph (f) of this section is selected, the full-scale of the low measurement range shall not exceed five times the MEC value (where the MEC is rounded upward to the next highest multiple of 10 ppm). For units with two SO_2 spans, use the low range whenever the SO_2 concentrations are expected to be consistently below 20.0 percent of the high full-scale range value, i.e., when the MEC of the fuel or blend being combusted is less than 20.0 percent of the high full-scale range value. When the full-scale of the low range is exceeded, the high range shall be used to measure and record the SO_2 concentrations; or, if applicable, the default high range value in paragraph (f) of this section shall be reported for each hour of the full-scale exceedance.

2.1.1.5 Adjustment of Span and Range

For each affected unit or common stack, the owner or operator shall make a periodic evaluation of the MPC, MEC, span, and range values for each SO_2 monitor (at a minimum, an annual evaluation is required) and shall make any necessary span and range adjustments, with corresponding monitoring plan updates, as described in paragraphs (a), (b), and (c) of this section. Span and range adjustments may be required, for example, as a result of changes in the fuel supply, changes in the manner of operation of the unit, or installation or removal of emission controls. In implementing the provisions in paragraphs (a) and (b) of this section, SO_2 data recorded during short-term, non-representative process operating conditions (e.g., a trial burn of a different type of fuel) shall be excluded from consideration. The owner or operator shall keep the results of the most recent span and range evaluation on-site, in a format suitable for inspection. Make each required span or range adjustment no later than 45 days after the end of the quarter in which the need to adjust the span or range is identified, except that up to 90 days after the end of that quarter may be taken to implement a span adjustment if the calibration gases currently being used for daily calibration error tests and linearity checks are unsuitable for use with the new span value.

(a) If the fuel supply, the composition of the fuel blend(s), the emission controls, or the manner of operation change such that the maximum expected or potential concentration changes significantly, adjust the span and range setting to assure the continued accuracy of the monitoring system. A ''significant'' change in the MPC or MEC means that the guidelines in section 2.1 of this appendix can no longer be met, as determined by either a periodic evaluation by the owner or operator or from the results of an audit by the Administrator. The owner or operator should evaluate whether any planned changes in operation of the unit may affect the concentration of emissions being emitted from the unit or stack and should plan any necessary span and range changes needed to account for these changes, so that they are made in as timely a manner as practicable to coordinate with the operational changes. Determine the adjusted span(s) using the procedures in sections 2.1.1.3 and 2.1.1.4 of this appendix (as applicable). Select the full-scale range(s) of the instrument to be greater than or equal to the new span value(s) and to be consistent with the guidelines of section 2.1 of this appendix.

(b) Whenever a full-scale range is exceeded during a quarter and the exceedance is not caused by a monitor out-of-control period, proceed as follows:

(1) For exceedances of the high range, report 200.0 percent of the current full-scale range as the hourly SO_2 concentration for each hour of the full-scale exceedance and make appropriate adjustments to the MPC, span, and range to prevent future full-scale exceedances.

(2) For units with two SO_2 spans and ranges, if the low range is exceeded, no further action is required, provided that the high range is available and its most recent calibration error test and linearity check have not expired. However, if either of these quality assurance tests has expired and the high range is not able to provide quality assured data at the time of the low range exceedance or at any time during the continuation of the exceedance, report the MPC as the SO_2 concentration until the readings return to the low range or until the high range is able to provide quality assured data (unless the reason that the high-scale range is not able to provide quality assured data is because the high-scale range has been exceeded; if the high-scale range is exceeded follow the procedures in paragraph (b)(1) of this section).

(c) Whenever changes are made to the MPC, MEC, full-scale range, or span value of the SO_2 monitor, as described in paragraphs (a) or (b) of this section, record and report (as applicable) the new full-scale range setting, the new MPC or MEC and calculations of the adjusted span value in an updated monitoring plan. The monitoring plan update shall be made in the quarter in which the changes become effective. In addition, record and report the adjusted span as part of the records for the daily calibration error test and linearity check specified by appendix B to this part. Whenever the span value is adjusted, use calibration gas concentrations that meet the requirements of section 5.1 of this appendix, based on the adjusted span value. When a span adjustment is so significant that the calibration gases currently being used for daily calibration error tests and linearity checks are unsuitable for use with the new span value, then a diagnostic linearity test using the new calibration gases must be performed and passed. Use the data validation procedures in §75.20(b)(3), beginning with the hour in which the span is changed.

2.1.2 NO_X Pollutant Concentration Monitors

Determine, as indicated in sections 2.1.2.1 through 2.1.2.5 of this appendix, the span and range value(s) for the NO_X pollutant concentration monitor so that all expected NO_X concentrations can be determined and recorded accurately.

2.1.2.1 Maximum Potential Concentration

(a) The maximum potential concentration (MPC) of NO_X for each affected unit shall be based upon whichever fuel or blend combusted in the unit produces the highest level of NO_X emissions. For the purposes of this section, 2.1.2.1, and section 2.1.2.2 of this appendix, a ''blend'' means a frequently-used fuel mixture having a consistent composition (e.g., an oil and gas mixture where the relative proportions of the two fuels vary by no more than 10%, on average). Make an initial determination of the MPC using the appropriate option as follows:

Option 1: Use 800 ppm for coal-fired and 400 ppm for oil- or gas-fired units as the maximum potential concentration of NO_X (if an MPC of 1600 ppm for coal-fired units or 480 ppm for oil- or gas-fired units was previously selected under this section, that value may still be used, provided that the guidelines of section 2.1 of this appendix are met); For cement kilns, use 2000 ppm as the MPC. For process heaters, use 200 ppm if the unit burns only gaseous fuel and 500 ppm if the unit burns oil;

Option 2: Use the specific values based on boiler type and fuel combusted, listed in Table 2–1 or Table 2–2; For a new gas-fired or oil-fired combustion turbine, if a default MPC value of 50 ppm was previously selected from Table 2–2, that value may be used until March 31, 2003;

Option 3: Use NO_X emission test results;

Option 4: Use historical CEM data over the previous 720 (or more) unit operating hours when combusting the fuel or blend with the highest NO_X emission rate; or

Option 5: If a reliable estimate of the uncontrolled NO_X emissions from the unit is available from the manufacturer, the estimated value may be used.

(b) For the purpose of providing substitute data during NO_X missing data periods in accordance with §§75.31 and 75.33 and as required elsewhere under this part, the owner or operator shall also calculate the maximum potential NO_X emission rate (MER), in lb/mmBtu, by substituting the MPC for NO_X in conjunction with the minimum expected CO_2 or maximum O_2 concentration (under all unit operating conditions except for unit startup, shutdown, and upsets) and the appropriate F-factor into the applicable equation in appendix F to this part. The diluent cap value of 5.0 percent CO_2 (or 14.0 percent O_2) for boilers or 1.0 percent CO_2 (or 19.0 percent O_2) for combustion turbines may be used in the NO_X MER calculation. As a second alternative, when the NO_X MPC is determined from emission test results or from historical CEM data, as described in paragraphs (a), (d) and (e) of this section, quality-assured diluent gas (i.e., O_2 or CO_2) data recorded concurrently with the MPC may be used to calculate the MER.

(c) Report the method of determining the initial MPC and the calculation of the maximum potential NO_X emission rate in the monitoring plan for the unit. Note that whichever MPC option in paragraph 2.1.2.1(a) of this appendix is selected, the initial MPC value is subject to periodic review under section 2.1.2.5 of this appendix. If an MPC value is found to be either inappropriately high or low, the MPC shall be adjusted in accordance with section 2.1.2.5, and corresponding span and range adjustments shall be made, if necessary.

(d) For units with add-on NO_X controls (whether or not the unit is equipped with low-NO_X burner technology), or for units equipped with dry low-NO_X (DLN) technology, NO_X emission testing may only be used to determine the MPC if testing can be performed either upstream of the add-on controls or during a time or season when the add-on controls are not in operation or when the DLN controls are not in the premixed (low-NO_X) mode. If NO_X emission testing is performed, use the following guidelines. Use Method 7E from appendix A to part 60 of this chapter to measure total NO_X concentration. (Note: Method 20 from appendix A to part 60 may be used for gas turbines, instead of Method 7E.) Operate the unit, or group of units sharing a common stack, at the minimum safe and stable load, the normal load, and the maximum load. If the normal load and maximum load are identical, an intermediate level need not be tested. Operate at the highest excess O_2 level expected under normal operating conditions. Make at least three runs of 20 minutes (minimum) duration with three traverse points per run at each operating condition. Select the highest point NO_X concentration from all test runs as the MPC for NO_X.

(e) If historical CEM data are used to determine the MPC, the data must, for uncontrolled units or units equipped with low-NO_X burner technology and no other NO_X controls, represent a minimum of 720 quality-assured monitor operating hours from the NO_X component of a certified monitoring system, obtained under various operating conditions including the minimum safe and stable load, normal load (including periods of high excess air at normal load), and maximum load. For the purposes of this section, 2.1.2.1, a ''certified'' CEMS means a CEM system that has met the applicable certification requirements of either: this part, or part 60 of this chapter, or a State CEM program, or the source operating permit. For a unit with add-on NO_X controls (whether or not the unit is equipped with low-NO_X burner technology), or for a unit equipped with dry low-NO_X (DLN) technology, historical CEM data may only be used to determine the MPC if the 720 quality-assured monitor operating hours of CEM data are collected upstream of the add-on controls or if the 720 hours of data include periods when the add-on controls are not in operation or when the DLN controls are not in the premixed (low-NO_X mode). For units that do not produce electrical or thermal output, the data must represent the full range of normal process operation. The highest hourly NO_X concentration in ppm shall be the MPC.

TABLE 2–1—MAXIMUM POTENTIAL CONCENTRATION FOR NO_X—COAL-FIRED UNITS

Unit type	Maximum potential concentration for NO_X (ppm)
Tangentially-fired dry bottom and fluidized bed	460
Wall-fired dry bottom, turbo-fired dry bottom, stokers	675
Roof-fired (vertically-fired) dry bottom, cell burners, arch-fired	975
Cyclone, wall-fired wet bottom, wet bottom turbo-fired	1200
Others	(1)

[1] As approved by the Administrator.

TABLE 2-2. -- MAXIMUM POTENTIAL CONCENTRATION FOR NO_X --
Gas- And Oil-Fired Units

Unit type	Maximum potential concentration for NO_x (ppm)
Tangentially-fired dry bottom	380
Wall-fired dry bottom	600
Roof-fired (vertically-fired) dry bottom, arch-fired	550
Existing combustion turbine	200
New combustion turbine, permitted to fire either oil or natural gas	200
New combustion turbine, permitted to fire only natural gas	150
Others	[1]

[1] As approved by the Administrator

2.1.2.2 Maximum Expected Concentration

(a) Make an initial determination of the maximum expected concentration (MEC) of NO_X during normal operation for affected units with add-on NO_X controls of any kind (*e.g.*, steam injection, water injection, SCR, or SNCR) and for turbines that use dry low-NO_X technology. Determine a separate MEC value for each type of fuel (or blend) combusted in the unit, except for fuels that are only used for unit startup and/or flame stabilization. Calculate the MEC of NO_X using Equation A–2, if applicable, inserting the maximum potential concentration, as determined using the procedures in section 2.1.2.1 of this appendix. Where Equation A–2 is not applicable, set the MEC either by: (1) measuring the NO_X concentration using the testing procedures in this section; (2) using historical CEM data over the previous 720 (or more) quality-assured monitor operating hours; or (3) if the unit has add-on NO_X controls or uses dry low NO_X technology, and has a federally-enforceable permit limit for NO_X concentration, the permit limit may be used as the MEC. Include in the monitoring plan for the unit each MEC value and the method by which the MEC was determined. Note that each initial MEC value is subject to periodic review under section 2.1.2.5 of this appendix. If an MEC value is found to be either inappropriately high or low, the MEC shall be adjusted in accordance with section 2.1.2.5, and corresponding span and range adjustments shall be made, if necessary.

(b) If NO_X emission testing is used to determine the MEC value(s), the MEC for each type of fuel (or blend) shall be based upon testing at minimum load, normal load, and maximum load. At least three tests of 20 minutes (minimum) duration, using at least three traverse points, shall be performed at each load, using Method 7E from appendix A to part 60 of this chapter (Note: Method 20 from appendix A to part 60 may be used for gas turbines instead of Method 7E). The test must be performed at a time when all NO_X control devices and methods used to reduce NO_X emissions (if applicable) are operating properly. The testing shall be conducted downstream of all NO_X controls. The highest point NO_X concentration (e.g., the highest one-minute average) recorded during any of the test runs shall be the MEC.

(c)If historical CEM data are used to determine the MEC value(s), the MEC for each type of fuel shall be based upon 720 (or more) hours of quality-assured data from the NO_X component of a certified monitoring system representing the entire load range under stable operating conditions. For the purposes of this section, 2.1.2.2, a "certified" CEMS means a CEM system that has met the applicable certification requirements of either: this part, or part 60 of this chapter, or a State CEM program, or the source operating permit. The data base for the MEC shall not include any CEM data recorded during unit startup, shutdown, or malfunction or (for units with add-on NO_X controls or turbines using dry low NO_X technology) during any NO_X control device malfunctions or outages. All NO_X control devices and methods used to reduce NO_X emissions (if applicable) must be operating properly during each hour. The CEM data shall be collected downstream of all NO_X controls. For each type of fuel, the highest of the 720 (or more) quality-assured hourly average NO_X concentrations recorded by the CEMS shall be the MEC.

2.1.2.3 Span Value(s) and Range(s)

(a) Determine the high span value of the NO_X monitor as follows. The high span value shall be obtained by multiplying the MPC by a factor no less than 1.00 and no greater than 1.25. Round the span value upward to the next highest multiple of 100 ppm. If the NO_X

span concentration is ≤500 ppm, the span value may either be rounded upward to the next highest multiple of 10 ppm, or to the next highest multiple of 100 ppm. The high span value shall be used to determine the concentrations of the calibration gases required for daily calibration error checks and linearity tests. Note that for certain applications, a second (low) NO_X span and range may be required (see section 2.1.2.4 of this appendix).

(b) If an existing State, local, or federal requirement for span of a NO_X pollutant concentration monitor requires or allows the use of a span value lower than that required by this section or by section 2.1.2.4 of this appendix, the State, local, or federal span value may be used, where a satisfactory explanation is included in the monitoring plan, unless span and/or range adjustments become necessary in accordance with section 2.1.2.5 of this appendix. Span values higher than required by this section or by section 2.1.2.4 of this appendix must be approved by the Administrator.

(c) Select the full-scale range of the instrument to be consistent with section 2.1 of this appendix and to be greater than or equal to the high span value. Include the full-scale range setting and calculations of the MPC and span in the monitoring plan for the unit.

2.1.2.4 Dual Span and Range Requirements

For most units, the high span value based on the MPC, as determined under section 2.1.2.3 of this appendix will suffice to measure and record NO_X concentrations (unless span and/or range adjustments must be made in accordance with section 2.1.2.5 of this appendix). In some instances, however, a second (low) span value based on the MEC may be required to ensure accurate measurement of all expected and potential NO_X concentrations. To determine whether two NO_X spans are required, proceed as follows:

(a) Compare the MEC value(s) determined in section 2.1.2.2 of this appendix to the high full-scale range value determined in section 2.1.2.3 of this appendix. If the MEC values for all fuels (or blends) are ≥20.0 percent of the high range value, the high span and range values determined under section 2.1.2.3 of this appendix are sufficient, irrespective of which fuel or blend is combusted in the unit. If any of the MEC values is <20.0 percent of the high range value, two spans (low and high) are required, one based on the MPC and the other based on the MEC.

(b) When two NO_X spans are required, the owner or operator may either use a single NO_X analyzer with a dual range (low-and high-scales) or two separate NO_X analyzers connected to a common sample probe and sample interface. Two separate NO_X analyzers connected to separate probes and sample interfaces may be used if RATAs are passed on both ranges. For units with add-on NO_X emission controls (e.g., steam injection, water injection, SCR, or SNCR) or units equipped with dry low-NO_X technology, the owner or operator may use a low range analyzer and a ''default high range value,'' as described in paragraph 2.1.2.4(e) of this section, in lieu of maintaining and quality assuring a high-scale range. Other monitor configurations are subject to the approval of the Administrator.

(c) The owner or operator shall designate the monitoring systems and components in the monitoring plan under §75.53 as follows: when a single probe and sample interface are used, either designate the low and high ranges as separate NO_X components of a single, primary NO_X monitoring system; designate the low and high ranges as the NO_X components of two separate, primary NO_X monitoring systems; designate the normal range as a primary monitoring system and the other range as a non-redundant backup monitoring system; or, when a single, dual-range NO_X analyzer is used, designate the low and high ranges as a single NO_X component of a primary NO_X monitoring system (if this option is selected, use a special dual-range component type code, as specified by the Administrator, to satisfy the requirements of §75.53(e)(1)(iv)(D)). When two NO_X analyzers are connected to separate probes and sample interfaces, designate the analyzers as the NO_X components of two separate, primary NO_X monitoring systems. For units with add-on NO_X controls or units equipped with dry low-NO_X technology, if the default high range value is used, designate the low range analyzer as the NO_X component of the primary NO_X monitoring system. Do not designate the default high range as a monitoring system or component. Other component and system designations are subject to approval by the Administrator. Note that the component and system designations for redundant backup monitoring systems shall be the same as for primary monitoring systems.

(d) Each monitoring system designated as primary or redundant backup shall meet the initial certification and quality assurance requirements in §75.20(c) (for primary monitoring systems), in §75.20(d)(1) (for redundant backup monitoring systems) and appendices A and B to this part, with one exception: relative accuracy test audits (RATAs) are required only on the normal range (for dual span units with add-on NO_X emission controls, the low range is considered normal). Each monitoring system designated as non-redundant backup shall meet the applicable quality assurance requirements in §75.20(d)(2).

(e) For dual span units with add-on NO_X emission controls (e.g., steam injection, water injection, SCR, or SNCR), or, for units that use dry low NO_X technology, the owner

or operator may, as an alternative to maintaining and quality assuring a high monitor range, use a default high range value. If this option is chosen, the owner or operator shall report a default value of 200.0 percent of the MPC for each unit operating hour in which the full-scale of the low range NO_X analyzer is exceeded.

(f) The high span and range shall be determined in accordance with section 2.1.2.3 of this appendix. The low span value shall be 100.0 to 125.0 percent of the MEC, rounded up to the next highest multiple of 10 ppm (or 100 ppm, if appropriate). If more than one MEC value (as determined in section 2.1.2.2 of this appendix) is <20.0 percent of the high full-scale range value, the low span value shall be based upon whichever MEC value is closest to 20.0 percent of the high range value. The low range must be greater than or equal to the low span value, and the required calibration gases for the low range must be selected based on the low span value. However, if the default high range option in paragraph (e) of this section is selected, the full-scale of the low measurement range shall not exceed five times the MEC value (where the MEC is rounded upward to the next highest multiple of 10 ppm). For units with two NO_X spans, use the low range whenever NO_X concentrations are expected to be consistently <20.0 percent of the high range value, i.e., when the MEC of the fuel being combusted is <20.0 percent of the high range value. When the full-scale of the low range is exceeded, the high range shall be used to measure and record the NO_X concentrations; or, if applicable, the default high range value in paragraph (e) of this section shall be reported for each hour of the full-scale exceedance.

2.1.2.5 Adjustment of Span and Range

For each affected unit or common stack, the owner or operator shall make a periodic evaluation of the MPC, MEC, span, and range values for each NO_X monitor (at a minimum, an annual evaluation is required) and shall make any necessary span and range adjustments, with corresponding monitoring plan updates, as described in paragraphs (a), (b), and (c) of this section. Span and range adjustments may be required, for example, as a result of changes in the fuel supply, changes in the manner of operation of the unit, or installation or removal of emission controls. In implementing the provisions in paragraphs (a) and (b) of this section, note that NO_X data recorded during short-term, non-representative operating conditions (e.g., a trial burn of a different type of fuel) shall be excluded from consideration. The owner or operator shall keep the results of the most recent span and range evaluation on-site, in a format suitable for inspection. Make each required span or range adjustment no later than 45 days after the end of the quarter in which the need to adjust the span or range is identified, except that up to 90 days after the end of that quarter may be taken to implement a span adjustment if the calibration gases currently being used for daily calibration error tests and linearity checks are unsuitable for use with the new span value.

(a) If the fuel supply, emission controls, or other process parameters change such that the maximum expected concentration or the maximum potential concentration changes significantly, adjust the NO_X pollutant concentration span(s) and (if necessary) monitor range(s) to assure the continued accuracy of the monitoring system. A ''significant'' change in the MPC or MEC means that the guidelines in section 2.1 of this appendix can no longer be met, as determined by either a periodic evaluation by the owner or operator or from the results of an audit by the Administrator. The owner or operator should evaluate whether any planned changes in operation of the unit or stack may affect the concentration of emissions being emitted from the unit and should plan any necessary span and range changes needed to account for these changes, so that they are made in as timely a manner as practicable to coordinate with the operational changes. An example of a change that may require a span and range adjustment is the installation of low-NO_X burner technology on a previously uncontrolled unit. Determine the adjusted span(s) using the procedures in section 2.1.2.3 or 2.1.2.4 of this appendix (as applicable). Select the full-scale range(s) of the instrument to be greater than or equal to the adjusted span value(s) and to be consistent with the guidelines of section 2.1 of this appendix.

(b) Whenever a full-scale range is exceeded during a quarter and the exceedance is not caused by a monitor out-of-control period, proceed as follows:

(1) For exceedances of the high range, report 200.0 percent of the current full-scale range as the hourly NO_X concentration for each hour of the full-scale exceedance and make appropriate adjustments to the MPC, span, and range to prevent future full-scale exceedances.

(2) For units with two NO_X spans and ranges, if the low range is exceeded, no further action is required, provided that the high range is available and its most recent calibration error test and linearity check have not expired. However, if either of these quality assurance tests has expired and the high range is not able to provide quality assured data at the time of the low range exceedance or at any time during the continuation of the exceedance, report the MPC as the NO_X concentration until the readings return to the low range or until the high range is able to provide quality assured data (unless the reason that the high-scale range is not able to provide quality assured data is

because the high-scale range has been exceeded; if the high-scale range is exceeded, follow the procedures in paragraph (b)(1) of this section).

(c) Whenever changes are made to the MPC, MEC, full-scale range, or span value of the NO_X monitor as described in paragraphs (a) and (b) of this section, record and report (as applicable) the new full-scale range setting, the new MPC or MEC, maximum potential NO_X emission rate, and the adjusted span value in an updated monitoring plan for the unit. The monitoring plan update shall be made in the quarter in which the changes become effective. In addition, record and report the adjusted span as part of the records for the daily calibration error test and linearity check required by appendix B to this part. Whenever the span value is adjusted, use calibration gas concentrations that meet the requirements of section 5.1 of this appendix, based on the adjusted span value. When a span adjustment is significant enough that the calibration gases currently being used for daily calibration error tests and linearity checks are unsuitable for use with the new span value, a diagnostic linearity test using the new calibration gases must be performed and passed. Use the data validation procedures in §75.20(b)(3), beginning with the hour in which the span is changed.

2.1.3 CO_2 and O_2 Monitors

* * * If a dual-range or autoranging diluent analyzer is installed, the analyzer may be represented in the monitoring plan as a single component, using a special component type code specified by the Administrator to satisfy the requirements of §75.53(e)(1)(iv)(D).

2.1.3 CO_2 and O_2 Monitors

For an O_2 monitor (including O_2 monitors used to measure CO_2 emissions or percentage moisture), select a span value between 15.0 and 25.0 percent O_2. For a CO_2 monitor installed on a boiler, select a span value between 14.0 and 20.0 percent CO_2. For a CO_2 monitor installed on a combustion turbine, an alternative span value between 6.0 and 14.0 percent CO_2 may be used. An alternative CO_2 span value below 6.0 percent may be used if an appropriate technical justification is included in the hardcopy monitoring plan. An alternative O_2 span value below 15.0 percent O_2 may be used if an appropriate technical justification is included in the monitoring plan (e.g., O_2 concentrations above a certain level create an unsafe operating condition). Select the full-scale range of the instrument to be consistent with section 2.1 of this appendix and to be greater than or equal to the span value. Select the calibration gas concentrations for the daily calibration error tests and linearity checks in accordance with section 5.1 of this appendix, as percentages of the span value. For O_2 monitors with span values ≥21.0 percent O_2, purified instrument air containing 20.9 percent O_2 may be used as the high-level calibration material. If a dual-range or autoranging diluent analyzer is installed, the analyzer may be represented in the monitoring plan as a single component, using a special component type code specified by the Administrator to satisfy the requirements of §75.53(e)(1)(iv)(D).

2.1.3.1 Maximum Potential Concentration of CO_2

The MPC and MEC values for diluent monitors are subject to the same periodic review as SO_2 and NO_X monitors (see sections 2.1.1.5 and 2.1.2.5 of this appendix). If an MPC or MEC value is found to be either inappropriately high or low, the MPC shall be adjusted and corresponding span and range adjustments shall be made, if necessary.

For CO_2 pollutant concentration monitors, the maximum potential concentration shall be 14.0 percent CO_2 for boilers and 6.0 percent CO_2 for combustion turbines. Alternatively, the owner or operator may determine the MPC based on a minimum of 720 hours of quality-assured historical CEM data representing the full operating load range of the unit(s). Note that the MPC for CO_2 monitors shall only be used for the purpose of providing substitute data under this part. The CO_2 monitor span and range shall be determined according to section 2.1.3 of this appendix.

2.1.3.2 Minimum Potential Concentration of O_2

The owner or operator of a unit that uses a flow monitor and an O_2 diluent monitor to determine heat input in accordance with Equation F–17 or F–18 in appendix F to this part shall, for the purposes of providing substitute data under §75.36, determine the minimum potential O_2 concentration. The minimum potential O_2 concentration shall be based upon 720 hours or more of quality-assured CEM data, representing the full operating load range of the unit(s). The minimum potential O_2 concentration shall be the lowest quality-assured hourly average O_2 concentration recorded in the 720 (or more) hours of data used for the determination.

2.1.3.3 Adjustment of Span and Range

The MPC and MEC values for diluent monitors are subject to the same periodic review as SO_2 and NO_X monitors (see sections 2.1.1.5 and 2.1.2.5 of this appendix). If an MPC or MEC value is found to be either inappropriately high or low, the MPC shall be adjusted and corresponding span and range adjustments shall be made, if necessary. Adjust the span value and range of a CO_2 or O_2 monitor

in accordance with section 2.1.1.5 of this appendix (insofar as those provisions are applicable), with the term ''CO_2 or O_2'' applying instead of the term ''SO_2''. Set the new span and range in accordance with section 2.1.3 of this appendix and report the new span value in the monitoring plan.

2.1.4 Flow Monitors

Select the full-scale range of the flow monitor so that it is consistent with section 2.1 of this appendix and can accurately measure all potential volumetric flow rates at the flow monitor installation site.

2.1.4.1 Maximum Potential Velocity and Flow Rate

For this purpose, determine the span value of the flow monitor using the following procedure. Calculate the maximum potential velocity (MPV) using Equation A–3a or A–3b or determine the MPV (wet basis) from velocity traverse testing using Reference Method 2 (or its allowable alternatives) in appendix A to part 60 of this chapter. If using test values, use the highest average velocity (determined from the Method 2 traverses) measured at or near the maximum unit operating load (or, for units that do not produce electrical or thermal output, at the normal process operating conditions corresponding to the maximum stack gas flow rate). Express the MPV in units of wet standard feet per minute (fpm). For the purpose of providing substitute data during periods of missing flow rate data in accordance with §§75.31 and 75.33 and as required elsewhere in this part, calculate the maximum potential stack gas flow rate (MPF) in units of standard cubic feet per hour (scfh), as the product of the MPV (in units of wet, standard fpm) times 60, times the cross-sectional area of the stack or duct (in ft^2) at the flow monitor location.

$$MPV = \left(\frac{F_d H_f}{A}\right)\left(\frac{20.9}{20.9 - \%O_{2d}}\right)\left(\frac{100}{100 - \%H_2O}\right) \qquad \text{(Eq. A-3a)}$$

or

$$MPV = \left(\frac{F_c H_f}{A}\right)\left(\frac{100}{\%CO_{2d}}\right)\left(\frac{100}{100 - \%H_2O}\right) \qquad \text{(Eq. A-3b)}$$

Where:

MPV = maximum potential velocity (fpm, standard wet basis).

F_d = dry-basis F factor (dscf/mmBtu) from Table 1, Appendix F to this part.

F_c = carbon-based F factor (scf CO_2/mmBtu) from Table 1, Appendix F to this part.

Hf = maximum heat input (mmBtu/minute) for all units, combined, exhausting to the stack or duct where the flow monitor is located.

A = inside cross sectional area (ft^2) of the flue at the flow monitor location.

$\%O_{2d}$ = maximum oxygen concentration, percent dry basis, under normal operating conditions.

$\%CO_{2d}$ = minimum carbon dioxide concentration, percent dry basis, under normal operating conditions.

$\%H_2O$ = maximum percent flue gas moisture content under normal operating conditions.

2.1.4.2 Span Values and Range

Determine the span and range of the flow monitor as follows. Convert the MPV, as determined in section 2.1.4.1 of this appendix, to the same measurement units of flow rate that are used for daily calibration error tests (e.g., scfh, kscfh, kacfm, or differential pressure (inches of water)). Next, determine the ''calibration span value'' by multiplying the MPV (converted to equivalent daily calibration error units) by a factor no less than 1.00 and no greater than 1.25, and rounding up the result to at least two significant figures. For calibration span values in inches of water, retain at least two decimal places. Select appropriate reference signals for the daily calibration error tests as percentages of the calibration span value, as specified in section 2.2.2.1 of this appendix. Finally, calculate the ''flow rate span value'' (in scfh) as the product of the MPF, as determined in section 2.1.4.1 of this appendix, times the same factor (between 1.00 and 1.25) that was used to calculate the calibration span value. Round off the flow rate span value to the nearest 1000

scfh. Select the full-scale range of the flow monitor so that it is greater than or equal to the span value and is consistent with section 2.1 of this appendix. Include in the monitoring plan for the unit: calculations of the MPV, MPF, calibration span value, flow rate span value, and full-scale range (expressed both in scfh and, if different, in the measurement units of calibration).

2.1.4.3 Adjustment of Span and Range

For each affected unit or common stack, the owner or operator shall make a periodic evaluation of the MPV, MPF, span, and range values for each flow rate monitor (at a minimum, an annual evaluation is required) and shall make any necessary span and range adjustments with corresponding monitoring plan updates, as described in paragraphs (a) through (c) of this section 2.1.4.3. Span and range adjustments may be required, for example, as a result of changes in the fuel supply, changes in the stack or ductwork configuration, changes in the manner of operation of the unit, or installation or removal of emission controls. In implementing the provisions in paragraphs (a) and (b) of this section 2.1.4.3, note that flow rate data recorded during short-term, non-representative operating conditions (e.g., a trial burn of a different type of fuel) shall be excluded from consideration. The owner or operator shall keep the results of the most recent span and range evaluation on-site, in a format suitable for inspection. Make each required span or range adjustment no later than 45 days after the end of the quarter in which the need to adjust the span or range is identified.

(a) If the fuel supply, stack or ductwork configuration, operating parameters, or other conditions change such that the maximum potential flow rate changes significantly, adjust the span and range to assure the continued accuracy of the flow monitor. A ''significant'' change in the MPV or MPF means that the guidelines of section 2.1 of this appendix can no longer be met, as determined by either a periodic evaluation by the owner or operator or from the results of an audit by the Administrator. The owner or operator should evaluate whether any planned changes in operation of the unit may affect the flow of the unit or stack and should plan any necessary span and range changes needed to account for these changes, so that they are made in as timely a manner as practicable to coordinate with the operational changes. Calculate the adjusted calibration span and flow rate span values using the procedures in section 2.1.4.2 of this appendix.

(b) Whenever the full-scale range is exceeded during a quarter, provided that the exceedance is not caused by a monitor out-of-control period, report 200.0 percent of the current full-scale range as the hourly flow rate for each hour of the full-scale exceedance. If the range is exceeded, make appropriate adjustments to the MPF, flow rate span, and range to prevent future full-scale exceedances. Calculate the new calibration span value by converting the new flow rate span value from units of scfh to units of daily calibration. A calibration error test must be performed and passed to validate data on the new range.

(c) Whenever changes are made to the MPV, MPF, full-scale range, or span value of the flow monitor, as described in paragraphs (a) and (b) of this section, record and report (as applicable) the new full-scale range setting, calculations of the flow rate span value, calibration span value, MPV, and MPF in an updated monitoring plan for the unit. The monitoring plan update shall be made in the quarter in which the changes become effective. Record and report the adjusted calibration span and reference values as parts of the records for the calibration error test required by appendix B to this part. Whenever the calibration span value is adjusted, use reference values for the calibration error test that meet the requirements of section 2.2.2.1 of this appendix, based on the most recent adjusted calibration span value. Perform a calibration error test according to section 2.1.1 of appendix B to this part whenever making a change to the flow monitor span or range, unless the range change also triggers a recertification under §75.20(b).

2.1.5 Minimum Potential Moisture Percentage

Except as provided in section 2.1.6 of this appendix, the owner or operator of a unit that uses a continuous moisture monitoring system to correct emission rates and heat inputs from a dry basis to a wet basis (or vice-versa) shall, for the purpose of providing substitute data under §75.37, use a default value of 3.0 percent H_2O as the minimum potential moisture percentage. Alternatively, the minimum potential moisture percentage may be based upon 720 hours or more of quality-assured CEM data, representing the full operating load range of the unit(s). If this option is chosen, the minimum potential moisture percentage shall be the lowest quality-assured hourly average H_2O concentration recorded in the 720 (or more) hours of data used for the determination.

2.1.6 Maximum Potential Moisture Percentage

When Equation 19–3, 19–4 or 19–8 in Method 19 in appendix A to part 60 of this chapter is used to determine NO_X emission rate, the owner or operator of a unit that uses a continuous moisture monitoring system shall, for the purpose of providing substitute data

under §75.37, determine the maximum potential moisture percentage. The maximum potential moisture percentage shall be based upon 720 hours or more of quality-assured CEM data, representing the full operating load range of the unit(s). The maximum potential moisture percentage shall be the highest quality-assured hourly average H_2O concentration recorded in the 720 (or more) hours of data used for the determination. Alternatively, a default maximum potential moisture value of 15.0 percent H_2O may be used.

2.1.7 Hg Monitors

Determine the appropriate span and range value(s) for each Hg pollutant concentration monitor, so that all expected Hg concentrations can be determined accurately.

2.1.7.1 Maximum Potential Concentration

(a) The maximum potential concentration depends upon the type of coal combusted in the unit. For the initial MPC determination, there are three options:

(1) Use one of the following default values: 9 μgm/scm for bituminous coal; 10 μgm/scm for sub-bituminous coal; 16 μgm/scm for lignite, and 1 μgm/scm for waste coal, *i.e.*, anthracite culm or bituminous gob. If different coals are blended, use the highest MPC for any fuel in the blend; or

(2) You may base the MPC on the results of site-specific emission testing using the one of the Hg reference methods in §75.22, if the unit does not have add-on Hg emission controls or a flue gas desulfurization system, or if you test upstream of these control devices. A minimum of 3 test runs are required, at the normal operating load. Use the highest total Hg concentration obtained in any of the tests as the MPC; or

(3) You may base the MPC on 720 or more hours of historical CEMS data or data from a sorbent trap monitoring system, if the unit does not have add-on Hg emission controls or a flue gas desulfurization system (or if the CEMS or sorbent trap system is located upstream of these control devices) and if the Hg CEMS or sorbent trap system has been tested for relative accuracy against one of the Hg reference methods in §75.22 and has met a relative accuracy specification of 20.0% or less.

(b) For the purposes of missing data substitution, the fuel-specific or site-specific MPC values defined in paragraph (a) of this section apply to units using sorbent trap monitoring systems.

2.1.7.2 Maximum Expected Concentration

For units with FGD systems that significantly reduce Hg emissions (including fluidized bed units that use limestone injection) and for units equipped with add-on Hg emission controls (*e.g.*, carbon injection), determine the maximum expected Hg concentration (MEC) during normal, stable operation of the unit and emission controls. To calculate the MEC, substitute the MPC value from section 2.1.7.1 of this appendix into Equation A–2 in section 2.1.1.2 of this appendix. For units with add-on Hg emission controls, base the percent removal efficiency on design engineering calculations. For units with FGD systems, use the best available estimate of the Hg removal efficiency of the FGD system.

2.1.7.3 Span and Range Value(s)

(a) For each Hg monitor, determine a high span value, by rounding the MPC value from section 2.1.7.1 of this appendix upward to the next highest multiple of 10 μgm/scm.

(b) For an affected unit equipped with an FGD system or a unit with add-on Hg emission controls, if the MEC value from section 2.1.7.2 of this appendix is less than 20 percent of the high span value from paragraph (a) of this section, and if the high span value is 20 μgm/scm or greater, define a second, low span value of 10 μgm/scm.

(c) If only a high span value is required, set the full-scale range of the Hg analyzer to be greater than or equal to the span value.

(d) If two span values are required, you may either:

(1) Use two separate (high and low) measurement scales, setting the range of each scale to be greater than or equal to the high or low span value, as appropriate; or

(2) Quality-assure two segments of a single measurement scale.

2.1.7.4 Adjustment of Span and Range

For each affected unit or common stack, the owner or operator shall make a periodic evaluation of the MPC, MEC, span, and range values for each Hg monitor (at a minimum, an annual evaluation is required) and shall make any necessary span and range adjustments, with corresponding monitoring plan updates. Span and range adjustments may be required, for example, as a result of changes in the fuel supply, changes in the manner of operation of the unit, or installation or removal of emission controls. In implementing the provisions in paragraphs (a) and (b) of this section, data recorded during short-term, non-representative process operating conditions (*e.g.*, a trial burn of a different type of fuel) shall be excluded from consideration. The owner or operator shall keep the results of the most recent span and range evaluation on-site, in a format suitable for inspection. Make each required span or range adjustment no later than 45 days after the end of the quarter in which the need to adjust the span or range is identified, except

that up to 90 days after the end of that quarter may be taken to implement a span adjustment if the calibration gas concentrations currently being used for calibration error tests, system integrity checks, and linearity checks are unsuitable for use with the new span value and new calibration materials must be ordered.

(a) The guidelines of section 2.1 of this appendix do not apply to Hg monitoring systems.

(b) Whenever a full-scale range exceedance occurs during a quarter and is not caused by a monitor out-of-control period, proceed as follows:

(1) For monitors with a single measurement scale, report 200 percent of the full-scale range as the hourly Hg concentration until the readings come back on-scale and if appropriate, make adjustments to the MPC, span, and range to prevent future full-scale exceedances; or

(2) For units with two separate measurement scales, if the low range is exceeded, no further action is required, provided that the high range is available and is not out-of-control or out-of-service for any reason. However, if the high range is not able to provide quality assured data at the time of the low range exceedance or at any time during the continuation of the exceedance, report the MPC until the readings return to the low range or until the high range is able to provide quality assured data (unless the reason that the high-scale range is not able to provide quality assured data is because the high-scale range has been exceeded; if the high-scale range is exceeded follow the procedures in paragraph (b)(1) of this section).

(c) Whenever changes are made to the MPC, MEC, full-scale range, or span value of the Hg monitor, record and report (as applicable) the new full-scale range setting, the new MPC or MEC and calculations of the adjusted span value in an updated monitoring plan. The monitoring plan update shall be made in the quarter in which the changes become effective. In addition, record and report the adjusted span as part of the records for the daily calibration error test and linearity check specified by appendix B to this part. Whenever the span value is adjusted, use calibration gas concentrations that meet the requirements of section 5.1 of this appendix, based on the adjusted span value. When a span adjustment is so significant that the calibration gas concentrations currently being used for calibration error tests, system integrity checks and linearity checks are unsuitable for use with the new span value, then a diagnostic linearity or 3-level system integrity check using the new calibration gas concentrations must be performed and passed. Use the data validation procedures in §75.20(b)(3), beginning with the hour in which the span is changed.

2.2 Design for Quality Control Testing

2.2.1 Pollutant Concentration and CO_2 or O_2 Monitors

(a) Design and equip each pollutant concentration and CO_2 or O_2 monitor with a calibration gas injection port that allows a check of the entire measurement system when calibration gases are introduced. For extractive and dilution type monitors, all monitoring components exposed to the sample gas, (e.g., sample lines, filters, scrubbers, conditioners, and as much of the probe as practicable) are included in the measurement system. For in situ type monitors, the calibration must check against the injected gas for the performance of all active electronic and optical components (e.g. transmitter, receiver, analyzer).

(b) Design and equip each pollutant concentration or CO_2 or O_2 monitor to allow daily determinations of calibration error (positive or negative) at the zero- and mid-or high-level concentrations specified in section 5.2 of this appendix.

2.2.2 Flow Monitors

Design all flow monitors to meet the applicable performance specifications.

2.2.2.1 Calibration Error Test

Design and equip each flow monitor to allow for a daily calibration error test consisting of at least two reference values: Zero to 20 percent of span or an equivalent reference value (*e.g.*, pressure pulse or electronic signal) and 50 to 70 percent of span. Flow monitor response, both before and after any adjustment, must be capable of being recorded by the data acquisition and handling system. Design each flow monitor to allow a daily calibration error test of the entire flow monitoring system, from and including the probe tip (or equivalent) through and including the data acquisition and handling system, or the flow monitoring system from and including the transducer through and including the data acquisition and handling system.

2.2.2.2 Interference Check

(a) Design and equip each flow monitor with a means to ensure that the moisture expected to occur at the monitoring location does not interfere with the proper functioning of the flow monitoring system. Design and equip each flow monitor with a means to detect, on at least a daily basis, pluggage of each sample line and sensing port, and malfunction of each resistance temperature detector (RTD), transceiver or equivalent.

(b) Design and equip each differential pressure flow monitor to provide an automatic, periodic back purging (simultaneously on both sides of the probe) or equivalent method

of sufficient force and frequency to keep the probe and lines sufficiently free of obstructions on at least a daily basis to prevent velocity sensing interference, and a means for detecting leaks in the system on at least a quarterly basis (manual check is acceptable).

(c) Design and equip each thermal flow monitor with a means to ensure on at least a daily basis that the probe remains sufficiently clean to prevent velocity sensing interference.

(d) Design and equip each ultrasonic flow monitor with a means to ensure on at least a daily basis that the transceivers remain sufficiently clean (*e.g.*, backpurging system) to prevent velocity sensing interference.

2.2.3 Mercury Monitors.

Design and equip each mercury monitor to permit the introduction of known concentrations of elemental Hg and $HgCl_2$ separately, at a point immediately preceding the sample extraction filtration system, such that the entire measurement system can be checked. If the Hg monitor does not have a converter, the $HgCl_2$ injection capability is not required.

3. Performance Specifications

3.1 Calibration Error

(a) The calibration error performance specifications in this section apply only to 7-day calibration error tests under sections 6.3.1 and 6.3.2 of this appendix and to the offline calibration demonstration described in section 2.1.1.2 of appendix B to this part. The calibration error limits for daily operation of the continuous monitoring systems required under this part are found in section 2.1.4(a) of appendix B to this part.

(b) The calibration error of SO_2 and NO_X pollutant concentration monitors shall not deviate from the reference value of either the zero or upscale calibration gas by more than 2.5 percent of the span of the instrument, as calculated using Equation A–5 of this appendix. Alternatively, where the span value is less than 200 ppm, calibration error test results are also acceptable if the absolute value of the difference between the monitor response value and the reference value, $|R-A|$ in Equation A–5 of this appendix, is ≤5 ppm. The calibration error of CO_2 or O_2 monitors (including O_2 monitors used to measure CO_2 emissions or percent moisture) shall not deviate from the reference value of the zero or upscale calibration gas by >0.5 percent O_2 or CO_2, as calculated using the term $|R-A|$ in the numerator of Equation A–5 of this appendix. The calibration error of flow monitors shall not exceed 3.0 percent of the calibration span value of the instrument, as calculated using Equation A–6 of this appendix. For differential pressure-type flow monitors, the calibration error test results are also acceptable if $|R-A|$, the absolute value of the difference between the monitor response and the reference value in Equation A–6, does not exceed 0.01 inches of water.

(c) The calibration error of a Hg concentration monitor shall not deviate from the reference value of either the zero or upscale calibration gas by more than 5.0 percent of the span value, as calculated using Equation A–5 of this appendix. Alternatively, if the span value is 10 μgm/scm, the calibration error test results are also acceptable if the absolute value of the difference between the monitor response value and the reference value, $|R–A|$ in Equation A–5 of this appendix, is ≤ 1.0 μgm/scm.

3.2 Linearity Check

For SO_2 and NO_X pollutant concentration monitors, the error in linearity for each calibration gas concentration (low-, mid-, and high-levels) shall not exceed or deviate from the reference value by more than 5.0 percent (as calculated using equation A–4 of this appendix). Linearity check results are also acceptable if the absolute value of the difference between the average of the monitor response values and the average of the reference values, $|R-A|$ in equation A–4 of this appendix, is less than or equal to 5 ppm. For CO_2 or O_2 monitors (including O_2 monitors used to measure CO_2 emissions or percent moisture):

(1) The error in linearity for each calibration gas concentration (low-, mid-, and high-levels) shall not exceed or deviate from the reference value by more than 5.0 percent as calculated using equation A–4 of this appendix; or

(2) The absolute value of the difference between the average of the monitor response values and the average of the reference values, $|R-A|$ in equation A–4 of this appendix, shall be less than or equal to 0.5 percent CO_2 or O_2, whichever is less restrictive.

(3) For the linearity check and the 3-level system integrity check of an Hg monitor, which are required, respectively, under §75.20(c)(1)(ii) and (c)(1)(vi), the measurement error shall not exceed 10.0 percent of the reference value at any of the three gas levels. To calculate the measurement error at each level, take the absolute value of the difference between the reference value and mean CEM response, divide the result by the reference value, and then multiply by 100. Alternatively, the results at any gas level are acceptable if the absolute value of the difference between the average monitor response and the average reference value, *i.e.*, $|R-A|$ in Equation A–4 of this appendix, does not exceed 0.8 μg/m³. The principal and alternative performance specifications in this section also apply to the single-level system integrity check described in section 2.6 of appendix B to this part.

3.3 Relative Accuracy

3.3.1 Relative Accuracy for SO_2 Monitors

(a) The relative accuracy for SO_2 pollutant concentration monitors shall not exceed 10.0 percent except as provided in this section.

(b) For affected units where the average of the reference method measurements of SO_2 concentration during the relative accuracy test audit is less than or equal to 250.0 ppm, the difference between the mean value of the monitor measurements and the reference method mean value shall not exceed ±15.0 ppm, wherever the relative accuracy specification of 10.0 percent is not achieved.

3.3.2 Relative Accuracy for NO_X-Diluent Continuous Emission Monitoring Systems

(a) The relative accuracy for NO_X-diluent continuous emission monitoring systems shall not exceed 10.0 percent.

(b) For affected units where the average of the reference method measurements of NO_X emission rate during the relative accuracy test audit is less than or equal to 0.200 lb/mmBtu, the difference between the mean value of the continuous emission monitoring system measurements and the reference method mean value shall not exceed ±0.020 lb/mmBtu, wherever the relative accuracy specification of 10.0 percent is not achieved.

3.3.3 Relative Accuracy for CO_2 and O_2 Monitors

The relative accuracy for CO_2 and O_2 monitors shall not exceed 10.0 percent. The relative accuracy test results are also acceptable if the difference between the mean value of the CO_2 or O_2 monitor measurements and the corresponding reference method measurement mean value, calculated using equation A–7 of this appendix, does not exceed ±1.0 percent CO_2 or O_2.

3.3.4 Relative Accuracy for Flow Monitors

(a) The relative accuracy of flow monitors shall not exceed 10.0 percent at any load (or operating) level at which a RATA is performed (i.e., the low, mid, or high level, as defined in section 6.5.2.1 of this appendix).

(b) For affected units where the average of the flow reference method measurements of gas velocity at a particular load (or operating) level of the relative accuracy test audit is less than or equal to 10.0 fps, the difference between the mean value of the flow monitor velocity measurements and the reference method mean value in fps at that level shall not exceed ±2.0 fps, wherever the 10.0 percent relative accuracy specification is not achieved.

3.3.5 Combined SO_2/Flow Monitoring System [Reserved]

3.3.6 Relative Accuracy for Moisture Monitoring Systems

The relative accuracy of a moisture monitoring system shall not exceed 10.0 percent. The relative accuracy test results are also acceptable if the difference between the mean value of the reference method measurements (in percent H_2O) and the corresponding mean value of the moisture monitoring system measurements (in percent H_2O), calculated using Equation A–7 of this appendix does not exceed ±1.5 percent H_2O.

3.3.7 Relative Accuracy for NO_X Concentration Monitoring Systems

(a) The following requirement applies only to NO_X concentration monitoring systems (i.e., NO_X pollutant concentration monitors) that are used to determine NO_X mass emissions, where the owner or operator elects to monitor and report NO_X mass emissions using a NO_X concentration monitoring system and a flow monitoring system.

(b) The relative accuracy for NO_X concentration monitoring systems shall not exceed 10.0 percent. Alternatively, for affected units where the average of the reference method measurements of NO_X concentration during the relative accuracy test audit is less than or equal to 250.0 ppm, the difference between the mean value of the continuous emission monitoring system measurements and the reference method mean value shall not exceed ±15.0 ppm, wherever the 10.0 percent relative accuracy specification is not achieved.

3.3.8 *Relative Accuracy for Hg Monitoring Systems*

The relative accuracy of a Hg concentration monitoring system or a sorbent trap monitoring system shall not exceed 20.0 percent. Alternatively, for affected units where the average of the reference method measurements of Hg concentration during the relative accuracy test audit is less than 5.0 μgm/scm, the test results are acceptable if the difference between the mean value of the monitor measurements and the reference method mean value does not exceed 1.0 μgm/scm, in cases where the relative accuracy specification of 20.0 percent is not achieved.

3.4 Bias

3.4.1 SO_2 Pollutant Concentration Monitors, NO_X Concentration Monitoring Systems and NO_X-Diluent Continuous Emission Monitoring Systems

SO_2 pollutant concentration monitors, NO_X-diluent continuous emission monitoring systems and NO_X concentration monitoring

systems used to determine NO_X mass emissions, as defined in §75.71(a)(2), shall not be biased low as determined by the test procedure in section 7.6 of this appendix. The bias specification applies to all SO_2 pollutant concentration monitors and to all NO_X concentration monitoring systems, including those measuring an average SO_2 or NO_X concentration of 250.0 ppm or less, and to all NO_X-diluent continuous emission monitoring systems, including those measuring an average NO_X emission rate of 0.200 lb/mmBtu or less.

3.4.2 Flow Monitors

Flow monitors shall not be biased low as determined by the test procedure in section 7.6 of this appendix. The bias specification applies to all flow monitors including those measuring an average gas velocity of 10.0 fps or less.

3.4.3 *Hg Monitoring Systems*

Mercury concentration monitoring systems and sorbent trap monitoring systems shall not be biased low as determined by the test procedure in section 7.6 of this appendix.

3.5 Cycle Time

The cycle time for pollutant concentration monitors, oxygen monitors used to determine percent moisture, and any other monitoring component of a continuous emission monitoring system that is required to perform a cycle time test shall not exceed 15 minutes.

4. DATA ACQUISITION AND HANDLING SYSTEMS

Automated data acquisition and handling systems shall read and record the full range of pollutant concentrations and volumetric flow from zero through span and provide a continuous, permanent record of all measurements and required information as an ASCII flat file capable of transmission both by direct computer-to-computer electronic transfer via modem and EPA-provided software and by an IBM-compatible personal computer diskette. These systems also shall have the capability of interpreting and converting the individual output signals from an SO_2 pollutant concentration monitor, a flow monitor, a CO_2 monitor, an O_2 monitor, a NO_X pollutant concentration monitor, a NO_X-diluent CEMS, a moisture monitoring system, a Hg concentration monitoring system, and a sorbent trap monitoring system, to produce a continuous readout of pollutant emission rates or pollutant mass emissions (as applicable) in the appropriate units (*e.g.*, lb/hr, lb/MMBtu, ounces/hr, tons/hr).

Data acquisition and handling systems shall also compute and record monitor calibration error; any bias adjustments to SO_2, NO_X, and Hg pollutant concentration data, flow rate data, Hg emission rate data, or NO_X emission rate data; and all missing data procedure statistics specified in subpart D of this part.

For an excepted monitoring system under appendix D or E of this part, data acquisition and handling systems shall:

(1) Read and record the full range of fuel flowrate through the upper range value;

(2) Calculate and record intermediate values necessary to obtain emissions, such as mass fuel flowrate and heat input rate;

(3) Calculate and record emissions in the appropriate units (e.g., lb/hr of SO_2, lb/mmBtu of NO_X);

(4) Predict and record NO_X emission rate using the heat input rate and the NO_X/heat input correlation developed under appendix E of this part;

(5) Calculate and record all missing data substitution values specified in appendix D or E of this part; and

(6) Provide a continuous, permanent record of all measurements and required information as an ASCII flat file capable of transmission both by direct computer-to-computer electronic transfer via modem and EPA-provided software and by an IBM-compatible personal computer diskette.

5. CALIBRATION GAS

5.1 Reference Gases

For the purposes of part 75, calibration gases include the following:

5.1.1 Standard Reference Materials (SRM)

These calibration gases may be obtained from the National Institute of Standards and Technology (NIST) at the following address: Quince Orchard and Cloppers Road, Gaithersburg, MD 20899–0001.

5.1.2 SRM-Equivalent Compressed Gas Primary Reference Material (PRM)

Contact the Gas Metrology Team, Analytical Chemistry Division, Chemical Science and Technology Laboratory of NIST, at the address in section 5.1.1, for a list of vendors and cylinder gases.

5.1.3 NIST Traceable Reference Materials

Contact the Gas Metrology Team, Analytical Chemistry Division, Chemical Science and Technology Laboratory of NIST, at the address in section 5.1.1, for a list of vendors and cylinder gases that meet the definition for a NIST Traceable Reference Material (NTRM) provided in §72.2.

5.1.4 EPA Protocol Gases

(a) An EPA Protocol Gas is a calibration gas mixture prepared and analyzed according to Section 2 of the ''EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards,'' September 1997, EPA–600/R–97/121 or such revised procedure as

approved by the Administrator (EPA Traceability Protocol).

(b) An EPA Protocol Gas must have a specialty gas producer-certified uncertainty (95-percent confidence interval) that must not be greater than 2.0 percent of the certified concentration (tag value) of the gas mixture. The uncertainty must be calculated using the statistical procedures (or equivalent statistical techniques) that are listed in Section 2.1.8 of the EPA Traceability Protocol.

(c) On and after January 1, 2009, a specialty gas producer advertising calibration gas certification with the EPA Traceability Protocol or distributing calibration gases as ''EPA Protocol Gas'' must participate in the EPA Protocol Gas Verification Program (PGVP) described in Section 2.1.10 of the EPA Traceability Protocol or it cannot use ''EPA'' in any form of advertising for these products, unless approved by the Administrator. A specialty gas producer not participating in the PGVP may not certify a calibration gas as an EPA Protocol Gas, unless approved by the Administrator.

(d) A copy of EPA–600/R–97/121 is available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA, 703–605–6585 or *http://www.ntis.gov,* and from *http://www.epa.gov/ttn/emc/news.html* or *http://www.epa.gov/appcdwww/tsb/index.html.*

5.1.5 Research Gas Mixtures

Research gas mixtures must be vendor-certified to be within 2.0 percent of the concentration specified on the cylinder label (tag value), using the uncertainty calculation procedure in section 2.1.8 of the ''EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards,'' September 1997, EPA–600/R–97/121. Inquiries about the RGM program should be directed to: National Institute of Standards and Technology, Analytical Chemistry Division, Chemical Science and Technology Laboratory, B–324 Chemistry, Gaithersburg, MD 20899.

5.1.6 Zero Air Material

Zero air material is defined in §72.2 of this chapter.

5.1.7 NIST/EPA-Approved Certified Reference Materials

Existing certified reference materials (CRMs) that are still within their certification period may be used as calibration gas.

5.1.8 Gas Manufacturer's Intermediate Standards

Gas manufacturer's intermediate standards is defined in §72.2 of this chapter.

5.1.9 Mercury Standards.

For 7-day calibration error tests of Hg concentration monitors and for daily calibration error tests of Hg monitors, either NIST-traceable elemental Hg standards (as defined in §72.2 of this chapter) or a NIST-traceable source of oxidized Hg (as defined in §72.2 of this chapter) may be used. For linearity checks, NIST-traceable elemental Hg standards shall be used. For 3-level and single-point system integrity checks under §75.20(c)(1)(vi), sections 6.2(g) and 6.3.1 of this appendix, and sections 2.1.1, 2.2.1 and 2.6 of appendix B to this part, a NIST-traceable source of oxidized Hg shall be used. Alternatively, other NIST-traceable standards may be used for the required checks, subject to the approval of the Administrator. Notwithstanding these requirements, Hg calibration standards that are not NIST-traceable may be used for the tests described in this section until December 31, 2009. However, on and after January 1, 2010, only NIST-traceable calibration standards shall be used for these tests.

5.2 Concentrations

Four concentration levels are required as follows.

5.2.1 Zero-level Concentration

0.0 to 20.0 percent of span, including span for high-scale or both low- and high-scale for SO_2, NO_X, CO_2, and O_2 monitors, as appropriate.

5.2.2 Low-level Concentration

20.0 to 30.0 percent of span, including span for high-scale or both low- and high-scale for SO_2, NO_X, CO_2, and O_2 monitors, as appropriate.

5.2.3 Mid-level Concentration

50.0 to 60.0 percent of span, including span for high-scale or both low- and high-scale for SO_2, NO_X, CO_2, and O_2 monitors, as appropriate.

5.2.4 High-level Concentration

80.0 to 100.0 percent of span, including span for high-scale or both low-and high-scale for SO_2, NO_X, CO_2, and O_2 monitors, as appropriate.

6. Certification Tests and Procedures

6.1 General Requirements

6.1.1 Pretest Preparation

Install the components of the continuous emission monitoring system (i.e., pollutant concentration monitors, CO_2 or O_2 monitor, and flow monitor) as specified in sections 1, 2, and 3 of this appendix, and prepare each system component and the combined system for operation in accordance with the manufacturer's written instructions. Operate the unit(s) during each period when measurements are made. Units may be tested on non-

consecutive days. To the extent practicable, test the DAHS software prior to testing the monitoring hardware.

6.1.2 *Requirements for Air Emission Testing Bodies*

(a) On and after January 1, 2009, any Air Emission Testing Body (AETB) conducting relative accuracy test audits of CEMS and sorbent trap monitoring systems under this part must conform to the requirements of ASTM D7036–04 (incorporated by reference under §75.6 of this part). This section is not applicable to daily operation, daily calibration error checks, daily flow interference checks, quarterly linearity checks or routine maintenance of CEMS.

(b) The AETB shall provide to the affected source(s) certification that the AETB operates in conformance with, and that data submitted to the Agency has been collected in accordance with, the requirements of ASTM D7036–04 (incorporated by reference under §75.6 of this part). This certification may be provided in the form of:

(1) A certificate of accreditation of relevant scope issued by a recognized, national accreditation body; or

(2) A letter of certification signed by a member of the senior management staff of the AETB.

(c) The AETB shall either provide a Qualified Individual on-site to conduct or shall oversee all relative accuracy testing carried out by the AETB as required in ASTM D7036–04 (incorporated by reference under §75.6 of this part). The Qualified Individual shall provide the affected source(s) with copies of the qualification credentials relevant to the scope of the testing conducted.

6.2 Linearity Check (General Procedures)

Check the linearity of each SO_2, NO_X, CO_2, Hg, and O_2 monitor while the unit, or group of units for a common stack, is combusting fuel at conditions of typical stack temperature and pressure; it is not necessary for the unit to be generating electricity during this test. Notwithstanding these requirements, if the SO_2 or NO_X span value for a particular monitor range is ≤ 30 ppm, that range is exempted from the linearity check requirements of this part, for initial certification, recertification, and for on-going quality-assurance. For units with two measurement ranges (high and low) for a particular parameter, perform a linearity check on both the low scale (except for SO_2 or NO_X span values ≤ 30 ppm) and the high scale. Note that for a NO_X-diluent monitoring system with two NO_X measurement ranges, if the low NO_X scale has a span value ≤ 30 ppm and is exempt from linearity checks, this does not exempt either the diluent monitor or the high NO_X scale (if the span is > 30 ppm) from linearity check requirements. For on-going quality assurance of the CEMS, perform linearity checks, using the procedures in this section, on the range(s) and at the frequency specified in section 2.2.1 of appendix B to this part. Challenge each monitor with calibration gas, as defined in section 5.1 of this appendix, at the low-, mid-, and high-range concentrations specified in section 5.2 of this appendix. Introduce the calibration gas at the gas injection port, as specified in section 2.2.1 of this appendix. Operate each monitor at its normal operating temperature and conditions. For extractive and dilution type monitors, pass the calibration gas through all filters, scrubbers, conditioners, and other monitor components used during normal sampling and through as much of the sampling probe as is practical. For in-situ type monitors, perform calibration checking all active electronic and optical components, including the transmitter, receiver, and analyzer. Challenge the monitor three times with each reference gas (see example data sheet in Figure 1). Do not use the same gas twice in succession. To the extent practicable, the duration of each linearity test, from the hour of the first injection to the hour of the last injection, shall not exceed 24 unit operating hours. Record the monitor response from the data acquisition and handling system. For each concentration, use the average of the responses to determine the error in linearity using Equation A–4 in this appendix. Linearity checks are acceptable for monitor or monitoring system certification, recertification, or quality assurance if none of the test results exceed the applicable performance specifications in section 3.2 of this appendix. The status of emission data from a CEMS prior to and during a linearity test period shall be determined as follows:

(a) For the initial certification of a CEMS, data from the monitoring system are considered invalid until all certification tests, including the linearity test, have been successfully completed, unless the conditional data validation procedures in §75.20(b)(3) are used. When the procedures in §75.20(b)(3) are followed, the words ''initial certification'' apply instead of ''recertification,'' and complete all of the initial certification tests by the applicable deadline in §75.4, rather than within the time periods specified in §75.20(b)(3)(iv) for the individual tests.

(b) For the routine quality assurance linearity checks required by section 2.2.1 of appendix B to this part, use the data validation procedures in section 2.2.3 of appendix B to this part.

(c) When a linearity test is required as a diagnostic test or for recertification, use the data validation procedures in §75.20(b)(3).

(d) For linearity tests of non-redundant backup monitoring systems, use the data validation procedures in §75.20(d)(2)(iii).

(e) For linearity tests performed during a grace period and after the expiration of a grace period, use the data validation procedures in sections 2.2.3 and 2.2.4, respectively, of appendix B to this part.

(f) For all other linearity checks, use the data validation procedures in section 2.2.3 of appendix B to this part.

(g) For Hg monitors, follow the guidelines in section 2.2.3 of this appendix in addition to the applicable procedures in section 6.2 when performing the system integrity checks described in §75.20(c)(1)(vi) and in sections 2.1.1, 2.2.1 and 2.6 of appendix B to this part.

(h) For Hg concentration monitors, if moisture is added to the calibration gas during the required linearity checks or system integrity checks, the moisture content of the calibration gas must be accounted for. Under these circumstances, the dry basis concentration of the calibration gas shall be used to calculate the linearity error or measurement error (as applicable).

6.3 7-Day Calibration Error Test

6.3.1 Gas Monitor 7-day Calibration Error Test

The following monitors and ranges are exempted from the 7-day calibration error test requirements of this part: The SO_2, NO_X, CO_2 and O_2 monitors installed on peaking units (as defined in §72.2 of this chapter); and any SO_2 or NO_X measurement range with a span value of 50 ppm or less. In all other cases, measure the calibration error of each SO_2 monitor, each NO_X monitor, each Hg concentration monitor, and each CO_2 or O_2 monitor while the unit is combusting fuel (but not necessarily generating electricity) once each day for 7 consecutive operating days according to the following procedures. For Hg monitors, you may perform this test using either elemental Hg standards or a NIST-traceable source of oxidized Hg. Also for Hg monitors, if moisture is added to the calibration gas, the added moisture must be accounted for and the dry-basis concentration of the calibration gas shall be used to calculate the calibration error. (In the event that unit outages occur after the commencement of the test, the 7 consecutive unit operating days need not be 7 consecutive calendar days.) Units using dual span monitors must perform the calibration error test on both high- and low-scales of the pollutant concentration monitor. The calibration error test procedures in this section and in section 6.3.2 of this appendix shall also be used to perform the daily assessments and additional calibration error tests required under sections 2.1.1 and 2.1.3 of appendix B to this part. Do not make manual or automatic adjustments to the monitor settings until after taking measurements at both zero and high concentration levels for that day during the 7-day test. If automatic adjustments are made following both injections, conduct the calibration error test such that the magnitude of the adjustments can be determined and recorded. Record and report test results for each day using the unadjusted concentration measured in the calibration error test prior to making any manual or automatic adjustments (i.e., resetting the calibration). The calibration error tests should be approximately 24 hours apart, (unless the 7-day test is performed over non-consecutive days). Perform calibration error tests at both the zero-level concentration and high-level concentration, as specified in section 5.2 of this appendix. Alternatively, a mid-level concentration gas (50.0 to 60.0 percent of the span value) may be used in lieu of the high-level gas, provided that the mid-level gas is more representative of the actual stack gas concentrations. In addition, repeat the procedure for SO_2 and NO_X pollutant concentration monitors using the low-scale for units equipped with emission controls or other units with dual span monitors. Use only calibration gas, as specified in section 5.1 of this appendix. Introduce the calibration gas at the gas injection port, as specified in section 2.2.1 of this appendix. Operate each monitor in its normal sampling mode. For extractive and dilution type monitors, pass the calibration gas through all filters, scrubbers, conditioners, and other monitor components used during normal sampling and through as much of the sampling probe as is practical. For in-situ type monitors, perform calibration, checking all active electronic and optical components, including the transmitter, receiver, and analyzer. Challenge the pollutant concentration monitors and CO_2 or O_2 monitors once with each calibration gas. Record the monitor response from the data acquisition and handling system. Using Equation A–5 of this appendix, determine the calibration error at each concentration once each day (at approximately 24-hour intervals) for 7 consecutive days according to the procedures given in this section. The results of a 7-day calibration error test are acceptable for monitor or monitoring system certification, recertification or diagnostic testing if none of these daily calibration error test results exceed the applicable performance specifications in section 3.1 of this appendix. The status of emission data from a gas monitor prior to and during a 7-day calibration error test period shall be determined as follows:

(a) For initial certification, data from the monitor are considered invalid until all certification tests, including the 7-day calibration error test, have been successfully completed, unless the conditional data validation procedures in §75.20(b)(3) are used. When the procedures in §75.20(b)(3) are followed, the words ''initial certification'' apply instead of ''recertification,'' and complete all

of the initial certification tests by the applicable deadline in §75.4, rather than within the time periods specified in §75.20(b)(3)(iv) for the individual tests.

(b) When a 7-day calibration error test is required as a diagnostic test or for recertification, use the data validation procedures in §75.20(b)(3).

6.3.2 Flow Monitor 7-day Calibration Error Test

Flow monitors installed on peaking units (as defined in §72.2 of this chapter) are exempted from the 7-day calibration error test requirements of this part. In all other cases, perform the 7-day calibration error test of a flow monitor, when required for certification, recertification or diagnostic testing, according to the following procedures. Introduce the reference signal corresponding to the values specified in section 2.2.2.1 of this appendix to the probe tip (or equivalent), or to the transducer. During the 7-day certification test period, conduct the calibration error test while the unit is operating once each unit operating day (as close to 24-hour intervals as practicable). In the event that unit outages occur after the commencement of the test, the 7 consecutive operating days need not be 7 consecutive calendar days. Record the flow monitor responses by means of the data acquisition and handling system. Calculate the calibration error using Equation A–6 of this appendix. Do not perform any corrective maintenance, repair, or replacement upon the flow monitor during the 7-day test period other than that required in the quality assurance/quality control plan required by appendix B to this part. Do not make adjustments between the zero and high reference level measurements on any day during the 7-day test. If the flow monitor operates within the calibration error performance specification (i.e., less than or equal to 3.0 percent error each day and requiring no corrective maintenance, repair, or replacement during the 7-day test period), the flow monitor passes the calibration error test. Record all maintenance activities and the magnitude of any adjustments. Record output readings from the data acquisition and handling system before and after all adjustments. Record and report all calibration error test results using the unadjusted flow rate measured in the calibration error test prior to resetting the calibration. Record all adjustments made during the 7-day period at the time the adjustment is made, and report them in the certification or recertification application. The status of emissions data from a flow monitor prior to and during a 7-day calibration error test period shall be determined as follows:

(a) For initial certification, data from the monitor are considered invalid until all certification tests, including the 7-day calibration error test, have been successfully completed, unless the conditional data validation procedures in §75.20(b)(3) are used. When the procedures in §75.20(b)(3) are followed, the words ''initial certification'' apply instead of ''recertification,'' and complete all of the initial certification tests by the applicable deadline in §75.4, rather than within the time periods specified in §75.20(b)(3)(iv) for the individual tests.

(b) When a 7-day calibration error test is required as a diagnostic test or for recertification, use the data validation procedures in §75.20(b)(3).

6.3.3 For gas or flow monitors installed on peaking units, the exemption from performing the 7-day calibration error test applies as long as the unit continues to meet the definition of a peaking unit in §72.2 of this chapter. However, if at the end of a particular calendar year or ozone season, it is determined that peaking unit status has been lost, the owner or operator shall perform a diagnostic 7-day calibration error test of each monitor installed on the unit, by no later than December 31 of the following calendar year.

6.4 Cycle Time Test

Perform cycle time tests for each pollutant concentration monitor and continuous emission monitoring system while the unit is operating, according to the following procedures. Use a zero-level and a high-level calibration gas (as defined in section 5.2 of this appendix) alternately. For Hg monitors, the calibration gas used for this test may either be the elemental or oxidized form of Hg. To determine the downscale cycle time, measure the concentration of the flue gas emissions until the response stabilizes. Record the stable emissions value. Inject a zero-level concentration calibration gas into the probe tip (or injection port leading to the calibration cell, for in situ systems with no probe). Record the time of the zero gas injection, using the data acquisition and handling system (DAHS). Next, allow the monitor to measure the concentration of the zero gas until the response stabilizes. Record the stable ending calibration gas reading. Determine the downscale cycle time as the time it takes for 95.0 percent of the step change to be achieved between the stable stack emissions value and the stable ending zero gas reading. Then repeat the procedure, starting with stable stack emissions and injecting the high-level gas, to determine the upscale cycle time, which is the time it takes for 95.0 percent of the step change to be achieved between the stable stack emissions value and the stable ending high-level gas reading. Use the following criteria to assess when a stable reading of stack emissions or calibration gas concentration has been attained. A stable value is equivalent to a reading with a

change of less than 2.0 percent of the span value for 2 minutes, or a reading with a change of less than 6.0 percent from the measured average concentration over 6 minutes. Alternatively, the reading is considered stable if it changes by no more than 0.5 ppm, 0.5 μg/m^3 (for Hg), or 0.2% CO_2 or O_2 (as applicable) for two minutes. (Owners or operators of systems which do not record data in 1-minute or 3-minute intervals may petition the Administrator under §75.66 for alternative stabilization criteria). For monitors or monitoring systems that perform a series of operations (such as purge, sample, and analyze), time the injections of the calibration gases so they will produce the longest possible cycle time. Refer to Figures 6a and 6b in this appendix for example calculations of upscale and downscale cycle times. Report the slower of the two cycle times (upscale or downscale) as the cycle time for the analyzer. Prior to January 1, 2009 for the NO_X-diluent continuous emission monitoring system test, either record and report the longer cycle time of the two component analyzers as the system cycle time or record the cycle time for each component analyzer separately (as applicable). On and after January 1, 2009, record the cycle time for each component analyzer separately. For time-shared systems, perform the cycle time tests at each probe locations that will be polled within the same 15-minute period during monitoring system operations. To determine the cycle time for time-shared systems, at each monitoring location, report the sum of the cycle time observed at that monitoring location plus the sum of the time required for all purge cycles (as determined by the continuous emission monitoring system manufacturer) at each of the probe locations of the time-shared systems. For monitors with dual ranges, report the test results for each range separately. Cycle time test results are acceptable for monitor or monitoring system certification, recertification or diagnostic testing if none of the cycle times exceed 15 minutes. The status of emissions data from a monitor prior to and during a cycle time test period shall be determined as follows:

(a) For initial certification, data from the monitor are considered invalid until all certification tests, including the cycle time test, have been successfully completed, unless the conditional data validation procedures in §75.20(b)(3) are used. When the procedures in §75.20(b)(3) are followed, the words ''initial certification'' apply instead of ''recertification,'' and complete all of the initial certification tests by the applicable deadline in §75.4, rather than within the time periods specified in §75.20(b)(3)(iv) for the individual tests.

(b) When a cycle time test is required as a diagnostic test or for recertification, use the data validation procedures in §75.20(b)(3).

6.5 Relative Accuracy and Bias Tests (General Procedures)

Perform the required relative accuracy test audits (RATAs) as follows for each CO_2 emissions concentration monitor (including O_2 monitors used to determine CO_2 emissions concentration), each SO_2 pollutant concentration monitor, each NO_X concentration monitoring system used to determine NO_X mass emissions, each flow monitor, each NO_X-diluent CEMS, each O_2 or CO_2 diluent monitor used to calculate heat input, each Hg concentration monitoring system, each sorbent trap monitoring system, and each moisture monitoring system. For NO_X concentration monitoring systems used to determine NO_X mass emissions, as defined in §75.71(a)(2), use the same general RATA procedures as for SO_2 pollutant concentration monitors; however, use the reference methods for NO_X concentration specified in section 6.5.10 of this appendix:

(a) Except as otherwise provided in this paragraph or in §75.21(a)(5), perform each RATA while the unit (or units, if more than one unit exhausts into the flue) is combusting the fuel that is a normal primary or backup fuel for that unit (for some units, more than one type of fuel may be considered normal, *e.g.*, a unit that combusts gas or oil on a seasonal basis). For units that co-fire fuels as the predominant mode of operation, perform the RATAs while co-firing. For Hg monitoring systems, perform the RATAs while the unit is combusting coal. When relative accuracy test audits are performed on CEMS installed on bypass stacks/ducts, use the fuel normally combusted by the unit (or units, if more than one unit exhausts into the flue) when emissions exhaust through the bypass stack/ducts.

(b) Perform each RATA at the load (or operating) level(s) specified in section 6.5.1 or 6.5.2 of this appendix or in section 2.3.1.3 of appendix B to this part, as applicable.

(c) For monitoring systems with dual ranges, perform the relative accuracy test on the range normally used for measuring emissions. For units with add-on SO_2 or NO_X controls or add-on Hg controls that operate continuously rather than seasonally, or for units that need a dual range to record high concentration ''spikes'' during startup conditions, the low range is considered normal. However, for some dual span units (e.g., for units that use fuel switching or for which the emission controls are operated seasonally), provided that both monitor ranges are connected to a common probe and sample interface, either of the two measurement ranges may be considered normal; in such cases, perform the RATA on the range that is in use at the time of the scheduled test. If the

low and high measurement ranges are connected to separate sample probes and interfaces, RATA testing on both ranges is required.

(d) Record monitor or monitoring system output from the data acquisition and handling system.

(e) Complete each single-load relative accuracy test audit within a period of 168 consecutive unit operating hours, as defined in §72.2 of this chapter (or, for CEMS installed on common stacks or bypass stacks, 168 consecutive stack operating hours, as defined in §72.2 of this chapter). Notwithstanding this requirement, up to 336 consecutive unit or stack operating hours may be taken to complete the RATA of a Hg monitoring system, when ASTM 6784–02 (incorporated by reference under §75.6 of this part) or Method 29 in appendix A–8 to part 60 of this chapter is used as the reference method. For 2-level and 3-level flow monitor RATAs, complete all of the RATAs at all levels, to the extent practicable, within a period of 168 consecutive unit (or stack) operating hours; however, if this is not possible, up to 720 consecutive unit (or stack) operating hours may be taken to complete a multiple-load flow RATA.

(f) The status of emission data from the CEMS prior to and during the RATA test period shall be determined as follows:

(1) For the initial certification of a CEMS, data from the monitoring system are considered invalid until all certification tests, including the RATA, have been successfully completed, unless the conditional data validation procedures in §75.20(b)(3) are used. When the procedures in §75.20(b)(3) are followed, the words ''initial certification'' apply instead of ''recertification,'' and complete all of the initial certification tests by the applicable deadline in §75.4, rather than within the time periods specified in §75.20(b)(3)(iv) for the individual tests.

(2) For the routine quality assurance RATAs required by section 2.3.1 of appendix B to this part, use the data validation procedures in section 2.3.2 of appendix B to this part.

(3) For recertification RATAs, use the data validation procedures in §75.20(b)(3).

(4) For quality assurance RATAs of non-redundant backup monitoring systems, use the data validation procedures in §§75.20(d)(2)(v) and (vi).

(5) For RATAs performed during and after the expiration of a grace period, use the data validation procedures in sections 2.3.2 and 2.3.3, respectively, of appendix B to this part.

(6) For all other RATAs, use the data validation procedures in section 2.3.2 of appendix B to this part.

(g) For each SO_2 or CO_2 emissions concentration monitor, each flow monitor, each CO_2 or O_2 diluent monitor used to determine heat input, each NO_X concentration monitoring system used to determine NO_X mass emissions, as defined in §75.71(a)(2), each moisture monitoring system, each NO_X-diluent CEMS, each Hg concentration monitoring system, and each sorbent trap monitoring system, calculate the relative accuracy, in accordance with section 7.3 or 7.4 of this appendix, as applicable. In addition (except for CO_2, O_2, or moisture monitors), test for bias and determine the appropriate bias adjustment factor, in accordance with sections 7.6.4 and 7.6.5 of this appendix, using the data from the relative accuracy test audits.

6.5.1 Gas Monitoring System RATAs (Special Considerations)

(a) Perform the required relative accuracy test audits for each SO_2 or CO_2 emissions concentration monitor, each CO_2 or O_2 diluent monitor used to determine heat input, each NO_X-diluent CEMS, each NO_X concentration monitoring system used to determine NO_X mass emissions, as defined in §75.71(a)(2), each Hg concentration monitoring system, and each sorbent trap monitoring system at the normal load level or normal operating level for the unit (or combined units, if common stack), as defined in section 6.5.2.1 of this appendix. If two load levels or operating levels have been designated as normal, the RATAs may be done at either load level.

(b) For the initial certification of a gas or Hg monitoring system and for recertifications in which, in addition to a RATA, one or more other tests are required (*i.e.*, a linearity test, cycle time test, or 7-day calibration error test), EPA recommends that the RATA not be commenced until the other required tests of the CEMS have been passed.

6.5.2 Flow Monitor RATAs (Special Considerations)

(a) Except as otherwise provided in paragraph (b) or (e) of this section, perform relative accuracy test audits for the initial certification of each flow monitor at three different exhaust gas velocities (low, mid, and high), corresponding to three different load levels or operating levels within the range of operation, as defined in section 6.5.2.1 of this appendix. For a common stack/duct, the three different exhaust gas velocities may be obtained from frequently used unit/load or operating level combinations for the units exhausting to the common stack. Select the three exhaust gas velocities such that the audit points at adjacent load or operating levels (i.e., low and mid or mid and high), in megawatts (or in thousands of lb/hr of steam production or in ft/sec, as applicable), are separated by no less than 25.0 percent of the range of operation, as defined in section 6.5.2.1 of this appendix.

(b) For flow monitors on bypass stacks/ducts and peaking units, the flow monitor

relative accuracy test audits for initial certification and recertification shall be single-load tests, performed at the normal load, as defined in section 6.5.2.1(d) of this appendix.

(c) Flow monitor recertification RATAs shall be done at three load level(s) (or three operating levels), unless otherwise specified in paragraph (b) or (e) of this section or unless otherwise specified or approved by the Administrator.

(d) The semiannual and annual quality assurance flow monitor RATAs required under appendix B to this part shall be done at the load level(s) (or operating levels) specified in section 2.3.1.3 of appendix B to this part.

(e) For flow monitors installed on units that do not produce electrical or thermal output, the flow RATAs for initial certification or recertification may be done at fewer than three operating levels, if:

(1) The owner or operator provides a technical justification in the hardcopy portion of the monitoring plan for the unit required under §75.53(e)(2), demonstrating that the unit operates at only one level or two levels during normal operation (excluding unit startup and shutdown). Appropriate documentation and data must be provided to support the claim of single-level or two-level operation; and

(2) The justification provided in paragraph (e)(1) of this section is deemed to be acceptable by the permitting authority.

6.5.2.1 Range of Operation and Normal Load (or Operating) Level(s)

(a) The owner or operator shall determine the upper and lower boundaries of the ''range of operation'' as follows for each unit (or combination of units, for common stack configurations):

(1) For affected units that produce electrical output (in megawatts) or thermal output (in klb/hr of steam production or mmBtu/hr), the lower boundary of the range of operation of a unit shall be the minimum safe, stable loads for any of the units discharging through the stack. Alternatively, for a group of frequently-operated units that serve a common stack, the sum of the minimum safe, stable loads for the individual units may be used as the lower boundary of the range of operation. The upper boundary of the range of operation of a unit shall be the maximum sustainable load. The ''maximum sustainable load'' is the higher of either: the nameplate or rated capacity of the unit, less any physical or regulatory limitations or other deratings; or the highest sustainable load, based on at least four quarters of representative historical operating data. For common stacks, the maximum sustainable load is the sum of all of the maximum sustainable loads of the individual units discharging through the stack, unless this load is unattainable in practice, in which case use the highest sustainable combined load for the units that discharge through the stack. Based on at least four quarters of representative historical operating data. The load values for the unit(s) shall be expressed either in units of megawatts of thousands of lb/hr of steam load or mmBtu/hr of thermal output; or

(2) For affected units that do not produce electrical or thermal output, the lower boundary of the range of operation shall be the minimum expected flue gas velocity (in ft/sec) during normal, stable operation of the unit. The upper boundary of the range of operation shall be the maximum potential flue gas velocity (in ft/sec) as defined in section 2.1.4.1 of this appendix. The minimum expected and maximum potential velocities may be derived from the results of reference method testing or by using Equation A–3a or A–3b (as applicable) in section 2.1.4.1 of this appendix. If Equation A–3a or A–3b is used to determine the minimum expected velocity, replace the word ''maximum'' with the word ''minimum'' in the definitions of ''MPV,'' ''H_f,'' ''% O_{2d},'' and ''% H_2O,'' and replace the word ''minimum'' with the word ''maximum'' in the definition of ''CO_{2d}.'' Alternatively, 0.0 ft/sec may be used as the lower boundary of the range of operation.

(b) The operating levels for relative accuracy test audits shall, except for peaking units, be defined as follows: the ''low'' operating level shall be the first 30.0 percent of the range of operation; the ''mid'' operating level shall be the middle portion (>30.0 percent, but ≤60.0 percent) of the range of operation; and the ''high'' operating level shall be the upper end (>60.0 percent) of the range of operation. For example, if the upper and lower boundaries of the range of operation are 100 and 1100 megawatts, respectively, then the low, mid, and high operating levels would be 100 to 400 megawatts, 400 to 700 megawatts, and 700 to 1100 megawatts, respectively.

(c) Units that do not produce electrical or thermal output are exempted from the requirements of this paragraph, (c). The owner or operator shall identify, for each affected unit or common stack (except for peaking units and units using the low mass emissions (LME) excepted methodology under §75.19), the ''normal'' load level or levels (low, mid or high), based on the operating history of the unit(s). To identify the normal load level(s), the owner or operator shall, at a minimum, determine the relative number of operating hours at each of the three load levels, low, mid and high over the past four representative operating quarters. The owner or operator shall determine, to the nearest 0.1 percent, the percentage of the time that each load level (low, mid, high) has been used during that time period. A summary of the data used for this determination and the calculated results shall be kept on-site in a format suitable for inspection. For new units or

newly-affected units, the data analysis in this paragraph may be based on fewer than four quarters of data if fewer than four representative quarters of historical load data are available. Or, if no historical load data are available, the owner or operator may designate the normal load based on the expected or projected manner of operating the unit. However, in either case, once four quarters of representative data become available, the historical load analysis shall be repeated.

(d) Determination of normal load (or operating level)

(1) Based on the analysis of the historical load data described in paragraph (c) of this section, the owner or operator shall, for units that produce electrical or thermal output, designate the most frequently used load level as the normal load level for the unit (or combination of units, for common stacks). The owner or operator may also designate the second most frequently used load level as an additional normal load level for the unit or stack. For peaking units and LME units, normal load designations are unnecessary; the entire operating load range shall be considered normal. If the manner of operation of the unit changes significantly, such that the designated normal load(s) or the two most frequently used load levels change, the owner or operator shall repeat the historical load analysis and shall redesignate the normal load(s) and the two most frequently used load levels, as appropriate. A minimum of two representative quarters of historical load data are required to document that a change in the manner of unit operation has occurred. Update the electronic monitoring plan whenever the normal load level(s) and the two most frequently-used load levels are redesignated.

(2) For units that do not produce electrical or thermal output, the normal operating level(s) shall be determined using sound engineering judgment, based on knowledge of the unit and operating experience with the industrial process.

(e) The owner or operator shall report the upper and lower boundaries of the range of operation for each unit (or combination of units, for common stacks), in units of megawatts or thousands of lb/hr or mmBtu/hr of steam production or ft/sec (as applicable), in the electronic monitoring plan required under §75.53. Except for peaking units and LME units, the owner or operator shall indicate, in the electronic monitoring plan, the load level (or levels) designated as normal under this section and shall also indicate the two most frequently used load levels.

6.5.2.2 Multi-Load (or Multi-Level) Flow RATA Results

For each multi-load (or multi-level) flow RATA, calculate the flow monitor relative accuracy at each operating level. If a flow monitor relative accuracy test is failed or aborted due to a problem with the monitor on any level of a 2-level (or 3-level) relative accuracy test audit, the RATA must be repeated at that load (or operating) level. However, the entire 2-level (or 3-level) relative accuracy test audit does not have to be repeated unless the flow monitor polynomial coefficients or K-factor(s) are changed, in which case a 3-level RATA is required (or, a 2-level RATA, for units demonstrated to operate at only two levels, under section 6.5.2(e) of this appendix).

6.5.3 [Reserved]

6.5.4 Calculations

Using the data from the relative accuracy test audits, calculate relative accuracy and bias in accordance with the procedures and equations specified in section 7 of this appendix.

6.5.5 Reference Method Measurement Location

Select a location for reference method measurements that is (1) accessible; (2) in the same proximity as the monitor or monitoring system location; and (3) meets the requirements of Performance Specification 2 in appendix B of part 60 of this chapter for SO_2 and NO_X continuous emission monitoring systems, Performance Specification 3 in appendix B of part 60 of this chapter for CO_2 or O_2 monitors, or method 1 (or 1A) in appendix A of part 60 of this chapter for volumetric flow, except as otherwise indicated in this section or as approved by the Administrator.

6.5.6 Reference Method Traverse Point Selection

Select traverse points that ensure acquisition of representative samples of pollutant and diluent concentrations, moisture content, temperature, and flue gas flow rate over the flue cross section. To achieve this, the reference method traverse points shall meet the requirements of section 8.1.3 of Performance Specification 2 (''PS No. 2'') in appendix B to part 60 of this chapter (for SO_2, NO_X, and moisture monitoring system RATAs), Performance Specification 3 in appendix B to part 60 of this chapter (for O_2 and CO_2 monitor RATAs), Method 1 (or 1A) (for volumetric flow rate monitor RATAs), Method 3 (for molecular weight), and Method 4 (for moisture determination) in appendix A to part 60 of this chapter. The following alternative reference method traverse point locations are permitted for moisture and gas monitor RATAs:

(a) For moisture determinations where the moisture data are used only to determine stack gas molecular weight, a single reference method point, located at least 1.0

meter from the stack wall, may be used. For moisture monitoring system RATAs and for gas monitor RATAs in which moisture data are used to correct pollutant or diluent concentrations from a dry basis to a wet basis (or vice-versa), single-point moisture sampling may only be used if the 12-point stratification test described in section 6.5.6.1 of this appendix is performed prior to the RATA for at least one pollutant or diluent gas, and if the test is passed according to the acceptance criteria in section 6.5.6.3(b) of this appendix.

(b) For gas monitoring system RATAs, the owner or operator may use any of the following options:

(1) At any location (including locations where stratification is expected), use a minimum of six traverse points along a diameter, in the direction of any expected stratification. The points shall be located in accordance with Method 1 in appendix A to part 60 of this chapter.

(2) At locations where section 8.1.3 of PS No. 2 allows the use of a short reference method measurement line (with three points located at 0.4, 1.2, and 2.0 meters from the stack wall), the owner or operator may use an alternative 3-point measurement line, locating the three points at 4.4, 14.6, and 29.6 percent of the way across the stack, in accordance with Method 1 in appendix A to part 60 of this chapter.

(3) At locations where stratification is likely to occur (e.g., following a wet scrubber or when dissimilar gas streams are combined), the short measurement line from section 8.1.3 of PS No. 2 (or the alternative line described in paragraph (b)(2) of this section) may be used in lieu of the prescribed ''long'' measurement line in section 8.1.3 of PS No. 2, provided that the 12-point stratification test described in section 6.5.6.1 of this appendix is performed and passed one time at the location (according to the acceptance criteria of section 6.5.6.3(a) of this appendix) and provided that either the 12-point stratification test or the alternative (abbreviated) stratification test in section 6.5.6.2 of this appendix is performed and passed prior to each subsequent RATA at the location (according to the acceptance criteria of section 6.5.6.3(a) of this appendix).

(4) A single reference method measurement point, located no less than 1.0 meter from the stack wall and situated along one of the measurement lines used for the stratification test, may be used at any sampling location if the 12-point stratification test described in section 6.5.6.1 of this appendix is performed and passed prior to each RATA at the location (according to the acceptance criteria of section 6.5.6.3(b) of this appendix).

(5) If Method 7E is used as the reference method for the RATA of a NO_X CEMS installed on a combustion turbine, the reference method measurements may be made at the sampling points specified in section 6.1.2 of Method 20 in appendix A to part 60 of this chapter.

(c) For Hg monitoring systems, use the same basic approach for traverse point selection that is used for the other gas monitoring system RATAs, except that the stratification test provisions in sections 8.1.3 through 8.1.3.5 of Method 30A shall apply, rather than the provisions of sections 6.5.6.1 through 6.5.6.3 of this appendix.

6.5.6.1 Stratification Test

(a) With the unit(s) operating under steady-state conditions at the normal load level (or normal operating level), as defined in section 6.5.2.1 of this appendix, use a traversing gas sampling probe to measure the pollutant (SO_2 or NO_X) and diluent (CO_2 or O_2) concentrations at a minimum of twelve (12) points, located according to Method 1 in appendix A to part 60 of this chapter.

(b) Use Methods 6C, 7E, and 3A in appendix A to part 60 of this chapter to make the measurements. Data from the reference method analyzers must be quality-assured by performing analyzer calibration error and system bias checks before the series of measurements and by conducting system bias and calibration drift checks after the measurements, in accordance with the procedures of Methods 6C, 7E, and 3A.

(c) Measure for a minimum of 2 minutes at each traverse point. To the extent practicable, complete the traverse within a 2-hour period.

(d) If the load has remained constant (±3.0 percent) during the traverse and if the reference method analyzers have passed all of the required quality assurance checks, proceed with the data analysis.

(e) Calculate the average NO_X, SO_2, and CO_2 (or O_2) concentrations at each of the individual traverse points. Then, calculate the arithmetic average NO_X, SO_2, and CO_2 (or O_2) concentrations for all traverse points.

6.5.6.2 Alternative (Abbreviated) Stratification Test

(a) With the unit(s) operating under steady-state conditions at normal load level (or normal operating level), as defined in section 6.5.2.1 of this appendix, use a traversing gas sampling probe to measure the pollutant (SO_2 or NO_X) and diluent (CO_2 or O_2) concentrations at three points. The points shall be located according to the specifications for the long measurement line in section 8.1.3 of PS No. 2 (i.e., locate the points 16.7 percent, 50.0 percent, and 83.3 percent of the way across the stack). Alternatively, the concentration measurements may be made at six traverse points along a diameter. The six points shall be located in accordance with Method 1 in appendix A to part 60 of this chapter.

(b) Use Methods 6C, 7E, and 3A in appendix A to part 60 of this chapter to make the measurements. Data from the reference method analyzers must be quality-assured by performing analyzer calibration error and system bias checks before the series of measurements and by conducting system bias and calibration drift checks after the measurements, in accordance with the procedures of Methods 6C, 7E, and 3A.

(c) Measure for a minimum of 2 minutes at each traverse point. To the extent practicable, complete the traverse within a 1-hour period.

(d) If the load has remained constant (±3.0 percent) during the traverse and if the reference method analyzers have passed all of the required quality assurance checks, proceed with the data analysis.

(e) Calculate the average NO_X, SO_2, and CO_2 (or O_2) concentrations at each of the individual traverse points. Then, calculate the arithmetic average NO_X, SO_2, and CO_2 (or O_2) concentrations for all traverse points.

6.5.6.3 Stratification Test Results and Acceptance Criteria

(a) For each pollutant or diluent gas, the short reference method measurement line described in section 8.1.3 of PS No. 2 may be used in lieu of the long measurement line prescribed in section 8.1.3 of PS No. 2 if the results of a stratification test, conducted in accordance with section 6.5.6.1 or 6.5.6.2 of this appendix (as appropriate; see section 6.5.6(b)(3) of this appendix), show that the concentration at each individual traverse point differs by no more than ±10.0 percent from the arithmetic average concentration for all traverse points. The results are also acceptable if the concentration at each individual traverse point differs by no more than ±5ppm or ±0.5 percent CO_2 (or O_2) from the arithmetic average concentration for all traverse points.

(b) For each pollutant or diluent gas, a single reference method measurement point, located at least 1.0 meter from the stack wall and situated along one of the measurement lines used for the stratification test, may be used for that pollutant or diluent gas if the results of a stratification test, conducted in accordance with section 6.5.6.1 of this appendix, show that the concentration at each individual traverse point differs by no more than ±5.0 percent from the arithmetic average concentration for all traverse points. The results are also acceptable if the concentration at each individual traverse point differs by no more than ±3 ppm or ±0.3 percent CO_2 (or O_2) from the arithmetic average concentration for all traverse points.

(c) The owner or operator shall keep the results of all stratification tests on-site, in a format suitable for inspection, as part of the supplementary RATA records required under § 75.59(a)(7).

6.5.7 Sampling Strategy

(a) Conduct the reference method tests so they will yield results representative of the pollutant concentration, emission rate, moisture, temperature, and flue gas flow rate from the unit and can be correlated with the pollutant concentration monitor, CO_2 or O_2 monitor, flow monitor, and SO_2, Hg, or NO_X CEMS measurements. The minimum acceptable time for a gas monitoring system RATA run or for a moisture monitoring system RATA run is 21 minutes. For each run of a gas monitoring system RATA, all necessary pollutant concentration measurements, diluent concentration measurements, and moisture measurements (if applicable) must, to the extent practicable, be made within a 60-minute period. For NO_X-diluent monitoring system RATAs, the pollutant and diluent concentration measurements must be made simultaneously. For flow monitor RATAs, the minimum time per run shall be 5 minutes. Flow rate reference method measurements may be made either sequentially from port to port or simultaneously at two or more sample ports. The velocity measurement probe may be moved from traverse point to traverse point either manually or automatically. If, during a flow RATA, significant pulsations in the reference method readings are observed, be sure to allow enough measurement time at each traverse point to obtain an accurate average reading when a manual readout method is used (e.g., a ''sight-weighted'' average from a manometer). Also, allow sufficient measurement time to ensure that stable temperature readings are obtained at each traverse point, particularly at the first measurement point at each sample port, when a probe is moved sequentially from port-to-port. A minimum of one set of auxiliary measurements for stack gas molecular weight determination (i.e., diluent gas data and moisture data) is required for every clock hour of a flow RATA or for every three test runs (whichever is less restrictive). Alternatively, moisture measurements for molecular weight determination may be performed before and after a series of flow RATA runs at a particular load level (low, mid, or high), provided that the time interval between the two moisture measurements does not exceed three hours. If this option is selected, the results of the two moisture determinations shall be averaged arithmetically and applied to all RATA runs in the series. Successive flow RATA runs may be performed without waiting in-between runs. If an O_2-diluent monitor is used as a CO_2 continuous emission monitoring system, perform a CO_2 system RATA (i.e., measure CO_2, rather than O_2, with the reference method). For moisture monitoring systems, an appropriate coefficient, ''K'' factor or other suitable mathematical algorithm may be developed prior to the RATA,

to adjust the monitoring system readings with respect to the reference method. If such a coefficient, K-factor or algorithm is developed, it shall be applied to the CEMS readings during the RATA and (if the RATA is passed), to the subsequent CEMS data, by means of the automated data acquisition and handling system. The owner or operator shall keep records of the current coefficient, K factor or algorithm, as specified in 75.59(a)(5)(vii). Whenever the coefficient, K factor or algorithm is changed, a RATA of the moisture monitoring system is required. For the RATA of a Hg CEMS using the Ontario Hydro Method, or for the RATA of a sorbent trap system (irrespective of the reference method used), the time per run must be long enough to collect a sufficient mass of Hg to analyze. For the RATA of a sorbent trap monitoring system, the type of sorbent material used by the traps shall be the same as for daily operation of the monitoring system; however, the size of the traps used for the RATA may be smaller than the traps used for daily operation of the system. Spike the third section of each sorbent trap with elemental Hg, as described in section 7.1.2 of appendix K to this part. Install a new pair of sorbent traps prior to each test run. For each run, the sorbent trap data shall be validated according to the quality assurance criteria in section 8 of appendix K to this part.

(b) To properly correlate individual SO_2, Hg, or NO_X CEMS data (in lb/MMBtu) and volumetric flow rate data with the reference method data, annotate the beginning and end of each reference method test run (including the exact time of day) on the individual chart recorder(s) or other permanent recording device(s).

6.5.8 Correlation of Reference Method and Continuous Emission Monitoring System

Confirm that the monitor or monitoring system and reference method test results are on consistent moisture, pressure, temperature, and diluent concentration basis (e.g., since the flow monitor measures flow rate on a wet basis, method 2 test results must also be on a wet basis). Compare flow-monitor and reference method results on a scfh basis. Also, consider the response times of the pollutant concentration monitor, the continuous emission monitoring system, and the flow monitoring system to ensure comparison of simultaneous measurements.

For each relative accuracy test audit run, compare the measurements obtained from the monitor or continuous emission monitoring system (in ppm, percent CO_2, lb/mmBtu, or other units) against the corresponding reference method values. Tabulate the paired data in a table such as the one shown in Figure 2.

6.5.9 Number of Reference Method Tests

Perform a minimum of nine sets of paired monitor (or monitoring system) and reference method test data for every required (i.e., certification, recertification, diagnostic, semiannual, or annual) relative accuracy test audit. For 2-level and 3-level relative accuracy test audits of flow monitors, perform a minimum of nine sets at each of the operating levels.

NOTE: The tester may choose to perform more than nine sets of reference method tests. If this option is chosen, the tester may reject a maximum of three sets of the test results, as long as the total number of test results used to determine the relative accuracy or bias is greater than or equal to nine. Report all data, including the rejected CEMS data and corresponding reference method test results.

6.5.10 Reference Methods

The following methods are from appendix A to part 60 of this chapter or have been published by ASTM, and are the reference methods for performing relative accuracy test audits under this part: Method 1 or 1A in appendix A–1 to part 60 of this chapter for siting; Method 2 in appendices A–1 and A–2 to part 60 of this chapter or its allowable alternatives in appendix A to part 60 of this chapter (except for Methods 2B and 2E in appendix A–1 to part 60 of this chapter) for stack gas velocity and volumetric flow rate; Methods 3, 3A or 3B in appendix A–2 to part 60 of this chapter for O_2 and CO_2; Method 4 in appendix A–3 to part 60 of this chapter for moisture; Methods 6, 6A or 6C in appendix A–4 to part 60 of this chapter for SO_2; Methods 7, 7A, 7C, 7D or 7E in appendix A–4 to part 60 of this chapter for NO_X, excluding the exceptions of Method 7E in appendix A–4 to part 60 of this chapter identified in §75.22(a)(5); and for Hg, either ASTM D6784–02 (the Ontario Hydro Method) (incorporated by reference under §75.6 of this part), Method 29 in appendix A–8 to part 60 of this chapter, Method 30A, or Method 30B When using Method 7E in appendix A–4 to part 60 of this chapter for measuring NO_X concentration, total NO_X, both NO and NO_2, must be measured.

7. CALCULATIONS

7.1 Linearity Check

Analyze the linearity data for pollutant concentration and CO_2 or O_2 monitors as follows. Calculate the percentage error in linearity based upon the reference value at the low-level, mid-level, and high-level concentrations specified in section 6.2 of this appendix. Perform this calculation once during the certification test. Use the following equation to calculate the error in linearity for each reference value.

$$LE = \frac{|R-A|}{R} \times 100$$

(Eq. A–4)

where,

LE = Percentage Linearity error, based upon the reference value.

R = Reference value of Low-, mid-, or high-level calibration gas introduced into the monitoring system.

A = Average of the monitoring system responses.

7.2 Calibration Error

7.2.1 Pollutant Concentration and Diluent Monitors

For each reference value, calculate the percentage calibration error based upon instrument span for daily calibration error tests using the following equation:

$$CE = \frac{|R-A|}{S} \times 100$$

(Eq. A–5)

where,

CE = Calibration error as a percentage of the span of the instrument.

R = Reference value of zero or upscale (high-level or mid-level, as applicable) calibration gas introduced into the monitoring system.

A = Actual monitoring system response to the calibration gas.

S = Span of the instrument, as specified in section 2 of this appendix.

7.2.2 Flow Monitor Calibration Error

For each reference value, calculate the percentage calibration error based upon span using the following equation:

$$CE = \frac{|R-A|}{S} \times 100 \qquad \text{(Eq. A–6)}$$

where:

CE = Calibration error as a percentage of span.

R = Low or high level reference value specified in section 2.2.2.1 of this appendix.

A = Actual flow monitor response to the reference value.

S = Flow monitor calibration span value as determined under section 2.1.4.2 of this appendix.

7.3 Relative Accuracy for SO_2 and CO_2 Emissions Concentration Monitors, O_2 Monitors, NO_X Concentration Monitoring Systems, Hg Monitoring Systems, and Flow Monitors

Analyze the relative accuracy test audit data from the reference method tests for SO_2 and CO_2 emissions concentration monitors, CO_2 or O_2 monitors used only for heat input rate determination, NO_X concentration monitoring systems used to determine NO_X mass emissions under subpart H of this part, Hg monitoring systems used to determine Hg mass emissions under subpart I of this part, and flow monitors using the following procedures. An example is shown in Figure 2. Calculate the mean of the monitor or monitoring system measurement values. Calculate the mean of the reference method values. Using data from the automated data acquisition and handling system, calculate the arithmetic differences between the reference method and monitor measurement data sets. Then calculate the arithmetic mean of the difference, the standard deviation, the confidence coefficient, and the monitor or monitoring system relative accuracy using the following procedures and equations.

7.3.1 Arithmetic Mean

Calculate the arithmetic mean of the differences, $\bar{d}$, of a data set as follows.

$$\text{“}\sum_{i=1}^{n} di\text{”}$$

(Eq. A–7)

where,

n = Number of data points.

$\sum_{i=1}^{n} d_i$ = Algebraic sum of the individual differences d_i.

d_i = The difference between a reference method value and the corresponding continuous emission monitoring system value (RM_i–CEM_i) at a given point in time i.

7.3.2 Standard Deviation

Calculate the standard deviation, S_d, of a data set as follows:

$$S_d = \sqrt{\frac{\sum_{i=1}^{n} d_i^2 - \left[\frac{\left(\sum_{i=1}^{n} d_i\right)^2}{n}\right]}{n-1}}$$

(Eq. A–8)

7.3.3 Confidence Coefficient

Calculate the confidence coefficient (one-tailed), cc, of a data set as follows.

$$cc = t_{0.025} \frac{S_d}{\sqrt{n}}$$

(eq. A–9)

where,

$t_{0.025}$ = t value (see table 7–1).

TABLE 7–1—T-VALUES

n-1	$t_{0.025}$	n-1	$t_{0.025}$	n-1	$t_{0.025}$
1	12.706	12	2.179	23	2.069
2	4.303	13	2.160	24	2.064
3	3.182	14	2.145	25	2.060
4	2.776	15	2.131	26	2.056
5	2.571	16	2.120	27	2.052
6	2.447	17	2.110	28	2.048
7	2.365	18	2.101	29	2.045
8	2.306	19	2.093	30	2.042
9	2.262	20	2.086	40	2.021
10	2.228	21	2.080	60	2.000
11	2.201	22	2.074	>60	1.960

7.3.4 Relative Accuracy

Calculate the relative accuracy of a data set using the following equation.

$$RA = \frac{|\bar{d}| + |cc|}{\overline{RM}} \times 100$$

(Eq. A–10)

where,

RM = Arithmetic mean of the reference method values.

$|\bar{d}|$ = The absolute value of the mean difference between the reference method values and the corresponding continuous emission monitoring system values.

|cc| = The absolute value of the confidence coefficient.

7.4 Relative Accuracy for NO_X-diluent Continuous Emission Monitoring Systems

Analyze the relative accuracy test audit data from the reference method tests for NO_X-diluent continuous emissions monitoring system as follows.

7.4.1 Data Preparation

If C_{NOx}, the NO_X concentration, is in ppm, multiply it by 1.194×10^{-7} (lb/dscf)/ppm to convert it to units of lb/dscf. If C_{NOx} is in mg/dscm, multiply it by 6.24×10^{-8} (lb/dscf)/(mg/dscm) to convert it to lb/dscf. Then, use the diluent (O_2 or CO_2) reference method results for the run and the appropriate F or F_c factor from table 1 in appendix F of this part to convert C_{NOx} from lb/dscf to lb/mmBtu units. Use the equations and procedure in section 3 of appendix F to this part, as appropriate.

7.4.2 NO_X Emission Rate

For each test run in a data set, calculate the average NO_X emission rate (in lb/mmBtu), by means of the data acquisition and handling system, during the time period of the test run. Tabulate the results as shown in example Figure 4.

7.4.3 Relative Accuracy

Use the equations and procedures in section 7.3 above to calculate the relative accuracy for the NO_X continuous emission monitoring system. In using equation A–7, ''d'' is, for each run, the difference between the NO_X emission rate values (in lb/mmBtu) obtained from the reference method data and the NO_X continuous emission monitoring system.

7.5 Relative Accuracy for Combined SO_2/Flow [Reserved]

7.6 Bias Test and Adjustment Factor

Test the following relative accuracy test audit data sets for bias: SO_2 pollutant concentration monitors; flow monitors; NO_X concentration monitoring systems used to determine NO_X mass emissions, as defined in §75.71(a)(2); NO_X-diluent CEMS, Hg concentration monitoring systems, and sorbent trap monitoring systems, using the procedures outlined in sections 7.6.1 through 7.6.5 of this appendix. For multiple-load flow RATAs, perform a bias test at each load level designated as normal under section 6.5.2.1 of this appendix.

7.6.1 Arithmetic Mean

Calculate the arithmetic mean of the difference, $\bar{d}$, of the data set using equation A–7 of this appendix. To calculate bias for an SO_2 or NO_X pollutant concentration monitor, ''d'' is, for each paired data point, the difference between the SO_2 or NO_X concentration value (in ppm) obtained from the reference method and the monitor. To calculate bias for a flow monitor, ''d'' is, for each paired data point, the difference between the flow rate values (in scfh) obtained from the reference method and the monitor. To calculate bias for a NO_X-diluent continuous emission monitoring system, ''d'' is, for each paired data point, the difference between the NO_X-diluent emission rate values (in lb/

mmBtu) obtained from the reference method and the monitoring system. To calculate bias for a Hg monitoring system when using the Ontario Hydro Method or Method 29 in appendix A–8 to part 60 of this chapter, ''d'' is, for each data point, the difference between the average Hg concentration value (in μg/m³) from the paired Ontario Hydro or Method 29 in appendix A–8 to part 60 of this chapter sampling trains and the concentration measured by the monitoring system. For sorbent trap monitoring systems, use the average Hg concentration measured by the paired traps in the calculation of ''d''.

7.6.2 Standard Deviation

Calculate the standard deviation, S_d, of the data set using equation A–8.

7.6.3 CONFIDENCE COEFFICIENT

Calculate the confidence coefficient, cc, of the data set using equation A–9.

7.6.4 Bias Test

If, for the relative accuracy test audit data set being tested, the mean difference, $\bar{d}$, is less than or equal to the absolute value of the confidence coefficient, | cc |, the monitor or monitoring system has passed the bias test. If the mean difference, $\bar{d}$, is greater than the absolute value of the confidence coefficient, √ cc √, the monitor or monitoring system has failed to meet the bias test requirement.

7.6.5 Bias Adjustment

(a) If the monitor or monitoring system fails to meet the bias test requirement, adjust the value obtained from the monitor using the following equation:

$$CEM_i^{Adjusted} = CEM_i^{Monitor} \times BAF \qquad \text{(Eq. A-11)}$$

Where:

$CEM_i^{Monitor}$ = Data (measurement) provided by the monitor at time i.

$CEM_i^{Adjusted}$ = Data value, adjusted for bias, at time i.

BAF = Bias adjustment factor, defined by:

$$BAF = 1 + \frac{|\bar{d}|}{CEM_{avg}} \qquad \text{(Eq. A-12)}$$

Where:

BAF = Bias adjustment factor, calculated to the nearest thousandth.

$\bar{d}$ = Arithmetic mean of the difference obtained during the failed bias test using Equation A–7.

CEM_{avg} = Mean of the data values provided by the monitor during the failed bias test.

(b) For single-load RATAs of SO_2 pollutant concentration monitors, NO_X concentration monitoring systems, NO_X-diluent monitoring systems, Hg concentration monitoring systems, and sorbent trap monitoring systems, and for the single-load flow RATAs required or allowed under section 6.5.2 of this appendix and sections 2.3.1.3(b) and 2.3.1.3(c) of appendix B to this part, the appropriate BAF is determined directly from the RATA results at normal load, using Equation A–12. Notwithstanding, when a NO_X concentration CEMS or an SO_2 CEMS or a NO_X-diluent CEMS installed on a low-emitting affected unit (i.e., average SO_2 or NO_X concentration during the RATA ≤ 250 ppm or average NO_X emission rate ≤ 0.200 lb/mmBtu) meets the normal 10.0 percent relative accuracy specification (as calculated using Equation A–10) or the alternate relative accuracy specification in section 3.3 of this appendix for low-emitters, but fails the bias test, the BAF may either be determined using Equation A–12, or a default BAF of 1.111 may be used. Similarly, for Hg concentration and sorbent trap monitoring systems, where the average Hg concentration during the RATA is < 5.0 μgm/dscm, if the monitoring system meets the normal or the alternative relative accuracy specification in section 3.3.8 of this appendix but fails the bias test, the owner or operator may either use the bias adjustment factor (BAF) calculated from Equation A–12 or may use a default BAF of 1.250 for reporting purposes under this part.

(c) For 2-load or 3-load flow RATAs, when only one load level (low, mid or high) has been designated as normal under section 6.5.2.1 of this appendix and the bias test is passed at the normal load level, apply a BAF of 1.000 to the subsequent flow rate data. If the bias test is failed at the normal load level, use Equation A–12 to calculate the normal load BAF and then perform an additional bias test at the second most frequently-used load level, as determined under section 6.5.2.1 of this appendix. If the bias test is passed at this second load level, apply the normal load BAF to the subsequent flow rate data. If the bias test is failed at this second load level, use Equation A–12 to calculate the BAF at the second load level and apply the higher of the two BAFs (either

from the normal load level or from the second load level) to the subsequent flow rate data.

(d) For 2-load or 3-load flow RATAs, when two load levels have been designated as normal under section 6.5.2.1 of this appendix and the bias test is passed at both normal load levels, apply a BAF of 1.000 to the subsequent flow rate data. If the bias test is failed at one of the normal load levels but not at the other, use Equation A–12 to calculate the BAF for the normal load level at which the bias test was failed and apply that BAF to the subsequent flow rate data. If the bias test is failed at both designated normal load levels, use Equation A–12 to calculate the BAF at each normal load level and apply the higher of the two BAFs to the subsequent flow rate data.

(e) Each time a RATA is passed and the appropriate bias adjustment factor has been determined, apply the BAF prospectively to all monitoring system data, beginning with the first clock hour following the hour in which the RATA was completed. For a 2-load flow RATA, the ''hour in which the RATA was completed'' refers to the hour in which the testing at both loads was completed; for a 3-load RATA, it refers to the hour in which the testing at all three loads was completed.

(f) Use the bias-adjusted values in computing substitution values in the missing data procedure, as specified in subpart D of this part, and in reporting the concentration of SO_2 or Hg, the flow rate, the average NO_X emission rate, the unit heat input, and the calculated mass emissions of SO_2 and CO_2 during the quarter and calendar year, as specified in subpart G of this part. In addition, when using a NO_X concentration monitoring system and a flow monitor to calculate NO_X mass emissions under subpart H of this part, or when using a Hg concentration or sorbent trap monitoring system and a flow monitor to calculate Hg mass emissions under subpart I of this part, use bias-adjusted values for NO_X (or Hg) concentration and flow rate in the mass emission calculations and use bias-adjusted NO_X (or Hg) concentrations to compute the appropriate substitution values for NO_X (or Hg) concentration in the missing data routines under subpart D of this part.

(g) For units that do not produce electrical or thermal output, the provisions of paragraphs (a) through (f) of this section apply, except that the terms, ''single-load'', ''2-load'', ''3-load'', and ''load level'' shall be replaced, respectively, with the terms, ''single-level'', ''2-level'', ''3-level'', and ''operating level''.

7.7 Reference Flow-to-Load Ratio or Gross Heat Rate

(a) Except as provided in section 7.8 of this appendix, the owner or operator shall determine R_{ref}, the reference value of the ratio of flow rate to unit load, each time that a passing flow RATA is performed at a load level designated as normal in section 6.5.2.1 of this appendix. The owner or operator shall report the current value of R_{ref} in the electronic quarterly report required under §75.64 and shall also report the completion date of the associated RATA. If two load levels have been designated as normal under section 6.5.2.1 of this appendix, the owner or operator shall determine a separate R_{ref} value for each of the normal load levels. The reference flow-to-load ratio shall be calculated as follows:

$$R_{ref} = \frac{Q_{ref}}{L_{avg}} \times 10^{-5} \qquad \text{(Eq. A-13)}$$

Where:

R_{ref} = Reference value of the flow-to-load ratio, from the most recent normal-load flow RATA, scfh/megawatts, scfh/1000 lb/hr of steam, or scfh/(mmBtu/hr of steam output).

Q_{ref} = Average stack gas volumetric flow rate measured by the reference method during the normal-load RATA, scfh.

L_{avg} = Average unit load during the normal-load flow RATA, megawatts, 1000 lb/hr of steam, or mmBtu/hr of thermal output.

(b) In Equation A–13, for a common stack, determine L_{avg} by summing, for each RATA run, the operating loads of all units discharging through the common stack, and then taking the arithmetic average of the summed loads. For a unit that discharges its emissions through multiple stacks, either determine a single value of Q_{ref} for the unit or a separate value of Q_{ref} for each stack. In the former case, calculate Q_{ref} by summing, for each RATA run, the volumetric flow rates through the individual stacks and then taking the arithmetic average of the summed RATA run flow rates. In the latter case, calculate the value of Q_{ref} for each stack by taking the arithmetic average, for all RATA runs, of the flow rates through the stack. For a unit with a multiple stack discharge configuration consisting of a main stack and a bypass stack (e.g., a unit with a wet SO_2 scrubber), determine Q_{ref} separately for each stack at the time of the normal load flow RATA. Round off the value of R_{ref} to two decimal places.

(c) In addition to determining R_{ref} or as an alternative to determining R_{ref}, a reference value of the gross heat rate (GHR) may be determined. In order to use this option, quality-assured diluent gas (CO_2 or O_2) must be available for each hour of the most recent normal-load flow RATA. The reference value of the GHR shall be determined as follows:

$$(GHR)_{ref} = \frac{(\text{Heat Input})_{avg}}{L_{avg}} \times 1000 \qquad \text{(Eq. A-13a)}$$

Where:

$(GHR)_{ref}$ = Reference value of the gross heat rate at the time of the most recent normal-load flow RATA, Btu/kwh, Btu/lb steam load, or Btu heat input/mmBtu steam output.

$(\text{Heat Input})_{avg}$ = Average hourly heat input during the normal-load flow RATA, as determined using the applicable equation in appendix F to this part, mmBtu/hr. For multiple stack configurations, if the reference GHR value is determined separately for each stack, use the hourly heat input measured at each stack. If the reference GHR is determined at the unit level, sum the hourly heat inputs measured at the individual stacks.

L_{avg} = Average unit load during the normal-load flow RATA, megawatts, 1000 lb/hr of steam, or mmBtu/hr thermal output.

(d) In the calculation of $(\text{Heat Input})_{avg}$, use Q_{ref}, the average volumetric flow rate measured by the reference method during the RATA, and use the average diluent gas concentration measured during the flow RATA (i.e., the arithmetic average of the diluent gas concentrations for all clock hours in which a RATA run was performed).

7.8 Flow-to-Load Test Exemptions

(a) For complex stack configuations (e.g., when the effluent from a unit is divided and discharges through multiple stacks in such a manner that the flow rate in the individual stacks cannot be correlated with unit load), the owner or operator may petition the Administrator under §75.66 for an exemption from the requirements of section 7.7 of this appendix and section 2.2.5 fo appendix B to this part. The petition must include sufficient information and data to demonstrate that a flow-to-load or gross heat rate evaluation is infeasible for the complex stack configuration.

(b) Units that do not produce electrical output (in megawatts) or thermal output (in klb of steam per hour) are exempted from the flow-to-load ratio test requirements of section 7.7 of this appendix and section 2.2.5 of appendix B to this part.

FIGURE 1 TO APPENDIX A—LINEARITY ERROR DETERMINATION

Day	Date and time	Reference value	Monitor value	Difference	Percent of reference value
Low-level:					
Mid-level:					
High-level:					

FIGURE 1 TO APPENDIX A—LINEARITY ERROR DETERMINATION—Continued

Day	Date and time	Reference value	Monitor value	Difference	Percent of reference value

FIGURE 2 TO APPENDIX A—RELATIVE ACCURACY DETERMINATION (POLLUTANT CONCENTRATION MONITORS)

Run No.	Date and time	SO_2 (ppm [c])			Date and time	CO_2 (Pollutant) (ppm [c])		
		RM [a]	M [b]	Diff		RM [a]	M [b]	Diff
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
Arithmetic Mean Difference (Eq. A–7). Confidence Coefficient (Eq. A–9). Relative Accuracy (Eq. A–10).								

[a] RM means "reference method data."
[b] M means "monitor data."
[c] Make sure the RM and M data are on a consistent basis, either wet or dry.

FIGURE 3 TO APPENDIX A—RELATIVE ACCURACY DETERMINATION (FLOW MONITORS)

Run No.	Date and time	Flow rate (Low) (scf/hr)*			Date and time	Flow rate (Normal) (scf/hr)*			Date and time	Flow rate (High) (scf/hr)*		
		RM	M	Diff		RM	M	Diff		RM	M	Diff
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11.												

FIGURE 3 TO APPENDIX A—RELATIVE ACCURACY DETERMINATION (FLOW MONITORS)—Continued

Run No.	Date and time	Flow rate (Low) (scf/hr)*			Date and time	Flow rate (Normal) (scf/hr)*			Date and time	Flow rate (High) (scf/hr)*		
		RM	M	Diff		RM	M	Diff		RM	M	Diff
12.												
Arithmetic Mean Difference (Eq. A–7). Confidence Coefficient (Eq. A–9). Relative Accuracy (Eq. A–10).												

*Make sure the RM and M data are on a consistent basis, either wet or dry.

FIGURE 4 TO APPENDIX A—RELATIVE ACCURACY DETERMINATION (NO_X/DILUENT COMBINED SYSTEM)

Run No.	Date and time	Reference method data		NO_X system (lb/mmBtu)		
		NO_X( )[a]	O_2/CO_2%	RM	M	Difference
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
Arithmetic Mean Difference (Eq. A–7). Confidence Coefficient (Eq. A–9). Relative Accuracy (Eq. A–10).						

[a] Specify units: ppm, lb/dscf, mg/dscm.

FIGURE 5—CYCLE TIME

Date of test _____
Component/system ID#: _____
Analyzer type _____
Serial Number _____
High level gas concentration: _____ ppm/% (circle one)
Zero level gas concentration: _____ ppm/% (circle one)
Analyzer span setting: _____ ppm/% (circle one)
Upscale:
Stable starting monitor value: _____ ppm/% (circle one)
Stable ending monitor reading: _____ ppm/% (circle one)
Elapsed time: _____ seconds
Downscale:
Stable starting monitor value: _____ ppm/% (circle one)
Stable ending monitor value: _____ ppm/% (circle one)
Elapsed time: _____ seconds
Component cycle time= _____ seconds
System cycle time= _____ seconds

Figure 6a. Upscale Cycle Time Test

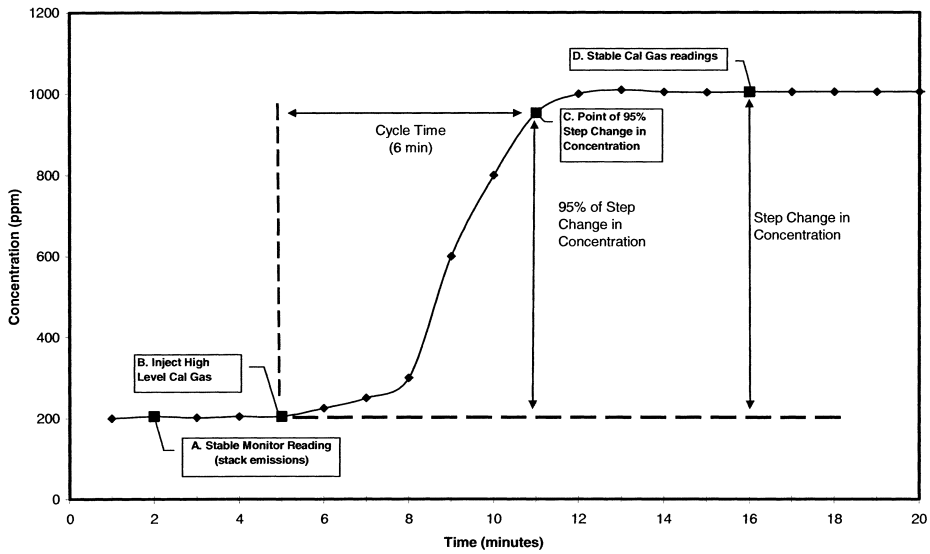
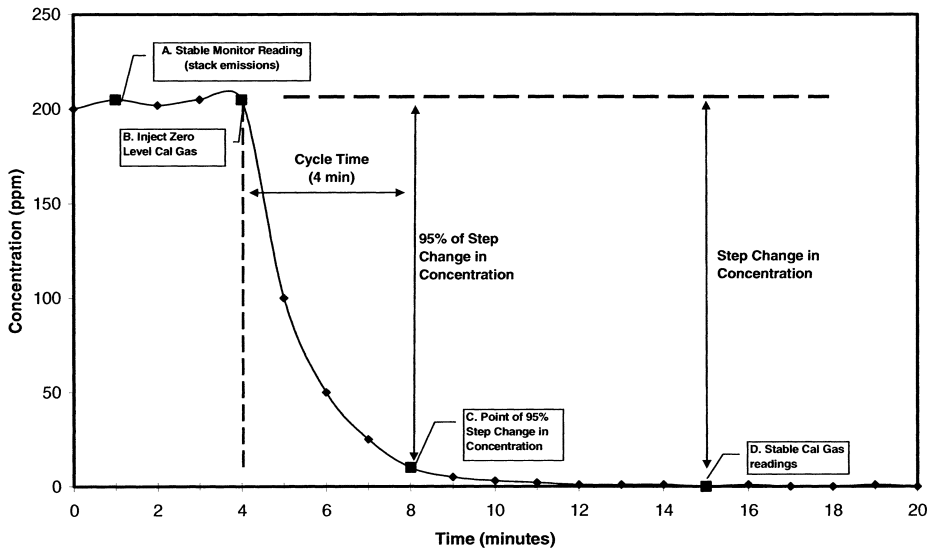


Figure 6b. Downscale Cycle Time Test



A. To determine the upscale cycle time (Figure 6a), measure the flue gas emissions until the response stabilizes. Record the stabilized value (see section 6.4 of this appendix for the stability criteria).

B. Inject a high-level calibration gas into the port leading to the calibration cell or thimble (Point B). Allow the analyzer to stabilize. Record the stabilized value.

C. Determine the step change. The step change is equal to the difference between the

final stable calibration gas value (Point D) and the stabilized stack emissions value (Point A).

D. Take 95% of the step change value and add the result to the stabilized stack emissions value (Point A). Determine the time at which 95% of the step change occurred (Point C).

E. Calculate the upscale cycle time by subtracting the time at which the calibration gas was injected (Point B) from the time at which 95% of the step change occurred (Point C). In this example, upscale cycle time = (11 − 5) = 6 minutes.

F. To determine the downscale cycle time (Figure 6b) repeat the procedures above, except that a zero gas is injected when the flue gas emissions have stabilized, and 95% of the step change in concentration is subtracted from the stabilized stack emissions value.

G. Compare the upscale and downscale cycle time values. The longer of these two times is the cycle time for the analyzer.

[58 FR 3701, Jan. 11, 1993, as amended at 60 FR 26541–26546, 26569–26570, May 17, 1995; 61 FR 25582, May 22, 1996; 61 FR 59162, Nov. 20, 1996; 63 FR 57512, Oct. 27, 1998; 64 FR 28631–28643, May 26, 1999; 64 FR 37582, July 12, 1999; 67 FR 40448, 40449, 40452, 40453, 40455, June 12, 2002; 67 FR 53505, Aug. 16, 2002; 70 FR 28690, May 18, 2005; 72 FR 51528, Sept. 7, 2007; 73 FR 4363, Jan. 24, 2008]

APPENDIX B TO PART 75—QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

1. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Develop and implement a quality assurance/quality control (QA/QC) program for the continuous emission monitoring systems, excepted monitoring systems approved under appendix D or E to this part, and alternative monitoring systems under subpart E of this part, and their components. At a minimum, include in each QA/QC program a written plan that describes in detail (or that refers to separate documents containing) complete, step-by-step procedures and operations for each of the following activities. Upon request from regulatory authorities, the source shall make all procedures, maintenance records, and ancillary supporting documentation from the manufacturer (e.g., software coefficients and troubleshooting diagrams) available for review during an audit. Electronic storage of the information in the QA/QC plan is permissible, provided that the information can be made available in hardcopy upon request during an audit.

1.1 Requirements for All Monitoring Systems

1.1.1 Preventive Maintenance

Keep a written record of procedures needed to maintain the monitoring system in proper operating condition and a schedule for those procedures. This shall, at a minimum, include procedures specified by the manufacturers of the equipment and, if applicable, additional or alternate procedures developed for the equipment.

1.1.2 Recordkeeping and Reporting

Keep a written record describing procedures that will be used to implement the recordkeeping and reporting requirements in subparts E, F, and G and appendices D and E to this part, as applicable.

1.1.3 Maintenance Records

Keep a record of all testing, maintenance, or repair activities performed on any monitoring system or component in a location and format suitable for inspection. A maintenance log may be used for this purpose. The following records should be maintained: date, time, and description of any testing, adjustment, repair, replacement, or preventive maintenance action performed on any monitoring system and records of any corrective actions associated with a monitor's outage period. Additionally, any adjustment that recharacterizes a system's ability to record and report emissions data must be recorded (e.g., changing of flow monitor or moisture monitoring system polynomial coefficients, K factors or mathematical algorithms, changing of temperature and pressure coefficients and dilution ratio settings), and a written explanation of the procedures used to make the adjustment(s) shall be kept.

1.1.4 The requirements in section 6.1.2 of appendix A to this part shall be met by any Air Emissions Testing Body (AETB) performing the semiannual/annual RATAs described in section 2.3 of this appendix and the Hg emission tests described in §§75.81(c) and 75.81(d)(4).

1.2 Specific Requirements for Continuous Emissions Monitoring Systems

1.2.1 Calibration Error Test and Linearity Check Procedures

Keep a written record of the procedures used for daily calibration error tests and linearity checks (e.g., how gases are to be injected, adjustments of flow rates and pressure, introduction of reference values, length of time for injection of calibration gases, steps for obtaining calibration error or error in linearity, determination of interferences, and when calibration adjustments should be made). Identify any calibration error test

and linearity check procedures specific to the continuous emission monitoring system that vary from the procedures in appendix A to this part.

1.2.2 Calibration and Linearity Adjustments

Explain how each component of the continuous emission monitoring system will be adjusted to provide correct responses to calibration gases, reference values, and/or indications of interference both initially and after repairs or corrective action. Identify equations, conversion factors and other factors affecting calibration of each continuous emission monitoring system.

1.2.3 Relative Accuracy Test Audit Procedures

Keep a written record of procedures and details peculiar to the installed continuous emission monitoring systems that are to be used for relative accuracy test audits, such as sampling and analysis methods.

1.2.4 Parametric Monitoring for Units With Add-on Emission Controls

The owner or operator shall keep a written (or electronic) record including a list of operating parameters for the add-on SO_2 or NO_X emission controls, including parameters in §75.55(b) or §75.58(b), as applicable, and the range of each operating parameter that indicates the add-on emission controls are operating properly. The owner or operator shall keep a written (or electronic) record of the parametric monitoring data during each SO_2 or NO_X missing data period.

1.3 Specific Requirements for Excepted Systems Approved Under Appendices D and E

1.3.1 Fuel Flowmeter Accuracy Test Procedures

Keep a written record of the specific fuel flowmeter accuracy test procedures. These may include: standard methods or specifications listed in and of appendix D to this part and incorporated by reference under §75.6; the procedures of sections 2.1.5.2 or 2.1.7 of appendix D to this part; or other methods approved by the Administrator through the petition process of §75.66(c).

1.3.2 Transducer or Transmitter Accuracy Test Procedures

Keep a written record of the procedures for testing the accuracy of transducers or transmitters of an orifice-, nozzle-, or venturi-type fuel flowmeter under section 2.1.6 of appendix D to this part. These procedures should include a description of equipment used, steps in testing, and frequency of testing.

1.3.3 Fuel Flowmeter, Transducer, or Transmitter Calibration and Maintenance Records

Keep a record of adjustments, maintenance, or repairs performed on the fuel flowmeter monitoring system. Keep records of the data and results for fuel flowmeter accuracy tests and transducer accuracy tests, consistent with appendix D to this part.

1.3.4 Primary Element Inspection Procedures

Keep a written record of the standard operating procedures for inspection of the primary element (i.e., orifice, venturi, or nozzle) of an orifice-, venturi-, or nozzle-type fuel flowmeter. Examples of the types of information to be included are: what to examine on the primary element; how to identify if there is corrosion sufficient to affect the accuracy of the primary element; and what inspection tools (e.g., baroscope), if any, are used.

1.3.5 Fuel Sampling Method and Sample Retention

Keep a written record of the standard procedures used to perform fuel sampling, either by utility personnel or by fuel supply company personnel. These procedures should specify the portion of the ASTM method used, as incorporated by reference under §75.6, or other methods approved by the Administrator through the petition process of §75.66(c). These procedures should describe safeguards for ensuring the availability of an oil sample (e.g., procedure and location for splitting samples, procedure for maintaining sample splits on site, and procedure for transmitting samples to an analytical laboratory). These procedures should identify the ASTM analytical methods used to analyze sulfur content, gross calorific value, and density, as incorporated by reference under §75.6, or other methods approved by the Administrator through the petition process of §75.66(c).

1.3.6 Appendix E Monitoring System Quality Assurance Information

Identify the recommended range of quality assurance- and quality control-related operating parameters. Keep records of these operating parameters for each hour of unit operation (i.e., fuel combustion). Keep a written record of the procedures used to perform NO_X emission rate testing. Keep a copy of all data and results from the initial and from the most recent NO_X emission rate testing, including the values of quality assurance parameters specified in section 2.3 of appendix E to this part.

1.4 Requirements for Alternative Systems Approved Under Subpart E

1.4.1 Daily Quality Assurance Tests

Explain how the daily assessment procedures specific to the alternative monitoring system are to be performed.

1.4.2 Daily Quality Assurance Test Adjustments

Explain how each component of the alternative monitoring system will be adjusted in response to the results of the daily assessments.

1.4.3 Relative Accuracy Test Audit Procedures

Keep a written record of procedures and details peculiar to the installed alternative monitoring system that are to be used for relative accuracy test audits, such as sampling and analysis methods.

1.5 Requirements for Sorbent Trap Monitoring Systems

1.5.1 Sorbent Trap Identification and Tracking

Include procedures for inscribing or otherwise permanently marking a unique identification number on each sorbent trap, for tracking purposes. Keep records of the ID of the monitoring system in which each sorbent trap is used, and the dates and hours of each Hg collection period.

1.5.2 Monitoring System Integrity and Data Quality

Explain the procedures used to perform the leak checks when sorbent traps are placed in service and removed from service. Also explain the other QA procedures used to ensure system integrity and data quality, including, but not limited to, gas flow meter calibrations, verification of moisture removal, and ensuring air-tight pump operation. In addition, the QA plan must include the data acceptance and quality control criteria in section 8 of appendix K to this part. All reference meters used to calibrate the gas flow meters (e.g., wet test meters) shall be periodically recalibrated. Annual, or more frequent, recalibration is recommended. If a NIST–traceable calibration device is used as a reference flow meter, the QA plan must include a protocol for ongoing maintenance and periodic recalibration to maintain the accuracy and NIST–traceability of the calibrator.

1.5.3 Hg Analysis

Explain the chain of custody employed in packing, transporting, and analyzing the sorbent traps (see sections 7.2.8 and 7.2.9 in appendix K to this part). Keep records of all Hg analyses. The analyses shall be performed in accordance with the procedures described in section 10 of appendix K to this part.

1.5.4 Laboratory Certification

The QA Plan shall include documentation that the laboratory performing the analyses on the carbon sorbent traps is certified by the International Organization for Standardization (ISO) to have a proficiency that meets the requirements of ISO 17025. Alternatively, if the laboratory performs the spike recovery study described in section 10.3 of appendix K to this part and repeats that procedure annually, ISO certification is not required.

1.5.5 Data Collection Period

State, and provide the rationale for, the minimum acceptable data collection period (*e.g.*, one day, one week, etc.) for the size of sorbent trap selected for the monitoring. Include in the discussion such factors as the Hg concentration in the stack gas, the capacity of the sorbent trap, and the minimum mass of Hg required for the analysis.

1.5.6 Relative Accuracy Test Audit Procedures

Keep records of the procedures and details peculiar to the sorbent trap monitoring systems that are to be followed for relative accuracy test audits, such as sampling and analysis methods.

2. FREQUENCY OF TESTING

A summary chart showing each quality assurance test and the frequency at which each test is required is located at the end of this appendix in Figure 1.

2.1 Daily Assessments

Perform the following daily assessments to quality-assure the hourly data recorded by the monitoring systems during each period of unit operation, or, for a bypass stack or duct, each period in which emissions pass through the bypass stack or duct. These requirements are effective as of the date when the monitor or continuous emission monitoring system completes certification testing.

2.1.1 Calibration Error Test

Except as provided in section 2.1.1.2 of this appendix, perform the daily calibration error test of each gas monitoring system (including moisture monitoring systems consisting of wet- and dry-basis O_2 analyzers) according to the procedures in section 6.3.1 of appendix A to this part, and perform the daily calibration error test of each flow monitoring system according to the procedure in section 6.3.2 of appendix A to this part. When two measurement ranges (low and high) are required for a particular parameter, perform

sufficient calibration error tests on each range to validate the data recorded on that range, according to the criteria in section 2.1.5 of this appendix.

2.1.1.1 On-line Daily Calibration Error Tests. Except as provided in section 2.1.1.2 of this appendix, all daily calibration error tests must be performed while the unit is in operation at normal, stable conditions (i.e. ''on-line'').

2.1.1.2 Off-line Daily Calibration Error Tests. Daily calibrations may be performed while the unit is not operating (i.e., ''off-line'') and may be used to validate data for a monitoring system that meets the following conditions:

(1) An initial demonstration test of the monitoring system is successfully completed and the results are reported in the quarterly report required under §75.64 of this part. The initial demonstration test, hereafter called the ''off-line calibration demonstration'', consists of an off-line calibration error test followed by an on-line calibration error test. Both the off-line and on-line portions of the off-line calibration demonstration must meet the calibration error performance specification in section 3.1 of appendix A of this part. Upon completion of the off-line portion of the demonstration, the zero and upscale monitor responses may be adjusted, but only toward the true values of the calibration gases or reference signals used to perform the test and only in accordance with the routine calibration adjustment procedures specified in the quality control program required under section 1 of appendix B to this part. Once these adjustments are made, no further adjustments may be made to the monitoring system until after completion of the on-line portion of the off-line calibration demonstration. Within 26 clock hours of the completion hour of the off-line portion of the demonstration, the monitoring system must successfully complete the first attempted calibration error test, i.e., the on-line portion of the demonstration.

(2) For each monitoring system that has passed the off-line calibration demonstration, off-line calibration error tests may be used on a limited basis to validate data, in accordance with paragraph (2) in section 2.1.5.1 of this appendix.

2.1.2 Daily Flow Interference Check

Perform the daily flow monitor interference checks specified in section 2.2.2.2 of appendix A of this part while the unit is in operation at normal, stable conditions.

2.1.3 Additional Calibration Error Tests and Calibration Adjustments

(a) In addition to the daily calibration error tests required under section 2.1.1 of this appendix, a calibration error test of a monitor shall be performed in accordance with section 2.1.1 of this appendix, as follows: whenever a daily calibration error test is failed; whenever a monitoring system is returned to service following repair or corrective maintenance that could affect the monitor's ability to accurately measure and record emissions data; or after making certain calibration adjustments, as described in this section. Except in the case of the routine calibration adjustments described in this section, data from the monitor are considered invalid until the required additional calibration error test has been successfully completed.

(b) Routine calibration adjustments of a monitor are permitted after any successful calibration error test. These routine adjustments shall be made so as to bring the monitor readings as close as practicable to the known tag values of the calibration gases or to the actual value of the flow monitor reference signals. An additional calibration error test is required following routine calibration adjustments where the monitor's calibration has been physically adjusted (e.g., by turning a potentiometer) to verify that the adjustments have been made properly. An additional calibration error test is not required, however, if the routine calibration adjustments are made by means of a mathematical algorithm programmed into the data acquisition and handling system. The EPA recommends that routine calibration adjustments be made, at a minimum, whenever the daily calibration error exceeds the limits of the applicable performance specification in appendix A to this part for the pollutant concentration monitor, CO_2 or O_2 monitor, or flow monitor.

(c) Additional (non-routine) calibration adjustments of a monitor are permitted prior to (but not during) linearity checks and RATAs and at other times, provided that an appropriate technical justification is included in the quality control program required under section 1 of this appendix. The allowable non-routine adjustments are as follows. The owner or operator may physically adjust the calibration of a monitor (e.g., by means of a potentiometer), provided that the post-adjustment zero and upscale responses of the monitor are within the performance specifications of the instrument given in section 3.1 of appendix A to this part. An additional calibration error test is required following such adjustments to verify that the monitor is operating within the performance specifications at both the zero and upscale calibration levels.

2.1.4 Data Validation

(a) An out-of-control period occurs when the calibration error of an SO_2 or NO_X pollutant concentration monitor exceeds 5.0 percent of the span value, when the calibration error of a CO_2 or O_2 monitor (including O_2

monitors used to measure CO_2 emissions or percent moisture) exceeds 1.0 percent CO_2 or O_2, or when the calibration error of a flow monitor or a moisture sensor exceeds 6.0 percent of the span value, which is twice the applicable specification of appendix A to this part. Notwithstanding, a differential pressure-type flow monitor for which the calibration error exceeds 6.0 percent of the span value shall not be considered out-of-control if |R–A|, the absolute value of the difference between the monitor response and the reference value in Equation A–6 of appendix A to this part, is < 0.02 inches of water. In addition, an SO_2 or NO_X monitor for which the calibration error exceeds 5.0 percent of the span value shall not be considered out-of-control if |RA| in Equation A–6 does not exceed 5.0 ppm (for span values ≤ 50 ppm), or if |R–A| does not exceed 10.0 ppm (for span values > 50 ppm, but ≤ 200 ppm). For a Hg monitor, an out-of-control period occurs when the calibration error exceeds 5.0% of the span value. Notwithstanding, the Hg monitor shall not be considered out-of-control if |R–A| in Equation A–6 does not exceed 1.0 μgm/scm. The out-of-control period begins upon failure of the calibration error test and ends upon completion of a successful calibration error test. Note, that if a failed calibration, corrective action, and successful calibration error test occur within the same hour, emission data for that hour recorded by the monitor after the successful calibration error test may be used for reporting purposes, provided that two or more valid readings are obtained as required by §75.10. A NO_X-diluent CEMS is considered out-of-control if the calibration error of either component monitor exceeds twice the applicable performance specification in appendix A to this part. Emission data shall not be reported from an out-of-control monitor.

(b) An out-of-control period also occurs whenever interference of a flow monitor is identified. The out-of-control period begins with the hour of completion of the failed interference check and ends with the hour of completion of an interference check that is passed.

2.1.5 Quality Assurance of Data With Respect to Daily Assessments

When a monitoring system passes a daily assessment (i.e., daily calibration error test or daily flow interference check), data from that monitoring system are prospectively validated for 26 clock hours (i.e., 24 hours plus a 2-hour grace period) beginning with the hour in which the test is passed, unless another assessment (i.e. a daily calibration error test, an interference check of a flow monitor, a quarterly linearity check, a quarterly leak check, or a relative accuracy test audit) is failed within the 26-hour period.

2.1.5.1 Data Invalidation with Respect to Daily Assessments. The following specific rules apply to the invalidation of data with respect to daily assessments:

(1) Data from a monitoring system are invalid, beginning with the first hour following the expiration of a 26-hour data validation period or beginning with the first hour following the expiration of an 8-hour start-up grace period (as provided under section 2.1.5.2 of this appendix), if the required subsequent daily assessment has not been conducted.

(2) For a monitor that has passed the off-line calibration demonstration, a combination of on-line and off-line calibration error tests may be used to validate data from the monitor, as follows. For a particular unit (or stack) operating hour, data from a monitor may be validated using a successful off-line calibration error test if: (a) An on-line calibration error test has been passed within the previous 26 unit (or stack) operating hours; and (b) the 26 clock hour data validation window for the off-line calibration error test has not expired. If either of these conditions is not met, then the data from the monitor are invalid with respect to the daily calibration error test requirement. Data from the monitor shall remain invalid until the appropriate on-line or off-line calibration error test is successfully completed so that both conditions (a) and (b) are met.

(3) For units with two measurement ranges (low and high) for a particular parameter, when separate analyzers are used for the low and high ranges, a failed or expired calibration on one of the ranges does not affect the quality-assured data status on the other range. For a dual-range analyzer (i.e., a single analyzer with two measurement scales), a failed calibration error test on either the low or high scale results in an out-of-control period for the monitor. Data from the monitor remain invalid until corrective actions are taken and ''hands-off'' calibration error tests have been passed on both ranges. However, if the most recent calibration error test on the high scale was passed but has expired, while the low scale is up-to-date on its calibration error test requirements (or vice-versa), the expired calibration error test does not affect the quality-assured status of the data recorded on the other scale.

2.1.5.2 Daily Assessment Start-Up Grace Period. For the purpose of quality assuring data with respect to a daily assessment (i.e. a daily calibration error test or a flow interference check), a start-up grace period may apply when a unit begins to operate after a period of non-operation. The start-up grace period for a daily calibration error test is independent of the start-up grace period for a daily flow interference check. To qualify for a start-up grace period for a daily assessment, there are two requirements:

(1) The unit must have resumed operation after being in outage for 1 or more hours

(i.e., the unit must be in a start-up condition) as evidenced by a change in unit operating time from zero in one clock hour to an operating time greater than zero in the next clock hour.

(2) For the monitoring system to be used to validate data during the grace period, the previous daily assessment of the same kind must have been passed on-line within 26 clock hours prior to the last hour in which the unit operated before the outage. In addition, the monitoring system must be in-control with respect to quarterly and semi-annual or annual assessments.

If both of the above conditions are met, then a start-up grace period of up to 8 clock hours applies, beginning with the first hour of unit operation following the outage. During the start-up grace period, data generated by the monitoring system are considered quality-assured. For each monitoring system, a start-up grace period for a calibration error test or flow interference check ends when either: (1) a daily assessment of the same kind (i.e., calibration error test or flow interference check) is performed; or (2) 8 clock hours have elapsed (starting with the first hour of unit operation following the outage), whichever occurs first.

2.1.6 Data Recording

Record and tabulate all calibration error test data according to month, day, clock-hour, and magnitude in either ppm, percent volume, or scfh. Program monitors that automatically adjust data to the corrected calibration values (e.g., microprocessor control) to record either: (1) The unadjusted concentration or flow rate measured in the calibration error test prior to resetting the calibration, or (2) the magnitude of any adjustment. Record the following applicable flow monitor interference check data: (1) Sample line/sensing port pluggage, and (2) malfunction of each RTD, transceiver, or equivalent.

2.2 Quarterly Assessments

For each primary and redundant backup monitor or monitoring system, perform the following quarterly assessments. This requirement is applies as of the calendar quarter following the calendar quarter in which the monitor or continuous emission monitoring system is provisionally certified.

2.2.1 Linearity Check

Unless a particular monitor (or monitoring range) is exempted under this paragraph or under section 6.2 of appendix A to this part, perform a linearity check, in accordance with the procedures in section 6.2 of appendix A to this part, for each primary and redundant backup SO_2, Hg, and NO_X pollutant concentration monitor and each primary and redundant backup CO_2 or O_2 monitor (including O_2 monitors used to measure CO_2 emissions or to continuously monitor moisture) at least once during each QA operating quarter, as defined in §72.2 of this chapter. For Hg monitors, perform the linearity checks using elemental Hg standards. Alternatively, you may perform 3-level system integrity checks at the same three calibration gas levels (*i.e.*, low, mid, and high), using a NIST-traceable source of oxidized Hg. If you choose this option, the performance specification in section 3.2(c)(3) of appendix A to this part must be met at each gas level. For units using both a low and high span value, a linearity check is required only on the range(s) used to record and report emission data during the QA operating quarter. Conduct the linearity checks no less than 30 days apart, to the extent practicable. The data validation procedures in section 2.2.3(e) of this appendix shall be followed.

2.2.2 Leak Check

For differential pressure flow monitors, perform a leak check of all sample lines (a manual check is acceptable) at least once during each QA operating quarter. For this test, the unit does not have to be in operation. Conduct the leak checks no less than 30 days apart, to the extent practicable. If a leak check is failed, follow the applicable data validation procedures in section 2.2.3(g) of this appendix.

2.2.3 Data Validation

(a) A linearity check shall not be commenced if the monitoring system is operating out-of-control with respect to any of the daily or semiannual quality assurance assessments required by sections 2.1 and 2.3 of this appendix or with respect to the additional calibration error test requirements in section 2.1.3 of this appendix.

(b) Each required linearity check shall be done according to paragraph (b)(1), (b)(2) or (b)(3) of this section:

(1) The linearity check may be done ''cold,'' i.e., with no corrective maintenance, repair, calibration adjustments, re-linearization or reprogramming of the monitor prior to the test.

(2) The linearity check may be done after performing only the routine or non-routine calibration adjustments described in section 2.1.3 of this appendix at the various calibration gas levels (zero, low, mid or high), but no other corrective maintenance, repair, re-linearization or reprogramming of the monitor. Trial gas injection runs may be performed after the calibration adjustments and additional adjustments within the allowable limits in section 2.1.3 of this appendix may be made prior to the linearity check, as necessary, to optimize the performance of the monitor. The trial gas injections need not be

reported, provided that they meet the specification for trial gas injections in §75.20(b)(3)(vii)(E)(*1*). However, if, for any trial injection, the specification in §75.20(b)(3)(vii)(E)(*1*) is not met, the trial injection shall be counted as an aborted linearity check.

(3) The linearity check may be done after repair, corrective maintenance or reprogramming of the monitor. In this case, the monitor shall be considered out-of-control from the hour in which the repair, corrective maintenance or reprogramming is commenced until the linearity check has been passed. Alternatively, the data validation procedures and associated timelines in §§75.20(b)(3)(ii) through (ix) may be followed upon completion of the necessary repair, corrective maintenance, or reprogramming. If the procedures in §75.20(b)(3) are used, the words ''quality assurance'' apply instead of the word ''recertification''.

(c) Once a linearity check has been commenced, the test shall be done hands-off. That is, no adjustments of the monitor are permitted during the linearity test period, other than the routine calibration adjustments following daily calibration error tests, as described in section 2.1.3 of this appendix. If a routine daily calibration error test is performed and passed just prior to a linearity test (or during a linearity test period) and a mathematical correction factor is automatically applied by the DAHS, the correction factor shall be applied to all subsequent data recorded by the monitor, including the linearity test data.

(d) If a daily calibration error test is failed during a linearity test period, prior to completing the test, the linearity test must be repeated. Data from the monitor are invalidated prospectively from the hour of the failed calibration error test until the hour of completion of a subsequent successful calibration error test. The linearity test shall not be commenced until the monitor has successfully completed a calibration error test.

(e) An out-of-control period occurs when a linearity test is failed (i.e., when the error in linearity at any of the three concentrations in the quarterly linearity check (or any of the six concentrations, when both ranges of a single analyzer with a dual range are tested) exceeds the applicable specification in section 3.2 of appendix A to this part) or when a linearity test is aborted due to a problem with the monitor or monitoring system. For a NO_X-diluent continuous emission monitoring system, the system is considered out-of-control if either of the component monitors exceeds the applicable specification in section 3.2 of appendix A to this part or if the linearity test of either component is aborted due to a problem with the monitor. The out-of-control period begins with the hour of the failed or aborted linearity check and ends with the hour of completion of a satisfactory linearity check following corrective action and/or monitor repair, unless the option in paragraph (b)(3) of this section to use the data validation procedures and associated timelines in §75.20(b)(3)(ii) through (ix) has been selected, in which case the beginning and end of the out-of-control period shall be determined in accordance with §§75.20(b)(3)(vii)(A) and (B). For a dual-range analyzer, ''hands-off'' linearity checks must be passed on both measurement scales to end the out-of-control period. Note that a monitor shall not be considered out-of-control when a linearity test is aborted for a reason unrelated to the monitor's performance (e.g., a forced unit outage).

(f) No more than four successive calendar quarters shall elapse after the quarter in which a linearity check of a monitor or monitoring system (or range of a monitor or monitoring system) was last performed without a subsequent linearity test having been conducted. If a linearity test has not been completed by the end of the fourth calendar quarter since the last linearity test, then the linearity test must be completed within a 168 unit operating hour or stack operating hour ''grace period'' (as provided in section 2.2.4 of this appendix) following the end of the fourth successive elapsed calendar quarter, or data from the CEMS (or range) will become invalid.

(g) An out-of-control period also occurs when a flow monitor sample line leak is detected. The out-of-control period begins with the hour of the failed leak check and ends with the hour of a satisfactory leak check following corrective action.

(h) For each monitoring system, report the results of all completed and partial linearity tests that affect data validation (i.e., all completed, passed linearity checks; all completed, failed linearity checks; and all linearity checks aborted due to a problem with the monitor, including trial gas injections counted as failed test attempts under paragraph (b)(2) of this section or under §75.20(b)(3)(vii)(F)), in the quarterly report required under §75.64. Note that linearity attempts which are aborted or invalidated due to problems with the reference calibration gases or due to operational problems with the affected unit(s) need not be reported. Such partial tests do not affect the validation status of emission data recorded by the monitor. A record of all linearity tests, trial gas injections and test attempts (whether reported or not) must be kept on-site as part of the official test log for each monitoring system.

2.2.4 Linearity and Leak Check Grace Period

(a) When a required linearity test or flow monitor leak check has not been completed by the end of the QA operating quarter in

which it is due or if, due to infrequent operation of a unit or infrequent use of a required high range of a monitor or monitoring system, four successive calendar quarters have elapsed after the quarter in which a linearity check of a monitor or monitoring system (or range) was last performed without a subsequent linearity test having been done, the owner or operator has a grace period of 168 consecutive unit operating hours, as defined in §72.2 of this chapter (or, for monitors installed on common stacks or bypass stacks, 168 consecutive stack operating hours, as defined in §72.2 of this chapter) in which to perform a linearity test or leak check of that monitor or monitoring system (or range). The grace period begins with the first unit or stack operating hour following the calendar quarter in which the linearity test was due. Data validation during a linearity or leak check grace period shall be done in accordance with the applicable provisions in section 2.2.3 of this appendix.

(b) If, at the end of the 168 unit (or stack) operating hour grace period, the required linearity test or leak check has not been completed, data from the monitoring system (or range) shall be invalid, beginning with the first unit operating hour following the expiration of the grace period. Data from the monitoring system (or range) remain invalid until the hour of completion of a subsequent successful hands-off linearity test or leak check of the monitor or monitoring system (or range). Note that when a linearity test or a leak check is conducted within a grace period for the purpose of satisfying the linearity test or leak check requirement from a previous QA operating quarter, the results of that linearity test or leak check may only be used to meet the linearity check or leak check requirement of the previous quarter, not the quarter in which the missed linearity test or leak check is completed.

2.2.5 Flow-to-Load Ratio or Gross Heat Rate Evaluation

(a) *Applicability and methodology*. Unless exempted from the flow-to-load ratio test under section 7.8 of appendix A to this part, the owner or operator shall, for each flow rate monitoring system installed on each unit, common stack or multiple stack, evaluate the flow-to-load ratio quarterly, i.e., for each QA operating quarter (as defined in §72.2 of this chapter). At the end of each QA operating quarter, the owner or operator shall use Equation B–1 to calculate the flow-to-load ratio for every hour during the quarter in which: the unit (or combination of units, for a common stack) operated within ±10.0 percent of L_{avg}, the average load during the most recent normal-load flow RATA; and a quality-assured hourly average flow rate was obtained with a certified flow rate monitor. Alternatively, for the reasons stated in paragraphs (c)(1) through (c)(6) of this section, the owner or operator may exclude from the data analysis certain hours within ±10.0 percent of L_{avg} and may calculate R_h values for only the remaining hours.

$$R_h = \frac{Q_h}{L_h} \times 10^{-5} \qquad \text{(Eq. B-1)}$$

Where:

R_h = Hourly value of the flow-to-load ratio, scfh/megawatts, scfh/1000 lb/hr of steam, or scfh/(mmBtu/hr thermal output).

Q_h = Hourly stack gas volumetric flow rate, as measured by the flow rate monitor, scfh.

L_h = Hourly unit load, megawatts, 1000 lb/hr of steam, or mmBtu/hr thermal output; must be within + 10.0 percent of L_{avg} during the most recent normal-load flow RATA.

(1) In Equation B–1, the owner or operator may use either bias-adjusted flow rates or unadjusted flow rates, provided that all of the ratios are calculated the same way. For a common stack, L_h shall be the sum of the hourly operating loads of all units that discharge through the stack. For a unit that discharges its emissions through multiple stacks or that monitors its emissions in multiple breechings, Q_h will be either the combined hourly volumetric flow rate for all of the stacks or ducts (if the test is done on a unit basis) or the hourly flow rate through each stack individually (if the test is performed separately for each stack). For a unit with a multiple stack discharge configuration consisting of a main stack and a bypass stack, each of which has a certified flow monitor (e.g., a unit with a wet SO_2 scrubber), calculate the hourly flow-to-load ratios separately for each stack. Round off each value of R_h to two decimal places.

(2) Alternatively, the owner or operator may calculate the hourly gross heat rates (GHR) in lieu of the hourly flow-to-load ratios. The hourly GHR shall be determined only for those hours in which quality-assured flow rate data and diluent gas (CO_2 or O_2) concentration data are both available

from a certified monitor or monitoring system or reference method. If this option is selected, calculate each hourly GHR value as follows:

$$(GHR)_h = \frac{(\text{Heat Input})_h}{L_h} \times 1000 \qquad \text{(Eq. B-1a)}$$

where:

$(GHR)_h$ = Hourly value of the gross heat rate, Btu/kwh, Btu/lb steam load, or 1000 mmBtu heat input/mmBtu thermal output.

$(\text{Heat Input})_h$ = Hourly heat input, as determined from the quality-assured flow rate and diluent data, using the applicable equation in appendix F to this part, mmBtu/hr.

L_h = Hourly unit load, megawatts, 1000 lb/hr of steam, or mmBtu/hr thermal output; must be within + 10.0 percent of L_{avg} during the most recent normal-load flow RATA.

(3) In Equation B–1a, the owner or operator may either use bias-adjusted flow rates or unadjusted flow rates in the calculation of $(\text{Heat Input})_h$, provided that all of the heat input rate values are determined in the same manner.

(4) The owner or operator shall evaluate the calculated hourly flow-to-load ratios (or gross heat rates) as follows. A separate data analysis shall be performed for each primary and each redundant backup flow rate monitor used to record and report data during the quarter. Each analysis shall be based on a minimum of 168 acceptable recorded hourly average flow rates (i.e., at loads within ±10 percent of L_{avg}). When two RATA load levels are designated as normal, the analysis shall be performed at the higher load level, unless there are fewer than 168 acceptable data points available at that load level, in which case the analysis shall be performed at the lower load level. If, for a particular flow monitor, fewer than 168 acceptable hourly flow-to-load ratios (or GHR values) are available at any of the load levels designated as normal, a flow-to-load (or GHR) evaluation is not required for that monitor for that calendar quarter.

(5) For each flow monitor, use Equation B–2 in this appendix to calculate E_h, the absolute percentage difference between each hourly R_h value and R_{ref}, the reference value of the flow-to-load ratio, as determined in accordance with section 7.7 of appendix A to this part. Note that R_{ref} shall always be based upon the most recent normal-load RATA, even if that RATA was performed in the calendar quarter being evaluated.

$$E_h = \frac{|R_{ref} - R_h|}{R_{ref}} \times 100 \qquad \text{(Eq. B-2)}$$

where:

E_h = Absolute percentage difference between the hourly average flow-to-load ratio and the reference value of the flow-to-load ratio at normal load.

R_h = The hourly average flow-to-load ratio, for each flow rate recorded at a load level within ±10.0 percent of L_{avg}.

R_{ref} = The reference value of the flow-to-load ratio from the most recent normal-load flow RATA, determined in accordance with section 7.7 of appendix A to this part.

(6) Equation B–2 shall be used in a consistent manner. That is, use R_{ref} and R_h if the flow-to-load ratio is being evaluated, and use $(GHR)_{ref}$ and $(GHR)_h$ if the gross heat rate is being evaluated. Finally, calculate E_f, the arithmetic average of all of the hourly E_h values. The owner or operator shall report the results of each quarterly flow-to-load (or gross heat rate) evaluation, as determined from Equation B–2, in the electronic quarterly report required under § 75.64.

(b) *Acceptable results.* The results of a quarterly flow-to-load (or gross heat rate) evaluation are acceptable, and no further action is required, if the calculated value of E_f is less than or equal to: (1) 15.0 percent, if L_{avg} for the most recent normal-load flow RATA is ≥60 megawatts (or ≥500 klb/hr of steam) and if unadjusted flow rates were used in the calculations; or (2) 10.0 percent, if L_{avg} for the most recent normal-load flow RATA is ≥60 megawatts (or ≥500 klb/hr of steam) and if bias-adjusted flow rates were used in the calculations; or (3) 20.0 percent, if L_{avg} for the most recent normal-load flow RATA is <60 megawatts (or <500 klb/hr of steam) and if unadjusted flow rates were used in the calculations; or (4) 15.0 percent, if L_{avg} for the

most recent normal-load flow RATA is <60 megawatts (or <500 klb/hr of steam) and if bias-adjusted flow rates were used in the calculations. If E_f is above these limits, the owner or operator shall either: implement Option 1 in section 2.2.5.1 of this appendix; or perform a RATA in accordance with Option 2 in section 2.2.5.2 of this appendix; or re-examine the hourly data used for the flow-to-load or GHR analysis and recalculate E_f, after excluding all non-representative hourly flow rates. If E_f is above these limits, the owner or operator shall either: implement Option 1 in section 2.2.5.1 of this appendix; perform a RATA in accordance with Option 2 in section 2.2.5.2 of this appendix; or (if applicable) re-examine the hourly data used for the flow-to-load or GHR analysis and recalculate E_f, after excluding all non-representative hourly flow rates, as provided in paragraph (c) of this section.

(c) *Recalculation of E_f.* If the owner or operator did not exclude any hours within ±10 percent of L_{avg} from the original data analysis and chooses to recalculate E_f, the flow rates for the following hours are considered non-representative and may be excluded from the data analysis:

(1) Any hour in which the type of fuel combusted was different from the fuel burned during the most recent normal-load RATA. For purposes of this determination, the type of fuel is different if the fuel is in a different state of matter (i.e., solid, liquid, or gas) than is the fuel burned during the RATA or if the fuel is a different classification of coal (e.g., bituminous versus sub-bituminous). Also, for units that co-fire different types of fuels, if the reference RATA was done while co-firing, then hours in which a single fuel was combusted may be excluded from the data analysis as different fuel hours (and vice-versa for co-fired hours, if the reference RATA was done while combusting only one type of fuel);

(2) For a unit that is equipped with an SO_2 scrubber and which always discharges its flue gases to the atmosphere through a single stack, any hour in which the SO_2 scrubber was bypassed;

(3) Any hour in which ''ramping'' occurred, i.e., the hourly load differed by more than ±15.0 percent from the load during the preceding hour or the subsequent hour;

(4) For a unit with a multiple stack discharge configuration consisting of a main stack and a bypass stack, any hour in which the flue gases were discharged through both stacks;

(5) If a normal-load flow RATA was performed and passed during the quarter being analyzed, any hour prior to completion of that RATA; and

(6) If a problem with the accuracy of the flow monitor was discovered during the quarter and was corrected (as evidenced by passing the abbreviated flow-to-load test in section 2.2.5.3 of this appendix), any hour prior to completion of the abbreviated flow-to-load test.

(7) After identifying and excluding all non-representative hourly data in accordance with paragraphs (c)(1) through (6) of this section, the owner or operator may analyze the remaining data a second time. At least 168 representative hourly ratios or GHR values must be available to perform the analysis; otherwise, the flow-to-load (or GHR) analysis is not required for that monitor for that calendar quarter.

(8) If, after re-analyzing the data, E_f meets the applicable limit in paragraph (b)(1), (b)(2), (b)(3), or (b)(4) of this section, no further action is required. If, however, E_f is still above the applicable limit, data from the monitor shall be declared out-of-control, beginning with the first unit operating hour following the quarter in which E_f exceeded the applicable limit. Alternatively, if a probationary calibration error test is performed and passed according to §75.20(b)(3)(ii), data from the monitor may be declared conditionally valid following the quarter in which E_f exceeded the applicable limit. The owner or operator shall then either implement Option 1 in section 2.2.5.1 of this appendix or Option 2 in section 2.2.5.2 of this appendix.

2.2.5.1 Option 1

Within 14 unit operating days of the end of the calendar quarter for which the E_f value is above the applicable limit, investigate and troubleshoot the applicable flow monitor(s). Evaluate the results of each investigation as follows:

(a) If the investigation fails to uncover a problem with the flow monitor, a RATA shall be performed in accordance with Option 2 in section 2.2.5.2 of this appendix.

(b) If a problem with the flow monitor is identified through the investigation (including the need to re-linearize the monitor by changing the polynomial coefficients or K factor(s)), data from the monitor are considered invalid back to the first unit operating hour after the end of the calendar quarter for which E_f was above the applicable limit. If the option to use conditional data validation was selected under section 2.2.5(c)(8) of this appendix, all conditionally valid data shall be invalidated, back to the first unit operating hour after the end of the calendar quarter for which E_f was above the applicable limit. Corrective actions shall be taken. All corrective actions (*e.g.*, non-routine maintenance, repairs, major component replacements, re-linearization of the monitor, etc.) shall be documented in the operation and maintenance records for the monitor. The owner or operator then shall either complete the abbreviated flow-to-load test in section 2.2.5.3 of this appendix, or, if the corrective action taken has required relinearization of the flow monitor, shall

perform a 3-load RATA. The conditional data validation procedures in §75.20(b)(3) may be applied to the 3-load RATA.

2.2.5.2 Option 2

Perform a single-load RATA (at a load designated as normal under section 6.5.2.1 of appendix A to this part) of each flow monitor for which E_f is outside of the applicable limit. If the RATA is passed hands-off, in accordance with section 2.3.2(c) of this appendix, no further action is required and the out-of-control period for the monitor ends at the date and hour of completion of a successful RATA, unless the option to use conditional data validation was selected under section 2.2.5(c)(8) of this appendix. In that case, all conditionally valid data from the monitor are considered to be quality-assured, back to the first unit operating hour following the end of the calendar quarter for which the E_f value was above the applicable limit. If the RATA is failed, all data from the monitor shall be invalidated, back to the first unit operating hour following the end of the calendar quarter for which the E_f value was above the applicable limit. Data from the monitor remain invalid until the required RATA has been passed. Alternatively, following a failed RATA and corrective actions, the conditional data validation procedures of §75.20(b)(3) may be used until the RATA has been passed. If the corrective actions taken following the failed RATA included adjustment of the polynomial coefficients or K-factor(s) of the flow monitor, a 3-level RATA is required, except as otherwise specified in section 2.3.1.3 of this appendix.

2.2.5.3 Abbreviated Flow-to-Load Test

(a) The following abbreviated flow-to-load test may be performed after any documented repair, component replacement, or other corrective maintenance to a flow monitor (except for changes affecting the linearity of the flow monitor, such as adjusting the flow monitor coefficients or K factor(s)) to demonstrate that the repair, replacement, or other maintenance has not significantly affected the monitor's ability to accurately measure the stack gas volumetric flow rate. Data from the monitoring system are considered invalid from the hour of commencement of the repair, replacement, or maintenance until either the hour in which the abbraviated flow-to-load test is passed, or the hour in which a probationary calibration error test is passed following completion of the repair, replacement, or maintenance and any associated adjustments to the monitor. If the latter option is selected, the abbreviated flow-to-load test shall be completed within 168 unit operating hours of the probationary calibration error test (or, for peaking units, within 30 unit operating days, if that is less restrictive). Data from the monitor are considered to be conditionally valid (as defined in §72.2 of this chapter), beginning with the hour of the probationary calibration error test.

(b) Operate the unit(s) in such a way as to reproduce, as closely as practicable, the exact conditions at the time of the most recent normal-load flow RATA. To achieve this, it is recommended that the load be held constant to within ±10.0 percent of the average load during the RATA and that the diluent gas (CO_2 or O_2) concentration be maintained within ±0.5 percent CO_2 or O_2 of the average diluent concentration during the RATA. For common stacks, to the extent practicable, use the same combination of units and load levels that were used during the RATA. When the process parameters have been set, record a minimum of six and a maximum of 12 consecutive hourly average flow rates, using the flow monitor(s) for which E_f was outside the applicable limit. For peaking units, a minimum of three and a maximum of 12 consecutive hourly average flow rates are required. Also record the corresponding hourly load values and, if applicable, the hourly diluent gas concentrations. Calculate the flow-to-load ratio (or GHR) for each hour in the test hour period, using Equation B–1 or B–1a. Determine E_h for each hourly flow-to-load ratio (or GHR), using Equation B–2 of this appendix and then calculate E_f, the arithmetic average of the E_h values.

(c) The results of the abbreviated flow-to-load test shall be considered acceptable, and no further action is required if the value of E_f does not exceed the applicable limit specified in section 2.2.5 of this appendix. All conditionally valid data recorded by the flow monitor shall be considered quality-assured, beginning with the hour of the probationary calibration error test that preceded the abbreviated flow-to-load test (if applicable). However, if E_f is outside the applicable limit, all conditionally valid data recorded by the flow monitor (if applicable) shall be considered invalid back to the hour of the probationary calibration error test that preceded the abbreviated flow-to-load test, and a single-load RATA is required in accordance with section 2.2.5.2 of this appendix. If the flow monitor must be re-linearized, however, a 3-load RATA is required.

2.3 Semiannual and Annual Assessments

For each primary and redundant backup monitoring system, perform relative accuracy assessments either semiannually or annually, as specified in section 2.3.1.1 or 2.3.1.2 of this appendix, for the type of test and the performance achieved. This requirement applies as of the calendar quarter following the calendar quarter in which the monitoring system is provisionally certified. A summary chart showing the frequency with which a

relative accuracy test audit must be performed, depending on the accuracy achieved, is located at the end of this appendix in Figure 2.

2.3.1 Relative Accuracy Test Audit (RATA)

2.3.1.1 Standard RATA Frequencies

(a) Except for Hg monitoring systems and as otherwise specified in §75.21(a)(6) or (a)(7) or in section 2.3.1.2 of this appendix, perform relative accuracy test audits semiannually, *i.e.*, once every two successive QA operating quarters (as defined in §72.2 of this chapter) for each primary and redundant backup SO_2 pollutant concentration monitor, flow monitor, CO_2 emissions concentration monitor (including O_2 monitors used to determine CO_2 emissions), CO_2 or O_2 diluent monitor used to determine heat input, moisture monitoring system, NO_X concentration monitoring system, NO_X-diluent CEMS, or SO_2-diluent CEMS. For each primary and redundant backup Hg concentration monitoring system and each sorbent trap monitoring system, RATAs shall be performed annually, *i.e.*, once every four successive QA operating quarters (as defined in §72.2 of this chapter). A calendar quarter that does not qualify as a QA operating quarter shall be excluded in determining the deadline for the next RATA. No more than eight successive calendar quarters shall elapse after the quarter in which a RATA was last performed without a subsequent RATA having been conducted. If a RATA has not been completed by the end of the eighth calendar quarter since the quarter of the last RATA, then the RATA must be completed within a 720 unit (or stack) operating hour grace period (as provided in section 2.3.3 of this appendix) following the end of the eighth successive elapsed calendar quarter, or data from the CEMS will become invalid.

(b) The relative accuracy test audit frequency of a CEMS may be reduced, as specified in section 2.3.1.2 of this appendix, for primary or redundant backup monitoring systems which qualify for less frequent testing. Perform all required RATAs in accordance with the applicable procedures and provisions in sections 6.5 through 6.5.2.2 of appendix A to this part and sections 2.3.1.3 and 2.3.1.4 of this appendix.

2.3.1.2 Reduced RATA Frequencies

Relative accuracy test audits of primary and redundant backup SO_2 pollutant concentration monitors, CO_2 pollutant concentration monitors (including O_2 monitors used to determine CO_2 emissions), CO_2 or O_2 diluent monitors used to determine heat input, moisture monitoring systems, NO_X concentration monitoring systems, flow monitors, NO_X-diluent monitoring systems or SO_2-diluent monitoring systems may be performed annually (i.e., once every four successive QA operating quarters, rather than once every two successive QA operating quarters) if any of the following conditions are met for the specific monitoring system involved:

(a) The relative accuracy during the audit of an SO_2 or CO_2 pollutant concentration monitor (including an O_2 pollutant monitor used to measure CO_2 using the procedures in appendix F to this part), or of a CO_2 or O_2 diluent monitor used to determine heat input, or of a NO_X concentration monitoring system, or of a NO_X-diluent monitoring system, or of an SO_2-diluent continuous emissions monitoring system is ≤ 7.5 percent;

(b) [Reserved]

(c) The relative accuracy during the audit of a flow monitor is ≤ 7.5 percent at each operating level tested;

(d) For low flow (≤ 10.0 fps, as measured by the reference method during the RATA) stacks/ducts, when the flow monitor fails to achieve a relative accuracy ≤ 7.5 percent during the audit, but the monitor mean value, calculated using Equation A–7 in appendix A to this part and converted back to an equivalent velocity in standard feet per second (fps), is within ±1.5 fps of the reference method mean value, converted to an equivalent velocity in fps;

(e) For low SO_2 or NO_X emitting units (average SO_2 or NO_X reference method concentrations ≤ 250 ppm) during the RATA, when an SO_2 pollutant concentration monitor or NO_X concentration monitoring system fails to achieve a relative accuracy ≤ 7.5 percent during the audit, but the monitor mean value from the RATA is within ±12 ppm of the reference method mean value;

(f) For units with low NO_X emission rates (average NO_X emission rate measured by the reference method during the RATA ≤ 0.200 lb/mmBtu), when a NO_X-diluent continuous emission monitoring system fails to achieve a relative accuracy ≤ 7.5 percent, but the monitoring system mean value from the RATA, calculated using Equation A–7 in appendix A to this part, is within ±0.015 lb/mmBtu of the reference method mean value;

(g) [Reserved]

(h) For a CO_2 or O_2 monitor, when the mean difference between the reference method values from the RATA and the corresponding monitor values is within ±0.7 percent CO_2 or O_2; and

(i) When the relative accuracy of a continuous moisture monitoring system is ≤ 7.5 percent or when the mean difference between the reference method values from the RATA and the corresponding monitoring system values is within ±1.0 percent H_2O.

2.3.1.3 RATA Load (or Operating) Levels and Additional RATA Requirements

(a) For SO_2 pollutant concentration monitors, CO_2 emissions concentration monitors

(including O_2 monitors used to determine CO_2 emissions), CO_2 or O_2 diluent monitors used to determine heat input, NO_X concentration monitoring systems, Hg concentration monitoring systems, sorbent trap monitoring systems, moisture monitoring systems, and NO_X-diluent monitoring systems, the required semiannual or annual RATA tests shall be done at the load level (or operating level) designated as normal under section 6.5.2.1(d) of appendix A to this part. If two load levels (or operating levels) are designated as normal, the required RATA(s) may be done at either load level (or operating level).

(b) For flow monitors installed on peaking units and bypass stacks, and for flow monitors that qualify to perform only single-level RATAs under section 6.5.2(e) of appendix A to this part, all required semiannual or annual relative accuracy test audits shall be single-load (or single-level) audits at the normal load (or operating level), as defined in section 6.5.2.1(d) of appendix A to this part.

(c) For all other flow monitors, the RATAs shall be performed as follows:

(1) An annual 2-load (or 2-level) flow RATA shall be done at the two most frequently used load levels (or operating levels), as determined under section 6.5.2.1(d) of appendix A to this part, or (if applicable) at the operating levels determined under section 6.5.2(e) of appendix A to this part. Alternatively, a 3-load (or 3-level) flow RATA at the low, mid, and high load levels (or operating levels), as defined under section 6.5.2.1(b) of appendix A to this part, may be performed in lieu of the 2-load (or 2-level) annual RATA.

(2) If the flow monitor is on a semiannual RATA frequency, 2-load (or 2-level) flow RATAs and single-load (or single-level) flow RATAs at the normal load level (or normal operating level) may be performed alternately.

(3) A single-load (or single-level) annual flow RATA may be performed in lieu of the 2-load (or 2-level) RATA if the results of an historical load data analysis show that in the time period extending from the ending date of the last annual flow RATA to a date that is no more than 21 days prior to the date of the current annual flow RATA, the unit (or combination of units, for a common stack) has operated at a single load level (or operating level) (low, mid, or high), for ≥ 85.0 percent of the time. Alternatively, a flow monitor may qualify for a single-load (or single-level) RATA if the 85.0 percent criterion is met in the time period extending from the beginning of the quarter in which the last annual flow RATA was performed through the end of the calendar quarter preceding the quarter of current annual flow RATA.

(4) A 3-load (or 3-level) RATA, at the low-, mid-, and high-load levels (or operating levels), as determined under section 6.5.2.1 of appendix A to this part, shall be performed at least once every twenty consecutive calendar quarters, except for flow monitors that are exempted from 3-load (or 3-level) RATA testing under section 6.5.2(b) or 6.5.2(e) of appendix A to this part.

(5) A 3-load (or 3-level) RATA is required whenever a flow monitor is re-linearized, *i.e.*, when its polynomial coefficients or K factor(s) are changed, except for flow monitors that are exempted from 3-load (or 3-level) RATA testing under section 6.5.2(b) or 6.5.2(e) of appendix A to this part. For monitors so exempted under section 6.5.2(b), a single-load flow RATA is required. For monitors so exempted under section 6.5.2(e), either a single-level RATA or a 2-level RATA is required, depending on the number of operating levels documented in the monitoring plan for the unit.

(6) For all multi-level flow audits, the audit points at adjacent load levels or at adjacent operating levels (*e.g.*, mid and high) shall be separated by no less than 25.0 percent of the ''range of operation,'' as defined in section 6.5.2.1 of appendix A to this part.

(d) A RATA of a moisture monitoring system shall be performed whenever the coefficient, K factor or mathematical algorithm determined under section 6.5.7 of appendix A to this part is changed.

2.3.1.4 Number of RATA Attempts

The owner or operator may perform as many RATA attempts as are necessary to achieve the desired relative accuracy test audit frequencies and/or bias adjustment factors. However, the data validation procedures in section 2.3.2 of this appendix must be followed.

2.3.2 Data Validation

(a) A RATA shall not commence if the monitoring system is operating out-of-control with respect to any of the daily and quarterly quality assurance assessments required by sections 2.1 and 2.2 of this appendix or with respect to the additional calibration error test requirements in section 2.1.3 of this appendix.

(b) Each required RATA shall be done according to paragraphs (b)(1), (b)(2) or (b)(3) of this section:

(1) The RATA may be done ''cold,'' i.e., with no corrective maintenance, repair, calibration adjustments, re-linearization or reprogramming of the monitoring system prior to the test.

(2) The RATA may be done after performing only the routine or non-routine calibration adjustments described in section 2.1.3 of this appendix at the zero and/or upscale calibration gas levels, but no other corrective maintenance, repair, re-

linearization or reprogramming of the monitoring system. Trial RATA runs may be performed after the calibration adjustments and additional adjustments within the allowable limits in section 2.1.3 of this appendix may be made prior to the RATA, as necessary, to optimize the performance of the CEMS. The trial RATA runs need not be reported, provided that they meet the specification for trial RATA runs in §75.20(b)(3)(vii)(E)(*2*). However, if, for any trial run, the specification in §75.20(b)(3)(vii)(E)(*2*) is not met, the trial run shall be counted as an aborted RATA attempt.

(3) The RATA may be done after repair, corrective maintenance, re-linearization or reprogramming of the monitoring system. In this case, the monitoring system shall be considered out-of-control from the hour in which the repair, corrective maintenance, re-linearization or reprogramming is commenced until the RATA has been passed. Alternatively, the data validation procedures and associated timelines in §§75.20(b)(3)(ii) through (ix) may be followed upon completion of the necessary repair, corrective maintenance, re-linearization or reprogramming. If the procedures in §75.20(b)(3) are used, the words ''quality assurance'' apply instead of the word ''recertification.''

(c) Once a RATA is commenced, the test must be done hands-off. No adjustment of the monitor's calibration is permitted during the RATA test period, other than the routine calibration adjustments following daily calibration error tests, as described in section 2.1.3 of this appendix. If a routine daily calibration error test is performed and passed just prior to a RATA (or during a RATA test period) and a mathematical correction factor is automatically applied by the DAHS, the correction factor shall be applied to all subsequent data recorded by the monitor, including the RATA test data. For 2-level and 3-level flow monitor audits, no linearization or reprogramming of the monitor is permitted in between load levels.

(d) For single-load (or single-level) RATAs, if a daily calibration error test is failed during a RATA test period, prior to completing the test, the RATA must be repeated. Data from the monitor are invalidated prospectively from the hour of the failed calibration error test until the hour of completion of a subsequent successful calibration error test. The subsequent RATA shall not be commenced until the monitor has successfully passed a calibration error test in accordance with section 2.1.3 of this appendix. Notwithstanding these requirements, when ASTM D6784–02 (incorporated by reference under §75.6 of this part) or Method 29 in appendix A–8 to part 60 of this chapter is used as the reference method for the RATA of a Hg CEMS, if a calibration error test of the CEMS is failed during a RATA test period, any test run(s) completed prior to the failed calibration error test need not be repeated; however, the RATA may not continue until a subsequent calibration error test of the Hg CEMS has been passed. For multiple-load (or multiple-level) flow RATAs, each load level (or operating level) is treated as a separate RATA (*i.e.*, when a calibration error test is failed prior to completing the RATA at a particular load level (or operating level), only the RATA at that load level (or operating level) must be repeated; the results of any previously-passed RATA(s) at the other load level(s) (or operating level(s)) are unaffected, unless re-linearization of the monitor is required to correct the problem that caused the calibration failure, in which case a subsequent 3-load (or 3-level) RATA is required), except as otherwise provided in section 2.3.1.3(c)(5) of this appendix.

(e) For a RATA performed using the option in paragraph (b)(1) or (b)(2) of this section, if the RATA is failed (that is, if the relative accuracy exceeds the applicable specification in section 3.3 of appendix A to this part) or if the RATA is aborted prior to completion due to a problem with the CEMS, then the CEMS is out-of-control and all emission data from the CEMS are invalidated prospectively from the hour in which the RATA is failed or aborted. Data from the CEMS remain invalid until the hour of completion of a subsequent RATA that meets the applicable specification in section 3.3 of appendix A to this part. If the option in paragraph (b)(3) of this section to use the data validation procedures and associated timelines in §§75.20(b)(3)(ii) through(b)(3)(ix) has been selected, the beginning and end of the out-of-control period shall be determined in accordance with §75.20(b)(3)(vii)(A) and (B). Note that when a RATA is aborted for a reason other than monitoring system malfunction (*see* paragraph (h) of this section), this does not trigger an out-of-control period for the monitoring system.

(f) For a 2-level or 3-level flow RATA, if, at any load level (or operating level), a RATA is failed or aborted due to a problem with the flow monitor, the RATA at that load level (or operating level) must be repeated. The flow monitor is considered out-of-control and data from the monitor are invalidated from the hour in which the test is failed or aborted and remain invalid until the passing of a RATA at the failed load level (or operating level), unless the option in paragraph (b)(3) of this section to use the data validation procedures and associated timelines in §75.20(b)(3)(ii) through (b)(3)(ix) has been selected, in which case the beginning and end of the out-of-control period shall be determined in accordance with §75.20(b)(3)(vii)(A) and (B). Flow RATA(s) that were previously passed at the other load level(s) (or operating level(s)) do not have to be repeated unless the flow monitor must be re-linearized following the failed or aborted test. If the

flow monitor is re-linearized, a subsequent 3-load (or 3-level) RATA is required, except as otherwise provided in section 2.3.1.3(c)(5) of this appendix.

(g) Data validation for failed RATAs for a CO_2 pollutant concentration monitor (or an O_2 monitor used to measure CO_2 emissions), a NO_X pollutant concentration monitor, and a NO_X-diluent monitoring system shall be done according to paragraphs (g)(1) and (g)(2) of this section:

(1) For a CO_2 pollutant concentration monitor (or an O_2 monitor used to measure CO_2 emissions) which also serves as the diluent component in a NO_X-diluent monitoring system, if the CO_2 (or O_2) RATA is failed, then both the CO_2 (or O_2) monitor and the associated NO_X-diluent system are considered out-of-control, beginning with the hour of completion of the failed CO_2 (or O_2) monitor RATA, and continuing until the hour of completion of subsequent hands-off RATAs which demonstrate that both systems have met the applicable relative accuracy specifications in sections 3.3.2 and 3.3.3 of appendix A to this part, unless the option in paragraph (b)(3) of this section to use the data validation procedures and associated timelines in §75.20(b)(3)(ii) through (b)(3)(ix) has been selected, in which case the beginning and end of the out-of-control period shall be determined in accordance with §75.20(b)(3)(vii)(A) and (B).

(2) This paragraph (g)(2) applies only to a NO_X pollutant concentration monitor that serves both as the NO_X component of a NO_X concentration monitoring system (to measure NO_X mass emissions) and as the NO_X component in a NO_X-diluent monitoring system (to measure NO_X emission rate in lb/mmBtu). If the RATA of the NO_X concentration monitoring system is failed, then both the NO_X concentration monitoring system and the associated NO_X-diluent monitoring system are considered out-of-control, beginning with the hour of completion of the failed NO_X concentration RATA, and continuing until the hour of completion of subsequent hands-off RATAs which demonstrate that both systems have met the applicable relative accuracy specifications in sections 3.3.2 and 3.3.7 of appendix A to this part, unless the option in paragraph (b)(3) of this section to use the data validation procedures and associated timelines in §75.20(b)(3)(ii) through (b)(3)(ix) has been selected, in which case the beginning and end of the out-of-control period shall be determined in accordance with §75.20(b)(3)(vii)(A) and (B).

(h) For each monitoring system, report the results of all completed and partial RATAs that affect data validation (i.e., all completed, passed RATAs; all completed, failed RATAs; and all RATAs aborted due to a problem with the CEMS, including trial RATA runs counted as failed test attempts under paragraph (b)(2) of this section or under §75.20(b)(3)(vii)(F)) in the quarterly report required under §75.64. Note that RATA attempts that are aborted or invalidated due to problems with the reference method or due to operational problems with the affected unit(s) need not be reported. Such runs do not affect the validation status of emission data recorded by the CEMS. However, a record of all RATAs, trial RATA runs and RATA attempts (whether reported or not) must be kept on-site as part of the official test log for each monitoring system.

(i) Each time that a hands-off RATA of an SO_2 pollutant concentration monitor, a NO_X-diluent monitoring system, a NO_X concentration monitoring system, a Hg concentration monitoring system, a sorbent trap monitoring system, or a flow monitor is passed, perform a bias test in accordance with section 7.6.4 of appendix A to this part. Apply the appropriate bias adjustment factor to the reported SO_2, Hg, NO_X, or flow rate data, in accordance with section 7.6.5 of appendix A to this part.

(j) Failure of the bias test does not result in the monitoring system being out-of-control.

2.3.3 RATA Grace Period

(a) The owner or operator has a grace period of 720 consecutive unit operating hours, as defined in §72.2 of this chapter (or, for CEMS installed on common stacks or bypass stacks, 720 consecutive stack operating hours, as defined in §72.2 of this chapter), in which to complete the required RATA for a particular CEMS whenever:

(1) A required RATA has not been performed by the end of the QA operating quarter in which it is due; or

(2) A required 3-load flow RATA has not been performed by the end of the calendar quarter in which it is due; or

(3) For a unit which is conditionally exempted under §75.21(a)(7) from the SO_2 RATA requirements of this part, an SO_2 RATA has not been completed by the end of the calendar quarter in which the annual usage of fuel(s) with a sulfur content higher than very low sulfur fuel (as defined in §72.2 of this chapter) exceeds 480 hours; or

(4) Eight successive calendar quarters have elapsed, following the quarter in which a RATA was last performed, without a subsequent RATA having been done, due either to infrequent operation of the unit(s) or frequent combustion of very low sulfur fuel, as defined in §72.2 of this chapter (SO_2 monitors, only), or a combination of these factors.

(b) Except for SO_2 monitoring system RATAs, the grace period shall begin with the first unit (or stack) operating hour following the calendar quarter in which the required RATA was due. For SO_2 monitor RATAs, the grace period shall begin with the first unit (or stack) operating hour in which fuel with

a total sulfur content higher than that of very low sulfur fuel (as defined in §72.2 of this chapter) is burned in the unit(s), following the quarter in which the required RATA is due. Data validation during a RATA grace period shall be done in accordance with the applicable provisions in section 2.3.2 of this appendix.

(c) If, at the end of the 720 unit (or stack) operating hour grace period, the RATA has not been completed, data from the monitoring system shall be invalid, beginning with the first unit operating hour following the expiration of the grace period. Data from the CEMS remain invalid until the hour of completion of a subsequent hands-off RATA. The deadline for the next test shall be either two QA operating quarters (if a semiannual RATA frequency is obtained) or four QA operating quarters (if an annual RATA frequency is obtained) after the quarter in which the RATA is completed, not to exceed eight calendar quarters.

(d) When a RATA is done during a grace period in order to satisfy a RATA requirement from a previous quarter, the deadline for the next RATA shall determined as follows:

(1) If the grace period RATA qualifies for a reduced, (i.e., annual), RATA frequency the deadline for the next RATA shall be set at three QA operating quarters after the quarter in which the grace period test is completed.

(2) If the grace period RATA qualifies for the standard, (i.e., semiannual), RATA frequency the deadline for the next RATA shall be set at two QA operating quarters after the quarter in which the grace period test is completed.

(3) Notwithstanding these requirements, no more than eight successive calendar quarters shall elapse after the quarter in which the grace period test is completed, without a subsequent RATA having been conducted.

2.3.4 Bias Adjustment Factor

Except as otherwise specified in section 7.6.5 of appendix A to this part, if an SO_2 pollutant concentration monitor, flow monitor, NO_X CEMS, NO_X concentration monitoring system used to calculate NO_X mass emissions, Hg concentration monitoring system, or sorbent trap monitoring system fails the bias test specified in section 7.6 of appendix A to this part, use the bias adjustment factor given in Equations A–11 and A–12 of appendix A to this part, or the allowable alternative BAF specified in section 7.6.5(b) of appendix A to this part, to adjust the monitored data.

2.4 Recertification, Quality Assurance, RATA Frequency and Bias Adjustment Factors (Special Considerations)

(a) When a significant change is made to a monitoring system such that recertification of the monitoring system is required in accordance with §75.20(b), a recertification test (or tests) must be performed to ensure that the CEMS continues to generate valid data. In all recertifications, a RATA will be one of the required tests; for some recertifications, other tests will also be required. A recertification test may be used to satisfy the quality assurance test requirement of this appendix. For example, if, for a particular change made to a CEMS, one of the required recertification tests is a linearity check and the linearity check is successful, then, unless another such recertification event occurs in that same QA operating quarter, it would not be necessary to perform an additional linearity test of the CEMS in that quarter to meet the quality assurance requirement of section 2.2.1 of this appendix. For this reason, EPA recommends that owners or operators coordinate component replacements, system upgrades, and other events that may require recertification, to the extent practicable, with the periodic quality assurance testing required by this appendix. When a quality assurance test is done for the dual purpose of recertification and routine quality assurance, the applicable data validation procedures in §75.20(b)(3) shall be followed.

(b) Except as provided in section 2.3.3 of this appendix, whenever a passing RATA of a gas monitor is performed, or a passing 2-load (or 2-level) RATA or a passing 3-load (or 3-level) RATA of a flow monitor is performed (irrespective of whether the RATA is done to satisfy a recertification requirement or to meet the quality assurance requirements of this appendix, or both), the RATA frequency (semi-annual or annual) shall be established based upon the date and time of completion of the RATA and the relative accuracy percentage obtained. For 2-load (or 2-level) and 3-load (or 3-level) flow RATAs, use the highest percentage relative accuracy at any of the loads (or levels) to determine the RATA frequency. The results of a single-load (or single-level) flow RATA may be used to establish the RATA frequency when the single-load (or single-level) flow RATA is specifically required under section 2.3.1.3(b) of this appendix or when the single-load (or single-level) RATA is allowed under section 2.3.1.3(c) of this appendix for a unit that has operated at one load level (or operating level) for ≥ 85.0 percent of the time since the last annual flow RATA. No other single-load (or single-level) flow RATA may be used to establish an annual RATA frequency; however, a 2-load or 3-load (or a 2-level or 3-level) flow RATA may be performed at any time or in place of any required single-load

(or single-level) RATA, in order to establish an annual RATA frequency.

2.5 Other Audits

Affected units may be subject to relative accuracy test audits at any time. If a monitor or continuous emission monitoring system fails the relative accuracy test during the audit, the monitor or continuous emission monitoring system shall be considered to be out-of-control beginning with the date and time of completion of the audit, and continuing until a successful audit test is completed following corrective action. If a monitor or monitoring system fails the bias test during an audit, use the bias adjustment factor given by equations A–11 and A–12 in appendix A to this part to adjust the monitored data. Apply this adjustment factor from the date and time of completion of the audit until the date and time of completion of a relative accuracy test audit that does not show bias.

2.6 System Integrity Checks for Hg Monitors

For each Hg concentration monitoring system (except for a Hg monitor that does not have a converter), perform a single-point system integrity check weekly, i.e., at least once every 168 unit or stack operating hours, using a NIST-traceable source of oxidized Hg. Perform this check using a mid- or high-level gas concentration, as defined in section 5.2 of appendix A to this part. The performance specifications in paragraph (3) of section 3.2 of appendix A to this part must be met, otherwise the monitoring system is considered out-of-control, from the hour of the failed check until a subsequent system integrity check is passed. If a required system integrity check is not performed and passed within 168 unit or stack operating hours of last successful check, the monitoring system shall also be considered out of control, beginning with the 169th unit or stack operating hour after the last successful check, and continuing until a subsequent system integrity check is passed. This weekly check is not required if the daily calibration assessments in section 2.1.1 of this appendix are performed using a NIST-traceable source of oxidized Hg.

FIGURE 1 TO APPENDIX B OF PART 75—QUALITY ASSURANCE TEST REQUIREMENTS

Test	Basic QA test frequency requirements*				
	Daily*	Weekly	Quarterly*	Semiannual*	Annual
Calibration Error Test (2 pt.)	✔				
Interference Check (flow)	✔				
Flow-to-Load Ratio			✔		
Leak Check (DP flow monitors)			✔		
Linearity Check or System Integrity Check** (3 pt.)			✔		
Single-point System Integrity Check**		✔			
RATA (SO_2, NO_X, CO_2, O_2, H_2O) [1]				✔	
RATA (All Hg monitoring systems)					✔
RATA (flow) [1 2]				✔	

*"Daily" means operating days, only. "Weekly" means once every 168 unit or stack operating hours. "Quarterly" means once every QA operating quarter. "Semiannual" means once every two QA operating quarters. "Annual" means once every four QA operating quarters.

**The system integrity check applies only to Hg monitors with converters. The single-point weekly system integrity check is not required if daily calibrations are performed using a NIST-traceable source of oxidized Hg. The 3-point quarterly system integrity check is not required if a linearity check is performed.

[1] Conduct RATA annually (i.e., once every four QA operating quarters), if monitor meets accuracy requirements to qualify for less frequent testing.

[2] For flow monitors installed on peaking units, bypass stacks, or units that qualify for single-level RATA testing under section 6.5.2(e) of this part, conduct all RATAs at a single, normal load (or operating level). For other flow monitors, conduct annual RATAs at two load levels (or operating levels). Alternating single-load and 2-load (or single-level and 2-level) RATAs may be done if a monitor is on a semiannual frequency. A single-load (or single-level) RATA may be done in lieu of a 2-load (or 2-level) RATA if, since the last annual flow RATA, the unit has operated at one load level (or operating level) for ≥85.0 percent of the time. A 3-level RATA is required at least once every five calendar years and whenever a flow monitor is re-linearized, except for flow monitors exempted from 3-level RATA testing under section 6.5.2(b) or 6.5.2(e) of appendix A to this part.

FIGURE 2 TO APPENDIX B OF PART 75—RELATIVE ACCURACY TEST FREQUENCY INCENTIVE SYSTEM

RATA	Semiannual [W] (percent)	Annual [W]
SO_2 or NO_X [Y]	7.5% <RA ≤10.0% or ±15.0 ppm [X]	RA ≤ 7.5% or ±12.0 ppm [X].
SO_2-diluent	7.5% <RA ≤10.0% or ±0.030 lb/mmBtu [X]	RA ≤7.5% or ±0.025 lb/mmBtu =G5X.
NO_X-diluent	7.5% <RA ≤10.0% or ±0.020 lb/mmBtu [X]	RA ≤ 7.5% or ±0. 015 lb/mmBtu [X].
Flow	7.5% < RA ≤ 10.0% or ±2.0 fps [X]	RA ≤ 7.5% or ±1.5 fps [X].
CO_2 or O_2	7.5% < RA ≤ 10.0% or ±1.0% CO_2/O_2 [X]	RA ≤ 7.5% or ±0.7% CO_2/O_2 [X].
Hg [X]	N/A	RA < 20.0% or ± 1.0 μg/scm [X].
Moisture	7.5% <RA ≤10.0% or ±1.5% H_2O [X]	RA ≤7.5% or ±1.0% H_2O [X].

[W] The deadline for the next RATA is the end of the second (if semiannual) or fourth (if annual) successive QA operating quarter following the quarter in which the CEMS was last tested. Exclude calendar quarters with fewer than 168 unit operating hours (or, for common stacks and bypass stacks, exclude quarters with fewer than 168 stack operating hours) in determining the RATA deadline. For SO_2 monitors, QA operating quarters in which only very low sulfur fuel as defined in § 72.2, is combusted may also be excluded. However, the exclusion of calendar quarters is limited as follows: the deadline for the next RATA shall be no more than 8 calendar quarters after the quarter in which a RATA was last performed.

[X] The difference between monitor and reference method mean values applies to moisture monitors, CO_2, and O_2 monitors, low emitters of SO_2, NO_X, or Hg, or and low flow, only. The specifications for Hg monitors also apply to sorbent trap monitoring systems.

[Y] A NO_X concentration monitoring system used to determine NO_X mass emissions under § 75.71.

[58 FR 3701, Jan. 11, 1993, as amended at 60 FR 26546, 26571, May 17, 1995; 61 FR 59165, Nov. 20, 1996; 64 FR 28644, May 26, 1999; 64 FR 37582, July 12, 1999; 67 FR 40456, 40457, June 12, 2002; 67 FR 53505, Aug. 16, 2002; 67 FR 57274, Sept. 9, 2002; 70 FR 28693, May 18, 2005; 72 FR 51528, Sept. 7, 2007; 73 FR 4367, Jan. 24, 2008]

APPENDIX C TO PART 75—MISSING DATA ESTIMATION PROCEDURES

1. PARAMETRIC MONITORING PROCEDURE FOR MISSING SO_2 CONCENTRATION OR NO_X EMISSION RATE DATA

1.1 Applicability

The owner or operator of any affected unit equipped with post-combustion SO_2 or NO_X emission controls and SO_2 pollutant concentration monitors and/or NO_X continuous emission monitoring systems at the inlet and outlet of the emission control system may apply to the Administrator for approval and certification of a parametric, empirical, or process simulation method or model for calculating substitute data for missing data periods. Such methods may be used to parametrically estimate the removal efficiency of the SO_2 of postcombustion NO_X emission controls which, with the monitored inlet concentration or emission rate data, may be used to estimate the average concentration of SO_2 emissions or average emission rate of NO_X discharged to the atmosphere. After approval by the Administrator, such method or model may be used for filling in missing SO_2 concentration or NO_X emission rate data when data from the outlet SO_2 pollutant concentration monitor or outlet NO_X continuous emission monitoring system have been reported with an annual monitor data availability of 90.0 percent or more.

Base the empirical and process simulation methods or models on the fundamental chemistry and engineering principles involved in the treatment of pollutant gas. On a case-by-case basis, the Administrator may pre-certify commercially available process simulation methods and models.

1.2 Petition Requirements

Continuously monitor, determine, and record hourly averages of the estimated SO_2 or NO_X removal efficiency and of the parameters specified below, at a minimum. The affected facility shall supply additional parametric information where appropriate. Measure the SO_2 concentration or NO_X emission rate, removal efficiency of the add-on emission controls, and the parameters for at least 2160 unit operating hours. Provide information for all expected operating conditions and removal efficiencies. At least 4 evenly spaced data points are required for a valid hourly average, except during periods of calibration, maintenance, or quality assurance activities, during which 2 data points per hour are sufficient. The Administrator will review all applications on a case-by-case basis.

1.2.1 Parameters for Wet Flue Gas Desulfurization System

1.2.1.1 Number of scrubber modules in operation.

1.2.1.2 Total slurry rate to each scrubber module (gal per min).

1.2.1.3 In-line absorber pH of each scrubber module.

1.2.1.4 Pressure differential across each scrubber module (inches of water column).

1.2.1.5 Unit load (MWe).

1.2.1.6 Inlet and outlet SO_2 concentration as determined by the monitor or missing data substitution procedures.

1.2.1.7 Percent solids in slurry for each scrubber module.

Appendix R. CEMS Installation and Certification Plan – We Energies

Mercury Continuous Emission Monitoring Systems (CEMS) Installation and Certification Plan for Oak Creek and Pleasant Prairie Power Plants

Rev 0 11/17/05

Wisconsin Electric Power Company, operating as We Energies (WE), lodged a consent decree with the U.S. Government on April 29, 2003, and amended it on July 21, 2003. Among other things, the consent decree requires We Energies to install and operate particulate matter (PM) continuous emission monitoring systems (CEMS) on a number of its coal-fired generating units. Specifically, We Energies must install and certify four (4) PM CEMS by April 1, 2005 and six additional PM CEMS installed by April 1, 2006. Paragraph 97 of the amended decree offers the option to "install two mercury CEMs, one of which will be installed at Pleasant Prairie Unit 1 or Unit 2, and one of which will be installed at Oak Creek Unit 7 or Unit 8, in lieu of a PM CEMs on Presque Isle Units 1-4 and one of the units at Valley."

We Energies proposed to exercise this option in a letter submitted the Agency on July 22, 2005. The agency responded and accepted our offer in a letter dated September 28, 2005.

Mercury CEMs

WE will be installing two Hg monitoring systems from Thermo Electron Corporation (Franklin, MA). We will be installing their "Mercury Freedom System ™, which consists of five primary components:

- Sample probe and converter
- Hg probe controller
- Hg analyzer
- Hg Calibrator
- Zero Air Supply

These systems will be installed and certified according to the revisions and requirements of 40 CFR 75, promulgated in the Federal Register, Volume 70, No.95, on May 18, 2005. Many parts of the text provided below are copied from the Federal Register entries.

Installation and Operating Strategy

The mercury CEMs will be installed and operating no later than April 1, 2006. WE will operate them continuously, to gain operating experience and to learn how they perform. Certification activities are tentatively scheduled to begin in mid June, 2006, with successful completion no later than 90 days following the installation deadline (June 29, 2006).

Prior to certification, all of the certification tests will be attempted until they can be successfully passed on a repetitive basis. This will give a chance for the plant people to

gain confidence and experience in dealing with this new type of measurement technology.

Sample Probe Location

The sample probe will be located to draw a representative sample from the outlet duct of Unit 8 at Oak Creek Power Plant and from a location on the common stack at Pleasant Prairie Power Plant. The location of the sample point will be based on gaseous stratification data.

Coal Types Being Burned

Both plants burn sub-bituminous coal from the Powder River Basin.

Maximum Potential Concentration, Span and Range of Monitoring System

We Energies has performed limited Ontario Hydro (OH) testing one these units. Mercury emission concentrations have been found to be in the single digit range (4-9 µg/scm). As outlined in section 2.1.7.1. (a)(2) (Maximum Potential Concentration) of Appendix A to Part 75, for the purposes of establishing the Maximum Potential Concentration (MPC) of the Hg monitoring system, we'll use the value of 9 µg/scm.

Neither of these current installation locations has a flue gas desulfurization (FGD) system. Following the guidance found in section 2.1.7.3(a) (Span and Range Values), we've rounded up the MPC to the next highest multiple of 10 µg/scm. Since neither monitoring location has a fuel gas desulfurization (FGD) systems, a single range has been selected for this system. The high range value will be equal to the span value, as allowed in section 2.1.7.3(c).

Data Acquisition and Handling Systems

App. A § 4 4. Data Acquisition and Handling Systems.

These systems also shall have the capability of interpreting and converting the individual output signals from an SO2 pollutant concentration monitor, a flow monitor, a CO2 monitor, an O2 monitor, a NOX pollutant concentration monitor, a NOX diluent CEMS, a moisture monitoring system, a Hg concentration monitoring system, and a sorbent trap monitoring system, to produce a continuous readout of pollutant emission rates or pollutant mass emissions (as applicable) in the appropriate units (e.g., lb/ hr, lb/MMBtu, ounces/hr, tons/hr). Our monitoring and data system will record mercury emissions in ounces/hr, as well as µg/scm.

<u>Certification Tests</u>

App. A § 3 3. Performance Specifications.

3.1 Calibration Error

- A 7-day calibration drift test

  In all cases, the calibration error of each Hg concentration monitor will be measured and recorded while the unit is combusting fuel (but not necessarily generating electricity) once each day for 7 consecutive operating days according to the following procedures.

  For 7-day calibration error tests of Hg concentration monitors and for daily calibration error tests of Hg monitors, either elemental Hg standards or a NIST-traceable source of oxidized Hg may be used. Alternatively, other NIST-traceable standards may be used for the required checks, subject to the approval of the Administrator.

  For each reference value, calculate the percentage calibration error based upon instrument span for daily calibration error tests using the following equation: (Eq. A-5)

  $$CE = |R-A|/S \times 100$$

  Where:

  CE = Calibration error as a percentage of the span of the instrument.
  R = Reference value of zero or upscale (high-level or mid-level, as applicable) calibration gas introduced into the monitoring system.
  A = Actual monitoring system response to the calibration gas.
  S = Span of the instrument, as defined earlier at 10 µg/scm.

  The calibration error of a Hg concentration monitor shall not deviate from the reference value of either the zero or upscale calibration gas by more than 5.0 percent of the span value, as calculated using Equation A–5 of this appendix. Alternatively, if the span value is 10µg/scm, the calibration error test results are also acceptable if the absolute value of the difference between the monitor response value and the reference value, |R–A| in Equation A–5 of this appendix, is ≤ 1.0 µg/scm. The span value of these systems will be 10µg/scm, which means if the absolute value difference is ≤ 1.0 µg/scm, the test is successful.

3.2 Linearity Check

- A linearity check, with elemental Hg standards 75.59 (a)(3)

  (3) For Hg monitors:
  (i) The error in linearity for each calibration gas concentration (low-, mid-, and high-levels) shall not exceed or deviate from the reference value by more than 10.0 percent as calculated using equation A–4 of this appendix; or

(ii) The absolute value of the difference between the average of the monitor response values and the average of the reference values, |R–A| in equation A–4 of this appendix, shall be less than or equal to 1.0 µg/scm, whichever is less restrictive.

Calculate the percentage linearity error based upon reference value at the low-, mid-, and high-level concentrations. Perform this calculation once during the certification process. Use the following equation to the linearity error of each reference value.

$$LE = |R-A|/R \times 100$$

(Eq. A-4)

Where:

LE = Percentage Linearity error, based upon the reference value,
R = Reference value of low-, mid- or high-level calibration gas introduced into the monitoring system.
A = Average monitoring system response to the calibration gas.
S = Span of the instrument, as defined earlier at 10 µg/scm.

For linearity checks, elemental Hg standards shall be used. Alternatively, other NIST-traceable standards may be used for the required checks, subject to the approval of the Administrator.

The linearity check of the Hg monitoring system shall be performed while the unit, or group of units for a common stack, is combusting fuel at conditions of typical stack temperature and pressure; it is not necessary for the unit to be generating electricity during this test.

3.3 Relative Accuracy

- A Relative Accuracy Tests Audit,

3.3.8 Relative Accuracy for Hg Monitoring Systems, performed on a µg/scm basis

The relative accuracy of a Hg concentration monitoring system or a sorbent trap monitoring system shall not exceed 20.0 percent. Alternatively, for affected units where the average of the reference method measurements of Hg concentration during the relative accuracy test audit is less than 5.0 µg/scm, the test results are acceptable if the difference between the mean value of the monitor measurements and the reference method mean value does not exceed 1.0 µg/ scm, in cases where the relative accuracy specification of 20.0 percent is not achieved.

WE will perform the RATAs while the unit is combusting coal. When relative accuracy test audits are performed on CEMS installed on bypass stacks/ducts, use

the fuel normally combusted by the unit (or units, if more than one unit exhausts into the flue).

For each Hg concentration monitoring system the relative accuracy will be calculated in accordance with section 7.3 or 7.4 of this appendix (Appendix A), as applicable. In addition, the test for bias and determination of the appropriate bias adjustment factor will be made in accordance with sections 7.6.4 and 7.6.5 of this appendix, using the data from the relative accuracy test audits.

Gas and Hg Monitoring System RATAs (Special Considerations)

WE will perform the required relative accuracy test audits for each Hg concentration monitoring system at the normal load level or normal operating level for the unit (or combined units, if common stack), as defined in section 6.5.2.1 of this appendix. If two load levels or operating levels have been designated as normal, the RATAs may be done at either load level.

For the initial certification of a Hg monitoring system in which, in addition to a RATA, one or more other tests are required (i.e., a linearity test, cycle time test, or 7-day calibration error test), WE will not commence the RATA until the other required tests of the CEMS have been passed.

Sampling Strategy

We will conduct the reference method tests so they will yield results representative of the Hg concentration present in the flue gas stream. For the RATA of a Hg CEMS using the Ontario Hydro Method, the time per run will be long enough to collect a sufficient mass of mercury to analyze. This sampling duration will be based upon based experience performing mercury baseline measurements using OH test methods.

- A bias test and potential adjustment

  For single-load RATAs of Hg concentration monitoring systems, the appropriate BAF is determined directly from the RATA results at normal load, using Equation A–12. Similarly, for Hg concentration monitoring systems, where the average Hg concentration during the RATA is < 5.0 μg/dscm, if the monitoring system meets the normal or the alternative relative accuracy specification in section 3.3.8 of this appendix but fails the bias test, the owner or operator may either use the bias adjustment factor (BAF) calculated from Equation A–12 or may use a default BAF of 1.250 for reporting purposes under the Acid Rain Program.

- Cycle time,

  The cycle time for pollutant concentration monitors, oxygen monitors used to determine percent moisture, and any other continuous emission monitoring system(s) required to perform a cycle time test shall not exceed 15 minutes.

WE will perform cycle time tests for each pollutant concentration monitor and continuous emission monitoring system while the unit is operating, according to the following procedures (see also Figure 6 at the end of appendix A, 40 CFR 75). Use a zero-level and a high-level calibration gas (as defined in section 5.2 of this appendix) alternately. To determine the upscale elapsed time, inject a zero-level concentration calibration gas into the probe tip (or injection port leading to the calibration cell, for in situ systems with no probe). Record the stable starting gas value and start time, using the data acquisition and handling system (DAHS). Next, allow the monitor to measure the concentration of flue gas emissions until the response stabilizes. Record the stable ending stack emissions value and the end time of the test using the DAHS. Determine the upscale elapsed time as the time it takes for 95.0 percent of the step change to be achieved between the stable starting gas value and the stable ending stack emissions value. Then repeat the procedure, starting by injecting the high-level gas concentration to determine the downscale elapsed time, which is the time it takes for 95.0 percent of the step change to be achieved between the stable starting gas value and the stable ending stack emissions value. End the downscale test by measuring the stable concentration of flue gas emissions. Record the stable starting and ending monitor values, the start and end times, and the downscale elapsed time for the monitor using the DAHS. A stable value is equivalent to a reading with a change of less than 2.0 percent of the span value for 2 minutes, or a reading with a change of less than 6.0 percent from the measured average concentration over 6 minutes. (Owners or operators of systems which do not record data in 1-minute or 3-minute intervals may petition the Administrator under § 75.66 for alternative stabilization criteria). For monitors or monitoring systems that perform a series of operations (such as purge, sample, and analyze), time the injections of the calibration gases so they will produce the longest possible cycle time. Report the slower of the two elapsed times (upscale or downscale) as the cycle time for the analyzer.

Cycle time test results are acceptable for monitor or monitoring system certification, recertification or diagnostic testing if none of the cycle times exceed 15 minutes.

- And a 3-level system integrity check, using NIST traceable source of oxidized Hg, as described in section 6.2 of Appendix A. Alternatively, other NIST-traceable standards may be used for the required checks, subject to the approval of the Administrator

  (iii) For the 3-level system integrity check required under § 75.20(c) (1) (vi), the system measurement error shall not exceed 5.0 percent of the span value at any of the three gas levels.

Appendix S. IRM Report

FIELD RATA TESTING WITH THE MERCURY INSTRUMENTAL REFERENCE METHOD

Sharon Sjostrom*, Steve Modrak
ADA-ES, Inc., 8100 SouthPark Way, Unit B, Littleton, CO 80120-4525

ABSTRACT

In June 2007, the EPA released draft Method 30A – Determination of Total Vapor Phase Mercury Emissions from Stationary Sources. Coal-fired power generators installing mercury CEMs are required to complete certification testing under the Clean Air Mercury Rule (CAMR) prior to January 1, 2009, including relative accuracy test audits (RATAs). The issued draft M30A, a work-in-process document, is offered as an option for RATA testing.

ADA-ES, Inc. has developed a portable mercury CEM system for use as an Instrumental Reference Method (IRM) as described in Method 30A in response to industry needs. This effort was conducted through a DOE NETL Clean Coal Power Initiative (CCPI) at We Energies Presque Isle Power Plant. A Thermo mercury CEM has been installed and operating at Presque Isle since June 2005 on the combined flue gas from Units 7, 8, and 9. The IRM was tested at Presque Isle in June 2007 in conjunction with Ontario Hydro RATAs on the installed CEM. Sorbent Trap Method measurements (EPA draft Method 30B) were also collected. This paper provides a discussion of draft Method 30A illustrated with results from the IRM RATA testing at Presque Isle including traversing, system integrity testing, and dynamic spiking. Performance of the installed mercury CEM, Ontario Hydro RATA, and M30B RATA results will also be presented.

INTRODUCTION

ADA-ES, Inc., and Thermo have been actively working together since 2003 through a DOE NETL Clean Coal Power Initiative at We Energies Presque Isle Power Plant to advance the mercury CEM state-of-the-art. A Thermo Mercury Freedom System has been installed and operating at Presque Isle since June 2005 on the combined flue gas exiting Units 7, 8, and 9.

Coal-fired power generators installing mercury CEMs are required to complete certification testing under the Clean Air Mercury Rule (CAMR) prior to January 1, 2009, including relative accuracy test audits (RATAs). Until recently the Ontario Hydro (OH) method has been the only valid reference method. This is a wet chemistry capture method that is very labor intensive, costly, and has a relatively high detection limit. The turnaround time for analysis with this method is several hours for on-site analysis or several days/weeks for off-site analysis. In June 2007, the EPA released draft Method 30A – Determination of Total Vapor Phase Mercury Emissions from Stationary Sources (Instrumental Analyzer Procedure).[1] The issued draft M30A was offered as an option for RATA testing. ADA-ES configured a portable Instrumental Reference Method (IRM) system as described in Method 30A (M30A) in response to industry needs using Thermo's 80i mercury analyzer and 81i mercury calibrator. This system was demonstrated at Presque Isle in June 2007.

BACKGROUND

The ADA-ES IRM consists of a standard Thermo Model 80i mercury analyzer and model 81i mercury calibrator installed in a temperature-controlled enclosure. Probe control (temperature, flow, pressure) is achieved through analog controls installed in the environmental enclosure. A standard model 83i probe enclosure was modified by removing the mantle and stinger, connecting calibration gas to a port upstream of the sampling filter, and adding additional flow monitoring capabilities to allow dynamic spiking tests. A custom traversing probe connected to the 83i probe enclosure was fabricated to facilitate traversing.

M30A details both certification requirements for an IRM and requirements for conducting RATAs. These are summarized below with comments specific to the approach used by ADA-ES when designing their system.

Certification Testing

Before measuring emissions, perform the following procedures:

a. 3-Point System Elemental Mercury Calibration Error Test:
Introduce the low-, mid-, and high-level calibration gases upstream of the sampling filter using Thermo's system calibration mode. During the system calibration, a valve automatically closes at the outlet of the sample extraction loop to isolate the system from flue gas and calibration gas is introduced upstream of the sampling filter to flood the sampling area with mercury calibration gas.

b. Measurement System Response Time Test:
The system response time is equal to the time, rounded to the nearest minute, that is required for the measured mercury concentration to increase from the stable low-level calibration gas concentration to a value within 5% of the high-level gas concentration. The response time test was done with elemental mercury and was done in conjunction with the calibration error test.

c. 2-Point System Integrity Check using oxidized mercury:
Zero gas and either the mid-level HgCl2 calibration gas was used for the check. Thermo's oxidized mercury calibrator was used as the source of oxidized mercury. The system integrity check is functionally very similar to the calibration error test, but oxidized mercury is used instead of elemental mercury.

d. Dynamic Spiking Test:
Dynamic spiking is required to determine if anything in the flue gas affects the accuracy of the measurement system. M30A requires that one spike level of oxidized mercury calibration gas be added to the flue gas sample at a volumetric flow rate of ≤20% to achieve resulting mercury concentrations in the gas that is 150 to 200% of the native mercury concentration. If the native mercury concentration is < 1 µg/m3, enough oxidized mercury should be added to increase the measured level by 1 to 4 µg/m3. The method requires that there are at least three separate spiking periods, and the native mercury concentration must be measured for at least 1 minute before and after each spiking period. The spike recovery must be 100±10% and the relative standard deviation of the three responses must be <5% or < 0.5 µg/m3. This is a challenging standard because the calculated recovery can be affected by the flow measurement as well as the mercury concentration. Although the requirement has been waived until January 1, 2009, the procedure was conducted at Presque Isle to evaluate the capabilities of the equipment.

Stratification Testing

Stratification testing must be conducted prior to relative accuracy testing. Mercury stratification testing is not required before January 1, 2009, and there is an exemption allowed if the mercury concentration in the stack gas is expected to be 3 $\mu g/m^3$ or less at the time of the mercury monitoring system RATA. A stratification test was scheduled at Presque Isle to test the procedure and the equipment.

Flue gas exiting the fabric filter at Presque Isle is split into three flues prior to entering the stack. These flues were originally the separate Unit 7, Unit 8, and Unit 9 flues prior to installation of the fabric filter. The inside diameter of each flue is 9' 6". Two 4-inch sampling ports positioned at 90 degrees are available on each flue for stratification testing. Stratification testing was conducted on a single flue, Unit 8. A 12-point per flue traverse specified by EPA Method 1 was conducted. The sampling time at each point was at least twice the system response time unless the probe was moved between ports when the sampling time was at least 4 times the response time to allow time for the system to flush. The minimum sampling time required for a single flue at Presque Isle is 12 times response time for sampling plus 2 times the response time to flush the system in each port, which equals 14 times response time. It is expected that 5 minutes will be required to change ports and it is estimated that the response time, rounded to the next highest minute, was 4 minutes. Thus, the minimum total time required for a stratification test at Presque Isle was approximately 61 minutes.

Relative Accuracy Testing

During relative accuracy testing, a system integrity check was conducted by introducing both zero and oxidized mercury calibration gas before and after each run. M30A allows the operator to conduct multiple sampling runs without pre- and post-system integrity checks at the risk of invalidating any run that is not followed by a successful system integrity check. Following the pre-test system integrity check, the probe should be positioned at the first sampling point, and allowed to flush and equilibrate for at least two times the measurement system response time before recording any data for the first sampling point. If a traverse is required as a result of the stratification test, then, traverse and record measurements at all required sampling points. The minimum sampling time at each sampling point must be at least two times the system response time, but not less than 10 minutes. Each traverse point should be sampled for an equal length of time.

Note that for unstratified gas where a single sampling point is being used, the minimum total time will be four times the system response time (two to flush after the system integrity check and two to sample).

The zero and upscale drift is the absolute difference between the pre- and post-run system integrity check calibration error. The upscale drift must be $\leq$ 3.0 % or $\leq$ 0.3 $\mu g/m^3$.

RESULTS

Initial Testing

The performance of the IRM during the initial checkout was disappointing. The IRM measurement appeared biased high and the signal was noisy. A trend of some initial data is presented in Figure 1. The Thermo system is designed to be installed in an environmental enclosure with fairly tight temperature control. It is difficult to design a portable system with comparable controls. However, fine tuning of the enclosure and minor modifications to the analyzer can be made to minimize the effects of temperature fluctuations. The trend shown in Figure 1 represents data collected after standard system upgrades were made to the 80i, but before any custom upgrades. Several modifications were made to improve system performance to the extent necessary for an effective IRM. These included:

1) Receiving replacement optics from Thermo based on their recommendations. This eliminated the high bias observed.
2) Modifying the air conditioner to reduce temperature fluctuations.
3) Modifying the 80i thermal controls to maintain more consistent temperatures.

Following these modifications, the IRM was steady and tracked well with the CEM installed at the site.

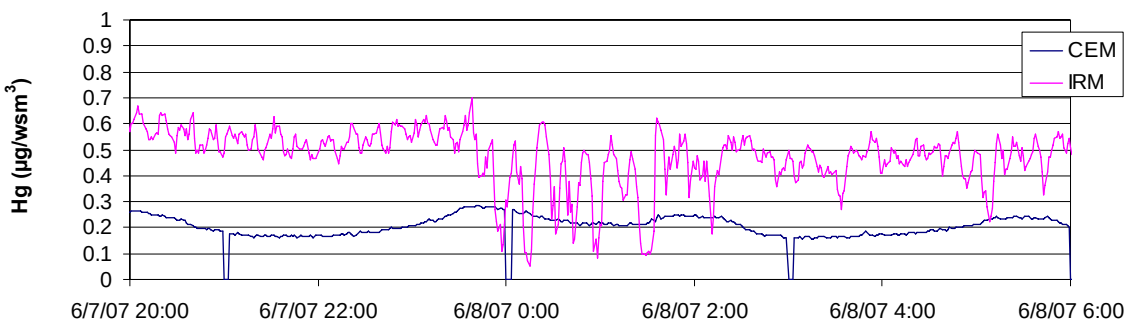


Fig. 1. Trend graph of initial IRM performance.

Certification Testing

The first test of the IRM equipment was a system calibration error test. The standard Thermo 80i and 81i controls allow the user to conduct a system zero followed by a system calibration to flood the area upstream of the sampling filter with calibration gas. The IRM equipment at Presque Isle responded well to the calibration error test. A trend graph of the IRM equipment response is shown in Figure 2.

System Calibration Error Testing

According to M30A, the system calibration error (SCE) must be within ± 5%.

$$SCE = \frac{C_s - C_v}{CS} x100$$

Where C_s = measured response
C_v = the calibration value, and
CS = the Calibration Span = 9 µg/sm^3

As an alternative, the absolute difference in the calibration value and the measured value must be ±0.5 µg/m^3. The calibration error response is shown graphically in Figure 2 and the EPA SCE evaluation is included in Table 1.

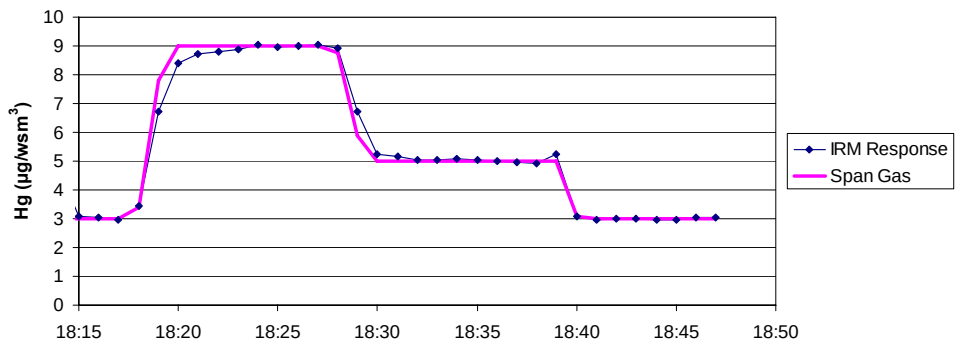


Fig. 2. Calibration error test response.

Table 1. Calibration Error for IRM equipment.

Date/Time	Calibration Gas Level	Calibration* Gas Concentration (µg/m^3)	System Response (µg/m^3)	Absolute Difference	Calibration Error
		C_v	C_s	$\|C_v - C_s\|$	$[\|C_v - C_s\|]$*100/CS
6/13/07 18:39	Low	3.00	3.00	0.00	0.00%
6/13/07 18:27	Mid	5.00	5.016	0.02	0.16%
6/13/07 18:17	High	9.00	9.00	0.00	0.00%

*Certified mercury generators were not available for this test. Calibrator output was sampled with sorbent traps and analyzed to assure accurate concentration.

System Response Time Evaluation
The system response time can be calculated using the system calibration error test shown in Figure 2. The response time, rounded to the nearest minute, was 4 minutes. This was used to determine the appropriate sampling times for the remaining tests.

System Integrity Check
The system integrity check was conducted immediately prior to beginning the relative accuracy test and is presented with the RATA discussion below.

Dynamic Spike Testing

During the dynamic spiking phase of testing, the sample conditioning enclosure was configured so that the output of Thermo's oxidized mercury calibration source was connected to a port upstream of the sampling filter. The flow rate of the calibration gas was monitored using Thermo's 81i calibrator with internal mass flow controllers. The calibrator was modified so that all the calibration gas was directed to the spiking port and none was bypassed to the calibrator exhaust. A CO_2 analyzer was used to measure the extent of dilution resulting from introducing the dynamic spike into the sampling probe. Since nitrogen is used as the carrier gas for the mercury from the calibrator, the ratio of CO_2 during the baseline measurement to the change in CO_2 from baseline to spiking indicates the dilution, where the dilution factor, DF is calculated by:

$$\mathrm{DF} = \frac{Q_{probe}}{Q_{spike}} = \frac{C_{CO2base}}{C_{CO2base} - C_{CO2spike}}$$

Q_{probe} = probe flow
Q_{spike} = calibration spike gas flow
$C_{CO2base}$ =Baseline CO_2 concentration
$C_{CO2spike}$ = CO_2 concentration measured during spiking period

To facilitate the M30A requirement to conduct three independent spiking tests, the spiking test procedure was automated. During the first spiking event, the dilution factor was calculated to assure that the spike flow was less than 20% of the probe flow, as required by the method. Because the dynamic spiking process was automated, several events could easily be repeated to determine the response of the equipment. A trend of several repeat tests is shown in Figure 3 with both the CO_2 and mercury measurements.

M30A allows multiple repeat tests to achieve the quality criteria specified. During the evaluation at Presque Isle, the system recovery was below the specified criteria for all runs with oxidized mercury calibration gas. Therefore, only the final three runs used to calculate the recovery and relative standard deviation are shown in Table 2 as an example. The dynamic spiking efforts with oxidized mercury failed according to both criteria identified in M30A. The spike recovery was 71%, which is outside the range specified (100±10%). The relative standard deviation (RSD) was 9.3%, compared to the method criteria of 5%. The response of the system is believed to be a result of the placement of the oxidized mercury calibration source and losses between the source and the extraction location, rather than a true measurement bias. A second test was conducted with elemental mercury to evaluate whether the poor recovery was specific to oxidized mercury or to the system. These results are presented in Table 3. As shown, the spike recovery with elemental mercury ranged from 94 to 103% with an RSD of 4.6%. This is within the criteria specified in M30A.

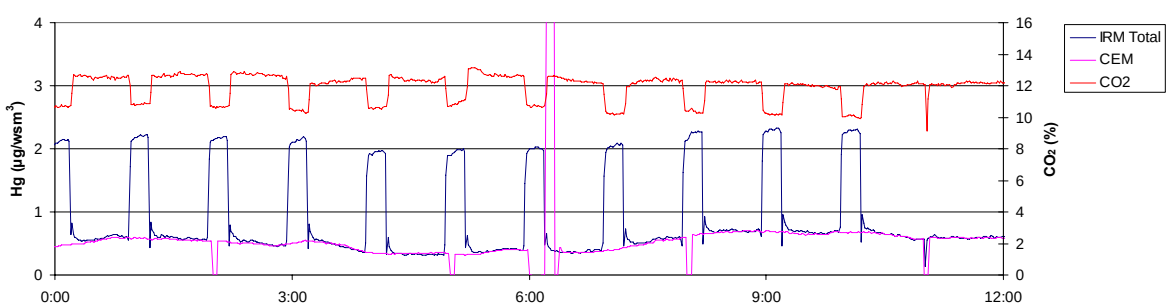


Fig. 3. Mercury and CO_2 concentrations during repeated dynamic spiking periods.

Modifications minimizing losses between the oxidized mercury calibration source and the injection port were made to the system following the test that should remedy the poor oxidized mercury recovery problem. M30A does not require dynamic spiking until January 1, 2009, and it is believed that improved recovery with oxidized mercury will be demonstrated long before this date.

Table 2. Results of Dynamic Spiking Tests with Oxidized Mercury (Spike = 14.25 µg/sm^3).

Time	Mercury		CO_2		DF	Spike Recovery (R)[1]	RSD[1]
	Baseline (C_{native})	Spike (C_{spike})	Baseline ($C_{CO2base}$)	Spike ($C_{CO2spike}$)			
6/23/07 7:54	0.56	2.09	12.33%	10.31%	6.50	79%	
6/23/07 8:54	0.70	2.19	12.25%	10.29%	6.23	68%	
6/23/07 9:54	0.68	2.13	12.00%	10.12%	6.07	67%	
					Mean ($\overline{R}$)	71%	9.3

[1]R $\geq$ 90% required and RSD <5%.

Table 3. Results of Dynamic Spiking Tests with Elemental Mercury (Spike = 15.5 µg/sm^3).

Time	Mercury		CO_2		DF	Spike Recovery (R)	RSD
	Baseline (C_{native})	Spike (C_{spike})	Baseline ($C_{CO2base}$)	Spike ($C_{CO2spike}$)			
6/14/07 7:12	0.92	2.70	12.08%	10.61%	8.21	100%	
6/14/07 8:12	0.80	2.04	12.21%	11.11%	11.09	94%	
6/14/07 9:12	0.78	2.14	12.25%	11.15%	11.21	103%	
					Mean ($\overline{R}$)	99%	4.6

Stratification Testing

The mercury concentration in the stack gas at Presque Isle was below the required 3 µg/m^3 both when the traverse was conducted and when the RATA tests were conducted. However, stratification tests were completed to evaluate both M30A and the IRM equipment.

To determine the extent of stratification, measurements were normalized to the compliance CEM to remove temporal variation. The normalization was conducted by multiplying the concentration at each traverse point by the ratio C_{Favg}/C_F, where C_F was the mercury concentration measured at a fixed point (the compliance CEM measurement) while IRM probe was at the traverse point, and C_{Favg} was the average fixed point concentration corresponding to all traverse points. The flue gas is unstratified if the normalized concentration at any point is within ± 5% of the average normalized concentration or the difference in each normalized concentration and the average normalized concentration is ± 0.2 µg/m^3 (whichever is less restrictive).

A trace of the mercury concentrations measured using the IRM equipment during a 12-point traverse of the Unit 8 stack is compared to the CEM in Figure 4. The times for each traverse point are superimposed on the figure. As shown, the two instruments compared very well. Analysis of the data, included in Table 4, indicates that the flue gas is unstratified.

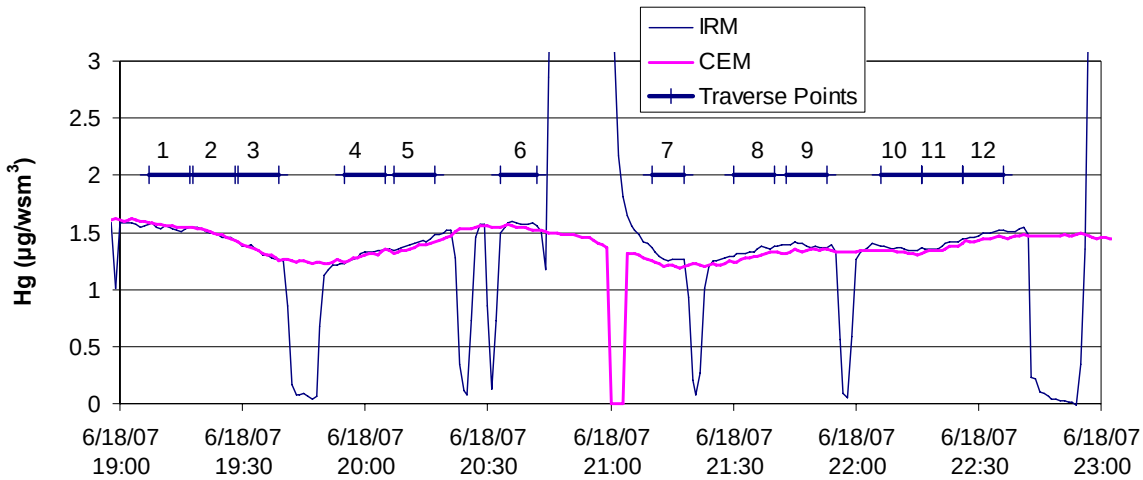


Fig. 4. Results of mercury traverse tests on Unit 8.

Table 4. Results of Mercury Traverse on Unit 8.

Sample Pt	CEM ($\mu g/sm^3$) C_F	IRM ($\mu g/sm^3$) I_x	Normalized IRM ($\mu g/sm^3$) I_{Nx}	Stratification[1] ($\mu g/sm^3$) (I_{Nx} – Avg I_N)	Stratification[1] (%) (I_{Nx} – Avg I_N)/ Avg I_N
1	1.93	1.87	1.37	-0.05	3.2
2	1.69	1.15	1.38	-0.03	2.2
3	1.61	1.52	1.38	-0.03	2.4
4	1.56	1.54	1.40	-0.02	1.3
5	1.50	1.50	1.42	0.00	0.1
6	1.34	1.34	1.41	0.00	0.0
7	1.29	1.30	1.48	0.06	4.4
8	1.36	1.39	1.45	0.03	2.4
9	1.54	1.58	1.43	0.02	1.4
10	1.23	1.31	1.42	0.00	0.1
11	1.33	1.39	1.42	0.00	0.1
12	1.34	1.39	1.42	0.01	0.6
	1.34	1.37	1.41		

[1] |Stratification|<0.1 $\mu g/sm^3$ or <5% for "Unstratified" classification

A traverse of the Unit 7 flue using an SO_2 monitor was conducted one week earlier. No adjustments for temporal variation were made. Without temporal adjustments, the data indicates that the stratification exceeded the allowed 5% for 3 of the 12 traverse points, but was <10%, so the duct would need to be considered minimally stratified.

Table 5. Results of SO_2 Traverse on Unit 7.

Sample Pt	Port	Point	SO_2 (ppm)	Stratification (ppm) (SO_2 – Avg SO_2)	Stratification (%) (SO_2 – Avg SO_2)/ Avg SO_2
1	1	1	196.8	-5.8	3.0%
2	1	2	196.3	-5.3	2.8%
3	1	2	190.8	0.2	0.1%
4	1	4	188.6	2.4	1.3%
5	1	5	193.7	-2.7	1.4%
6	1	6	195.5	-4.5	2.3%
7	2	6	177.9	13.1	6.9%
8	2	5	193.6	-2.6	1.3%
9	2	4	202.7	-11.7	6.1%
10	2	3	191.5	-0.5	0.2%
11	2	2	187.3	3.7	2.0%
12	2	1	177.8	13.2	6.9%
	Avg		191.0		

Relative Accuracy Testing

The initial set of relative accuracy tests were conducted with simultaneous OH, M30B, and M30A measurements. The baghouse at Presque Isle treats the gas from three separate boilers and splits into three separate flues in the stack. Each method sampled gas from a separate flue with OH on Unit 9, M30B on Unit 7, and M30A on Unit 8. Stack CEM measurements indicate that the flue gas from all three flues is homogeneous. The mercury CEM is installed on the combined duct.

A trend graph showing IRM readings and CEM readings with results from M30B and OH measurements is shown in Figure 5. The spikes on the IRM response before and after each run are the system integrity checks.

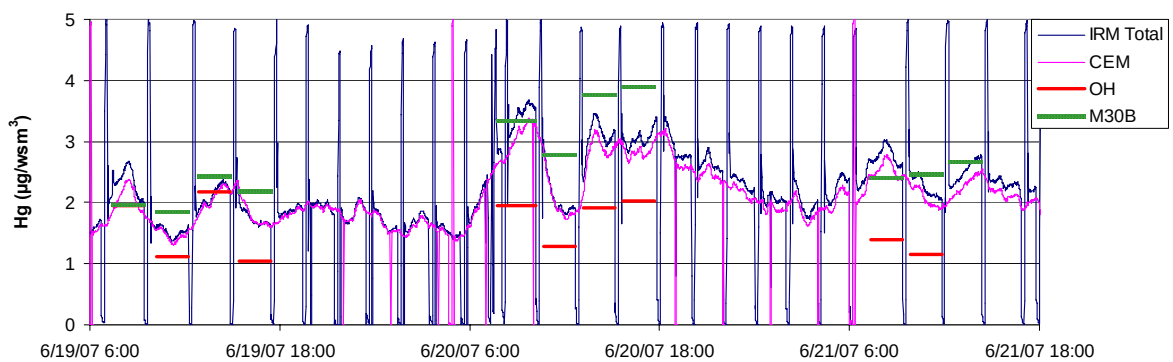


Fig. 5. Mercury trends during high-level RATA.

The IRM performed well during the RATA testing period. The relative accuracy of the three different reference methods and the maximum relative difference between the reference method and the CEM are summarized in Table 6. Relative Accuracy specifications for mercury monitors are contained in section 3.3.8 of Appendix A to 40 CFR Part 75.[2] All three methods indicate that the CEM passed the RATA based upon the relative difference criteria of ≤1 µg/m^3. However, the data also indicate that the CEM exceeded a relative accuracy of 20% when compared to the OH and M30B and that both the M30A and M30B failed the relative accuracy criteria when compared to the OH. This is an indication that it is difficult to obtain successful relative accuracy test results with the manual methods. This comparison data between each reference method and the CEM as well as the OH and the other reference methods are summarized in Table 7.

System integrity checks were conducted on the IRM before and after each sampling run. The IRM passed the system calibration error requirement of <5% for all periods and the maximum drift between any two sampling periods was 0.23 µg/m^3, which is below the maximum allowable drift of 0.3 µg/m^3. These data are summarized in Table 8.

Table 6. Method Comparison Summary.

Reference Method	Test Method	Maximum Relative Difference (RM – Test Method, µg/m^3)	RA	
OH	CEM	-0.93	56.6%	PASS
M30B	CEM	0.93	23.0%	PASS
M30A (IRM)	CEM	0.23	8.6%	PASS
OH	IRM (M30A)	-1.17	64.9%	FAIL
OH	M30B	1.51	90.7%	FAIL

Table 7. Comparison of Measurement Methods.

Point	M30A (µg/m^3)	M30B (µg/m^3)	OH (µg/m^3)	CEM (µg/m^3)
1	2.36	1.97	1.95	2.02
2	1.51	1.86	1.12	1.46
3	2.13	2.43	2.18	2.07
4	1.63	2.2	1.05	1.79
5	3.15	3.34	1.95	2.92
6	2.07	2.79	1.28	2.02
7	3.09	3.78	1.92	2.85
8	2.92	3.91	2.03	2.81
9	2.77	2.42	1.4	2.55
10	2.25	2.47	1.15	2.08
11	2.51	2.68	1.12	2.29
12	2.32	2.46	1.3	2.13

Table 8. System Integrity Checks and Drift.

		System Int. Check					
Pt	IRM Hg (µg/m^3)	Zero (µg/m^3)	Calibration Response (C_s) (µg/m^3)	SCE[1] (%)	|Δ| SCE[2] (µg/m^3)	Drift[3] (%)	|Δ| Drift[4] (µg/m^3)
Pre		0.04	4.99				
1	2.36	-0.01	4.91	-1.8	0.09	1.78	0.08
2	1.51	0.00	4.96	-0.9	0.04	0.92	0.05
3	2.13	0.00	4.83	-3.5	0.17	2.63	0.13
4	1.63	0.01	5.05	1.1	0.05	4.55	0.23
Pre		0.07	4.97				
5	3.15	0.01	4.99	-0.3	0.01	0.28	0.01
6	2.07	-0.03	4.87	-2.6	0.13	2.33	0.12
7	3.09	0.02	4.85	-3.0	0.15	0.38	0.02
8	2.92	0.01	4.91	-1.7	0.09	1.28	0.06
Pre		0.00	4.86				
9	2.77	-0.02	5.03	0.5	0.03	0.51	0.17
10	2.25	0.02	4.98	-0.4	0.02	0.90	0.05
11	2.51	0.02	5.02	0.4	0.02	0.82	0.04
12	2.32	-0.01	4.91	-1.8	0.09	2.22	0.11

[1] SCE $\leq$ 5% OR
[2] Absolute difference SCE $\leq$ 0.5 µg/m^3
[3] Drift must be $\leq$ 3% OR
[4] Absolute difference Drift < 0.3 µg/m^3

Two additional RATA tests were conducted using the IRM to assess the performance of the CEM at lower mercury concentrations at 1 to 1.5 ug/m3 and at nominally 0.5 ug/m^3. The resulting RA between the IRM and the CEM for these two ranges was 10.1% and 11.7% respectively.

CONCLUSIONS

RATA testing at Presque Isle indicated that M30A and M30B are viable methods that can be successfully achieved according to the pre-January 1, 2009, criteria. General observations from testing include:

- M30A provides an alternate reference method to the Ontario Hydro that will become more important to the industry as more units install mercury control and require accurate measurements at low concentrations.
- NIST Certified calibration sources are not yet available. These are required by M30A and no provisions are currently in the method to allow alternate validation of the calibration sources, such as measuring the output with sorbent traps or the Ontario Hydro method.
- A properly operating IRM can provide significant cost savings through both real-time feedback to assess compliance and automated RATA testing in unstratified ducts.
- Although the manual reference methods used at Presque Isle indicated the compliance CEM passed the RATA, the two methods did not pass a RATA when compared against each other.
- It is important to note that only one IRM of the design described in this paper exists and that custom modifications were made to production equipment to assure optimal performance. ADA-ES is working with an equipment manufacturer to accelerate the availability of IRM equipment to the industry in the near future. Unless fabrication can be implemented quickly, the industry as a whole will not benefit from IRM RATA testing prior to the January 1, 2009, certification testing deadline.

REFERENCES

1. Method 30A – Determination of Total Vapor Phase Mercury Emissions from Stationary Sources (Instrumental Analyzer Procedure). http://www.epa.gov/ttn/emc/prelim.html
2. Code of Federal Registers, Title 40: Protection of Environment, Part 75—Continuous Emission Monitoring, Subpart I—Hg Mass Emission Provisions, Appendix A to Part 75–Specifications and Test Procedures.

ACKNOWLEDGMENTS

The work described in this paper was made possible through funding and leadership of We Energies and DOE NETL through DOE CCPI Agreement DE-FC26-04NT41766. Any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the DOE or the other funders.

Special acknowledgments are given to Jon Konings and Steve Derenne at We Energies and Jean Bustard at ADA-ES for their support of this effort. Jeff Socha and Dieter Kita at ThermoFisher provided technical support to assure optimal operation of the 80i and oxidized mercury calibration system. Robin Stewart at ADA-ES assisted with testing, including extra efforts during late-night stratification testing. Paul Sartorelli and the staff at Presque Isle are also gratefully acknowledged for their support during testing at their facility.

Appendix T. Platt – Particulate and Halogens 2007

Particulate and Hydrogen Chloride Emission Test Report

We Energies
Presque Isle Power Plant
Toxecon System
Marquette, Michigan
June 26, 2007

Performed For
ADA-ES

Platt Environmental Services, Inc.

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Particulate and Hydrogen Chloride Emission Test Report

We Energies
Presque Isle Power Plant
Toxecon System
Marquette, Michigan
June 26, 2007

Performed For
ADA-ES

Prepared By

Platt Environmental Services, Inc.

Report No. M072505B

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 EXECUTIVE SUMMARY 2

3.0 TEST METHODOLOGY 2
- 3.1 Method 1 Sample and Velocity Traverse Determination 2
- 3.2 Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination 3
- 3.3 Method 17 Particulate Determination 3
- 3.4 Method 26A Hydrogen Chloride (HCl), Hydrogen Bromide (HBr) and Halide Determinations 4

5.0 PROCESS DATA 8

6.0 CONCLUSION AND CERTIFICATION 9

APPENDIX
- Test Section Diagram 11
- Sample Train Diagrams 13
- Calculation Nomenclature and Formulas 17
- Laboratory Sample Analysis 24
- Reference Method Test Data (Hand and Computerized Sheets) 29
- Calibration Data 40
- Field Data Sheets 51

1.0 Introduction

PLATT ENVIRONMENTAL SERVICES, INC. (PES) conducted a particulate and hydrogen chloride emission test program for ADA-ES, Inc., on the Toxecon System at the Presque Isle Power Plant of We Energies in Marquette, Michigan on June 26, 2007. This report summarizes the results of the test program and test methods used.

The test location, test date and test parameters are summarized below, in Table 1.

Table 1

Test Overview

Test Location	Test Date	Test Parameters
Toxecon Inlet	June 26, 2007	Filterable PM (M17)
Toxecon Outlet	June 26, 2007	Filterable PM (M17) and Hydrogen Chloride (M26A)

The identification of individuals associated with the test program, are summarized below.

Table 2

Contact Information

Location	Address	Contact
Test Facility	We Energies Presque Isle Power Plant Marquette, Michigan	Jon Konings (414) 221-2430 (phone) Jon.Konings@we-energies.com
Test Coordinator	ADA-ES 8100 SouthPark Way, Unit B Littleton, Colorado 80120-4525	Ms. Robin Stewart Manager of Contract R&D (303) 339-8863 robins@adaes.com
Testing Company Representative	Platt Environmental Services, Inc. 371 Balm Court Wood Dale, Illinois 60191	Eric L. Ehlers Senior Project Supervisor (630) 521-9400 (phone) (630) 521-9494 (fax) eehlers@plattenv.com

The test program was conducted by Ms. E. Osthus and Messrs. M. Platt, R. Savchenko, S. Banach and E. Ehlers of PES. The purpose of this test program was to the emissions of particulate and HCl as well as the particulate removal efficiency across the Toxecon baghouse.

2.0 Executive Summary

The test consisted of three (3) runs at the inlet and outlet of the Toxecon baghouse. Selected results of the test program are summarized below, in Table 3. A complete summary of emission test results follows the narrative portion of this report.

Table 3

Test Results

Parameter	Toxecon Inlet	Toxecon Outlet	Removal Efficiency %
Filterable PM lbs/hr	113.990	17.799	84.4
HCl lbs/hr	N/A	1.18	N/A
HBr lbs/hr	N/A	2.01	N/A
Cl2 lbs/hr	N/A	3.74	N/A
Br2 lbs/hr	N/A	<0.03	N/A

3.0 Test Methodology

Emissions testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A. Schematics of the sampling trains used and copies of field data sheets for each test run are included in the Appendix.

The following methodologies were used during the test program:

3.1 Method 1 Sample and Velocity Traverse Determination

Test measurement points were selected in accordance with Method 1, 40 CFR, Part 60, Appendix A. The characteristics of each measurement location are summarized below, in Table 4.

Table 4

Sample Point Selection

Location	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
Toxecon Inlet	< 2.0 Diameters	< 0.5 Diameters	M17	24
Toxecon Outlet	> 2.0 Diameters	> 0.5 Diameters	M17, M26A	24

3.2 Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

Stack gas molecular weight was determined in accordance with Method 3A. Servomex analyzers were used to determine stack gas oxygen and carbon dioxide content and, by difference, nitrogen content. All of the equipment used was calibrated in accordance with the specifications of the Method.

3.3 Method 17 Particulate Determination

Stack gas particulate concentrations and emission rates were determined in accordance with Method 17, using a dry, pre-weighed in stack glass fibre filter. An Environmental Supply Company sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method. Particulate matter in the nozzle was recovered using an acetone rinse. The nozzle wash and filter catch were analyzed by PES in accordance with the method.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix.

3.4 Method 26A Hydrogen Chloride (HCl), Hydrogen Bromide (HBr) and Halide Determinations

Hydrogen chloride (HCl) and Hydrogen Bromide(HBr) concentrations were determined using modified Method 26A, 40CFR60. The sampling was performed in the back of the Method 17 sampling train at the outlet of the Toxecon. The sample was passed through dilute (0.1 N) sulfuric acid. In the dilute acid, the HCl and HBr dissolved and formed chloride (Cl) and bromide (Br) ions. The Cl2 and the Br2 were collected in the dilute (0.1N) sodium hydroxide. The chloride and bromide ions were then analyzed by ion chromatography. The sample train consisted of a Teflon lined probe followed by a heated filter, and five impingers. The first and second impingers contained the dilute sulfuric acid, the third and fourth impingers contained the dilute sodium hydroxide and the fifth impinger contained silica gel to absorb any remaining moisture. The train was leak checked prior to and after each run. The sample was then extracted at a constant sample rate. The samples were recovered by quantitatively transferring the contents of the first three impingers and deionized water rinses to a glass sample jar. Similarly the contents of the fourth and fifth impingers were recovered for the halide determinations. The samples were mixed and labeled, and the level marked for transfer to the laboratory.

4.0 Test Result Summaries

Company: **We Energies**
Plant: **PIPP**
Unit: **Toxecon Outlet**

Source Condition	**Normal Load**	**Normal Load**	**Normal Load**	
Date	**6/26/07**	**6/26/07**	**6/26/07**	
Start Time	**9:15**	**11:35**	**13:15**	
End Time	**10:29**	**12:43**	**14:24**	
	Run 1	**Run 2**	**Run 3**	**Average**
Stack Conditions				
Average Gas Temperature, °F	356.8	357.9	358.9	357.9
Flue Gas Moisture, percent by volume	11.5%	11.3%	12.1%	11.6%
Average Flue Pressure, in. Hg	29.58	29.61	29.61	29.60
Gas Sample Volume, dscf	63.266	69.806	68.169	67.080
Average Gas Velocity, ft/sec	69.245	74.779	63.200	69.075
Gas Volumetric Flow Rate, acfm	1,271,345	1,372,948	1,160,352	1,268,215
Gas Volumetric Flow Rate, dscfm	718,826	778,110	650,780	715,905
Average %CO_2 by volume, dry basis	13.0	13.1	13.0	13.0
Average %O_2 by volume, dry basis	6.0	6.0	6.0	6.0
Isokinetic Variance	101.4	103.3	95.1	99.9
Filterable PM				
mg/acm	6.024	6.682	6.592	6.433
mg/dscm	6.196	6.880	6.838	6.638
grains/acf	0.0015	0.0017	0.0017	0.0016
grains/dscf	0.0027	0.0030	0.0030	0.0029
lb/hr	16.680	20.050	16.666	17.799
lb/mmBtu:	0.0053	0.0059	0.0059	0.0057

Company: **We Energies**
Plant: **PIPP**
Test Location: **Toxecon Outlet**

Source Condition	Normal Load	Normal Load	Normal Load	
Date	6/26/07	6/26/07	6/26/07	
Start Time	9:15	11:35	13:15	
End Time	10:29	12:43	14:24	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	356.8	357.9	358.9	356.0
Flue Gas Moisture, percent by volume	16.6%	16.4%	16.5%	15.5%
Average Flue Pressure, in. Hg	29.58	29.61	29.61	29.57
Gas Sample Volume, dscf	63.266	69.806	68.169	66.027
Average Gas Velocity, ft/sec	69.245	74.779	63.200	66.044
Gas Volumetric Flow Rate, acfm	1,271,345	1,372,948	1,160,352	1,212,566
Gas Volumetric Flow Rate, dscfm	718,826	778,110	650,780	683,699
Average %CO_2 by volume, dry basis	13.0	13.1	13.0	13.0
Average %O_2 by volume, dry basis	6.0	6.0	6.0	6.0
Isokinetic Variance	101.4	103.3	95.1	99.3
Hydrogen Chloride (HCl)				
ppm	0.74135	0.04522	0.08414	0.29024
µg/dscm	1124.6423	68.6001	127.6465	440.2963
lb/hr	3.028059	0.199936	0.311149	1.179715
lb/mmBtu	0.0010	0.0001	0.0001	0.0004
Hydrogen Bromide (HBr)				
ppm	0.19	0.27	0.22	0.23
µg/dscm	636.34	915.68	756.35	769.45
lb/hr	1.7133	2.4654	1.8437	2.0075
lb/mmBtu	0.0005	0.0008	0.0006	0.0007
Bromine (Br_2)				
ppm	0.0017	0.0015	0.0016	0.0016
µg/dscm	11.16	10.12	10.36	10.55
lb/hr	0.0301	0.0272	0.0253	0.0275
lb/mmBtu	0.000010	0.000009	0.000009	0.000009
Chlorine(Cl_2)				
ppm	0.4040	0.7868	0.2465	0.48
µg/dscm	1191.90	2321.12	727.18	1413.40
lb/hr	3.2092	6.2495	1.7726	3.7438
lb/mmBtu	0.0010	0.0020	0.0006	0.0012

Company: **We Energies**
Plant: **Presque Isle Power Plant**
Test Location: **Toxecon Inlet**

Source Condition	**Normal Load**	**Normal Load**	**Normal Load**	
Date	**6/26/07**	**6/26/07**	**6/26/07**	
Start Time	**9:17**	**11:35**	**13:!5**	
End Time	**10:27**	**12:44**	**14:25**	
	Run 1	**Run 2**	**Run 3**	**Average**
	Stack Conditions			
Average Gas Temperature, °F	351.1	355.4	354.8	353.8
Flue Gas Moisture, percent by volume	9.5%	10.0%	11.4%	10.3%
Average Flue Pressure, in. Hg	28.71	28.71	28.69	28.71
Gas Sample Volume, dscf	50.605	53.459	47.504	50.523
Average Gas Velocity, ft/sec	49.478	59.451	59.084	56.004
Gas Volumetric Flow Rate, acfm	1,000,494	1,202,147	1,194,719	1,132,453
Gas Volumetric Flow Rate, dscfm	565,719	672,188	658,084	631,997
Average %CO_2 by volume, dry basis	13.2	13.2	13.3	13.2
Average %O_2 by volume, dry basis	5.8	5.6	5.5	5.6
Isokinetic Variance	103.8	92.3	101.3	99.1
	Filterable PM			
mg/acm	30.621	40.549	60.578	43.916
grains/acf	0.0082	0.0107	0.0158	0.0116
grains/dscf	0.0145	0.0191	0.0287	0.0207
lb/hr	70.081	109.924	161.965	113.990
lb/mmBtu:	0.0279	0.0364	0.0544	0.0396

5.0 Process Data

Process data was recorded by We Energies and ADA personnel during each test run. The process data is kept on file at the plant.

6.0 Conclusion and Certification

PLATT ENVIRONMENTAL SERVICES is pleased to have been of service to ADA-ES. If you have any questions regarding this test report, please do not hesitate to contact us at 630-521-9400.

CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with those methods specified in this test report.

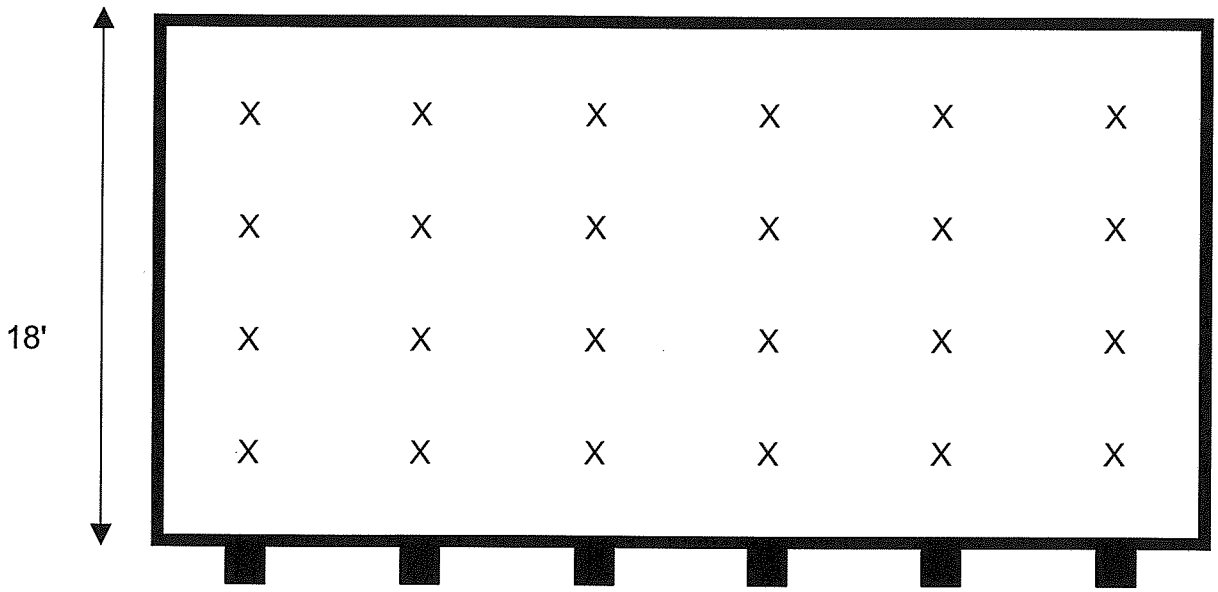
PLATT ENVIRONMENTAL SERVICES

Eric L. Ehlers — Project Manager

Scott W. Banach — Quality Assurance

Appendix

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



Job: We Energies Presque Isle Power Plant

Date: June 26, 2007

Test Location: Toxecon Outlet Duct

Length: 18 Feet

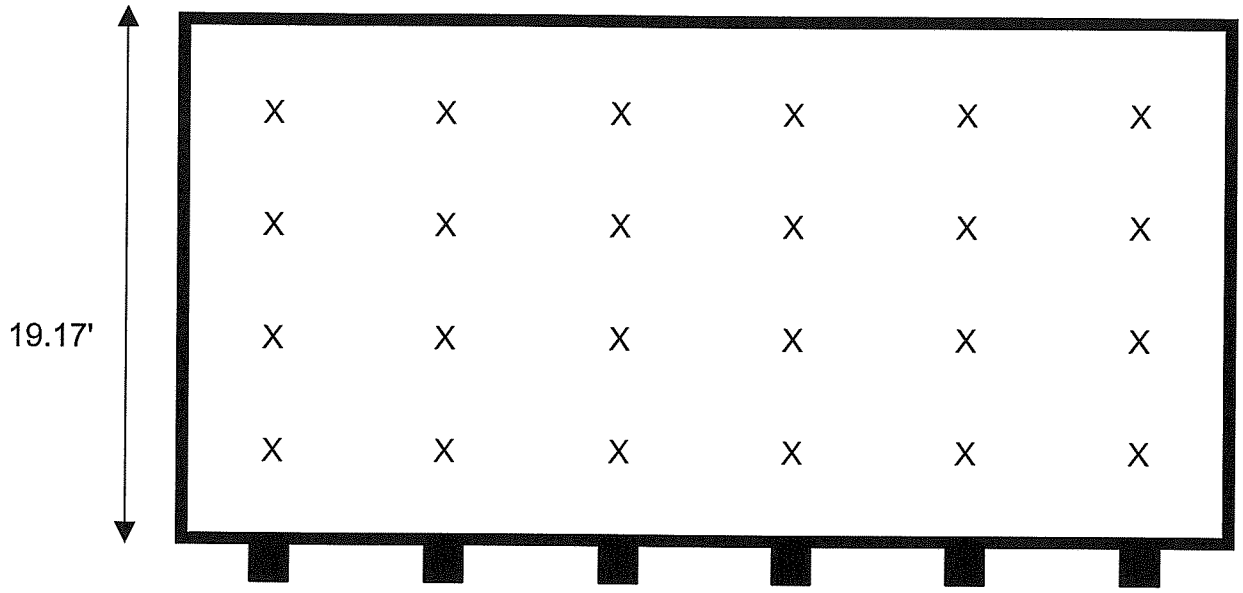
Width: 17 Feet

Duct Area: 306.00 Square Feet

No. of Points : 24

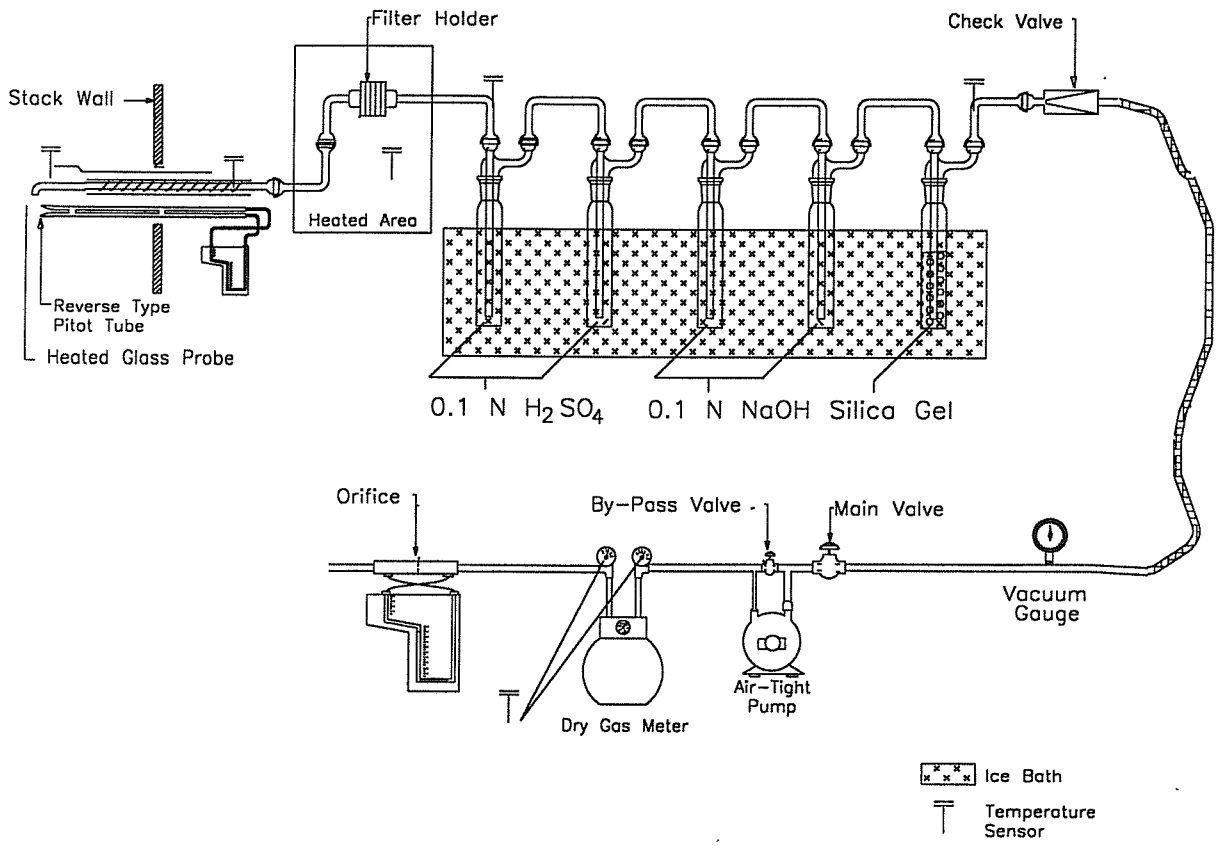
No. of Ports: 6

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS

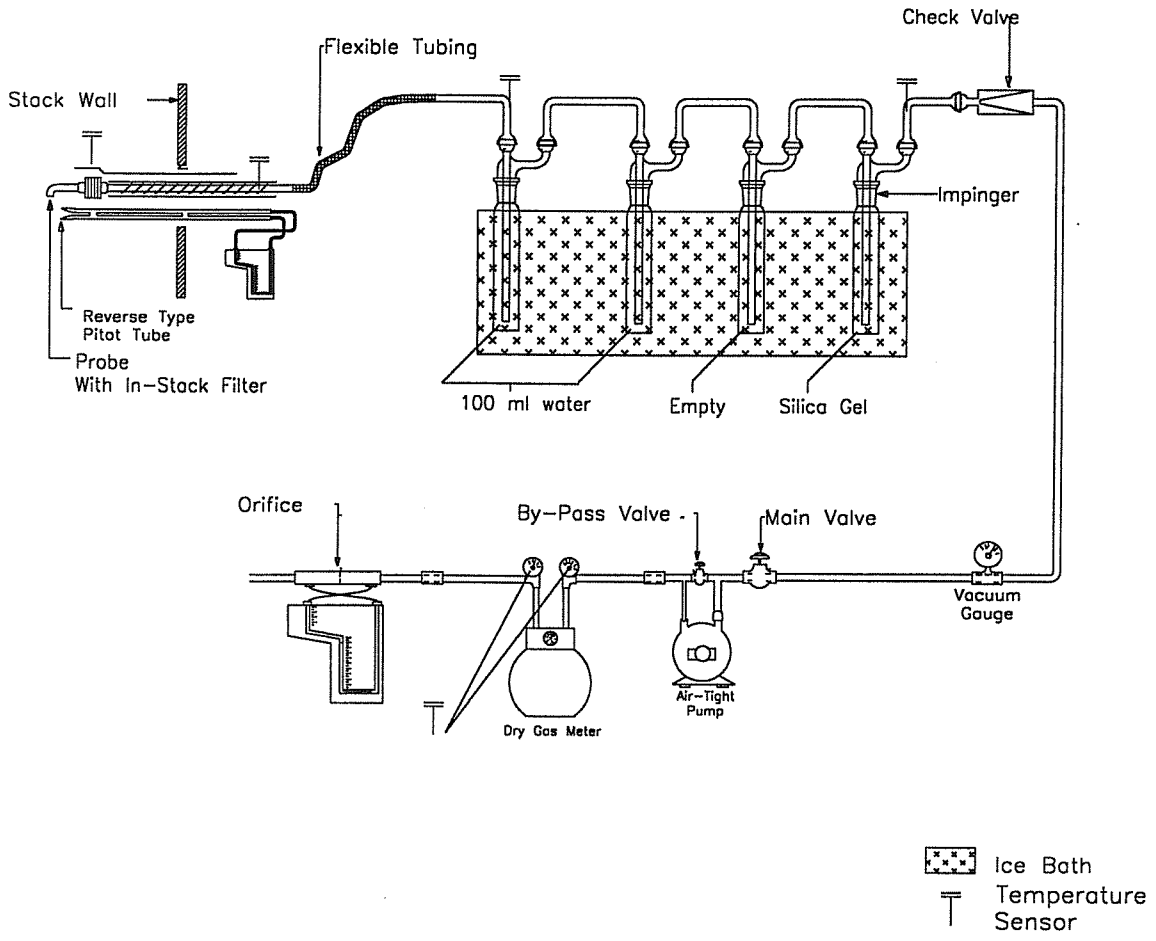


Job:	We Energies Presque Isle Power Plant
Date:	June 26, 2007
Test Location:	Toxecon Inlet Duct
Length:	19.17 Feet
Width:	17.58 Feet
Duct Area:	337.113 Square Feet
No. of Points :	24
No. of Ports:	6

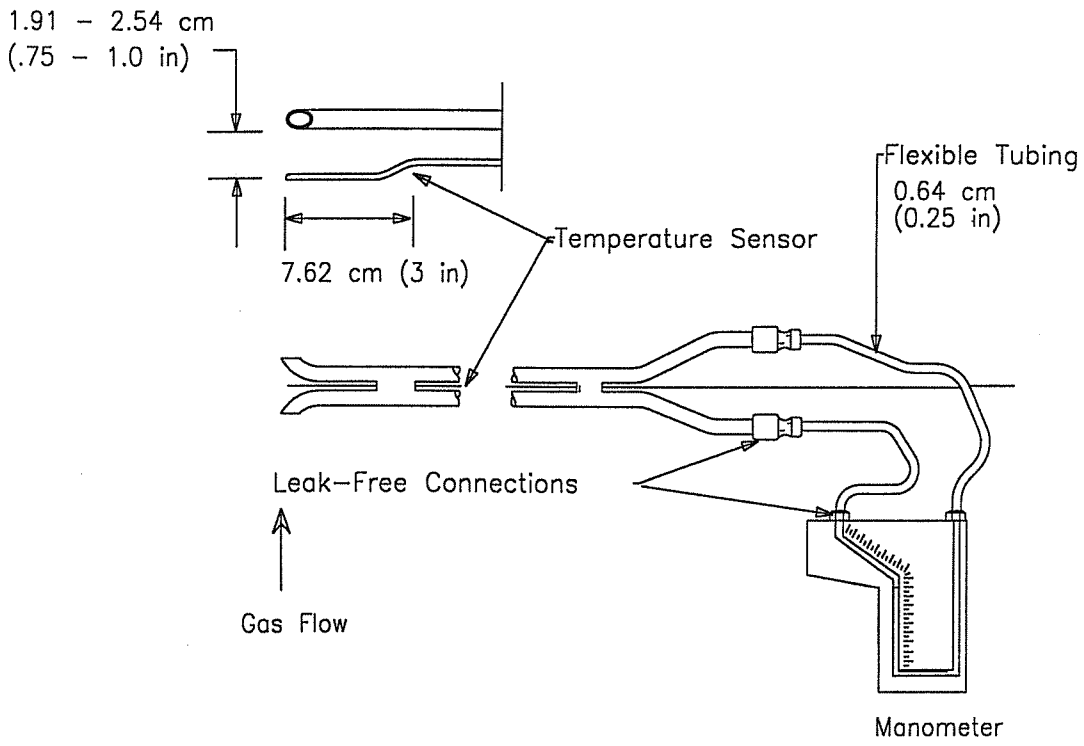
USEPA Method 17/26A – Combined Particulate and Halides Sample Train Diagram



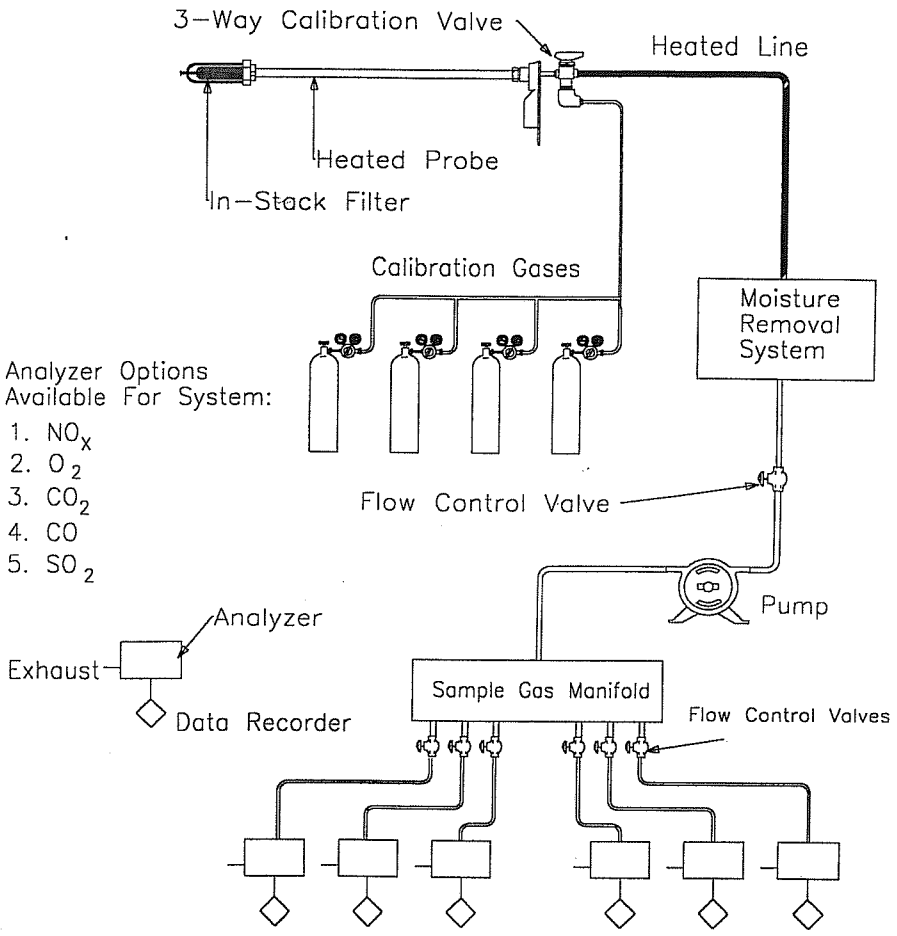
USEPA Method 17 - Particulate Sampling by In-Stack Filtration Sample Train



USEPA Method 2 - S-Type Pitot Tube Diagram



USEPA Method 3A Extractive Gaseous Sampling Diagram



Company:	**We Energies**
Plant:	**PIPP**
Test Location:	**Toxecon Outlet**
Run:	**1**
Date:	**6/26/2007**

Dry Molecular Weight

$$Md = 0.44 \times (\%CO_2) + 0.32 \times (\%O_2) + 0.28 \times \%N_2$$

$\%CO_2$ = 13.0 $\%O_2$ = 6.0 $\%N_2$ = 81.0

Md = 30.32

Wet Molecular Weight

$$Ms = Md \times (1-Bws) + (18.0 \times Bws)$$

Md = 30.32 Bws = 0.115

Ms = 28.90

Meter Volume at Standard Conditions

$$Vm(std) = 17.647 \times Y \times Vm \times \frac{(Pbar + DH/13.6)}{Tm}$$

Y = 1.005 Vm = 65.068 Pbar = 29.32

DH = 5.29 Tm = 81.9

Vm(std) = 63.266

Volume of Water Vapor Condensed

$$Vw(std) = 0.0471 \times (\text{net } H_2O \text{ gain})$$

Net H_2O = 174.9

Vw(std) = 8.238

Moisture Content

$$Bws = \frac{Vwc(std)}{Vwc(std) + Vm(std)}$$

Vw(std) = 8.238 Vm(std) = 63.266

Bws = 0.115

Company:	We Energies
Plant:	PIPP
Test Location:	Toxecon Outlet
Run:	1
Date:	6/26/2007

Average Duct Velocity

$$Vs = 85.49 \times Cp \times \text{Sqrt DP (avg)} \times (Ts\ (avg)/(Ps \times Ms))^{1/2}$$

Cp = 0.840 Ts (avg) = 816.8 Sqrt DP (avg): 0.986
Ps = 29.58 Ms = 28.90

Vs = 69.25

Volumetric Flow Rate (Actual Basis)

$$Q = Vs \times A \times 60$$

Vs = 69.25 A = 306.000

Q = 1271345

Volumetric Flow Rate (Standard Basis)

$$Qstd = 17.647 \times Q \times \frac{Ps}{Ts\ (avg)}$$

Q = 1271345 Ps = 29.58 Ts (avg) = 356.8

Qstd = 812423

Volumetric Flow Rate (Standard Dry Basis)

$$Qstd(dry) = Qstd \times (1-Bws)$$

Qstd = 812423 Bws = 0.115

Qstd(dry) = 718826

Isokinetic Variation:

$$\%ISO = \frac{0.0945 \times Ts \times Vm(std)}{Vs \times \theta \times An \times Ps \times (1-Bws)}$$

Ts = 356.8 Vm(std) = 65.068 Vs = 69.245
An = 0.0004000 θ = 60.0 Ps = 29.58
Bws = 0.115

%ISO = 101.4

Company: We Energies
Plant: PIPP
Test Location: Toxecon Outlet
Run: 1
Date: 6/26/2007

PM Concentration:
This example represents the filterable fraction. For other fractions, use the obtained m_n for that particulate fraction.

$$Co = \frac{m_n \times 15.43}{Vm(std)}$$

m_n (g) = 0.0111 Vm(std) = 63.266

Co = 0.0027 gr/dscf

PM Emission Rate:

$$ER\ lb/hr = \frac{Co}{7000} \times Qstd(dry) \times 60$$

$$ER\ lb/mmBtu = \frac{Co}{7000} \times Fd\ (dscf/mmBtu) \times \frac{20.9}{20.9 - O2\%}$$

Co = 0.0027 Qstd(dry) = 718826

ER lb/hr = 16.680 lb/hr

ER lb/mmBtu = 0.0053 lb/mmBtu

PLATT ENVIRONMENTAL SERVICES, INC.

Particulates Calculation Formulas

1. $V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2 V_{lc}$

2. $V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{P_{std}}\right) = K_1\ V_m\ Y \frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{T_m}$

3. $B_{ws} = \frac{V_{w(std)}}{(V_{m(std)} + V_{w(std)})}$

4. $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$

5. $M_s = M_d(1 - B_{ws}) + 18.0(B_{ws})$

6. $C_a = \frac{m_a}{V_a \rho_a}$

7. $W_a = C_a V_{aw} \rho_a$

8. $C_{acf} = 15.43 K_i \left(\frac{m_n P_s}{V_{w(std)} + V_{m(std)}\ T_s}\right)$

9. $C_S = (15.43\ \text{grains/gram})\ (m_n / V_{m(std)})$

10. $v_s = K_p C_p \sqrt{\frac{\Delta P\ T_s}{P_s M_s}}$

11. $Q_{acfm} = v_s A(60_{sec/min})$

12. $Q_{sd} = (3600_{sec/hr})(1 - B_{ws})\ v_s \left(\frac{T_{std} P_s}{T_s P_{std}}\right) A$

13. E (emission rate, lbs/hr) $= Q_{std}(C_s / 7000\ \text{grains/lb})$

14. $IKV = \frac{T_s V_{m(std)} P_{std}}{T_{std} v_s \theta A_n P_s 60(1 - B_{ws})} = K_4 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$

15. $\%EA = \left(\frac{\%O_2 - (0.5\ \%CO)}{0.264\ \%N_2 - (\%O_2 - 0.5\ \%CO)}\right) \times 100$

Coal Emission Rate Calculations

A pollutant emission rate (E), expressed as pounds of pollutant per million Btu heat input from the fuel combusted can be calculated by several methods as follows:

A. $C = C_s/7000$ where, C = pollutant concentration, lb/dscf
c_s = pollutant concentration, grains/dscf

B. If fuel flow is monitored and the fuel combusted during the test is sampled and analyzed for gross calorific value, then:

$$E = \frac{Q_{sd}C}{\text{fuel flow rate (lb/hr) GCV}} \times 10^6$$

where, E = lbs per million Btu
GCV = gross calorific value, Btu / lb
Q_{sd} = dry volumetric gas flow at standard conditions, dscf / hr

C. If an integrated gas sample is taken during the test and analyzed for $\%CO_2$ or $\%O_2$, dry basis by volume, with an approved USEPA Method 3 or 3A gas analyzer, then

$$E = C\,F_c \frac{100}{(\%CO_2)} \text{ or, } E = C\,F \frac{20.9}{(20.9 - \%O_2)} \quad \text{where,}$$

$\%CO_2$ and $\%O_2$ are expressed as percent values:

F_c = a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the fuel combusted, 1800 scf CO_2/million Btu.

F = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted, 9780 dscf/million Btu.

D. If fuel sample increments are taken and composited during the test and an ultimate analysis is performed and the GCV is determined, then

$$F_c = \frac{321 \times 10^3 (\%C)}{GCV} \text{ where, } \%C = \text{carbon content by weight expressed as percent}$$

$$F = \frac{[3.64(\%H) + 1.53(\%C) + 0.57(\%S) + 0.14(\%N) - 0.46(\%O_2)]}{GCV} \times 10^6$$

1. H = Hydrogen, percent
2. C = Carbon, percent
3. S = Sulfur, percent
4. N = Nitrogen, percent
5. O = Oxygen, percent

PLATT ENVIRONMENTAL SERVICES, INC.

Particulate Nomenclature

A = Cross-sectional area of stack or duct, square feet
A_n = Cross-sectional area of nozzle, square feet
B_{ws} = Water vapor in gas stream, by volume
C_a = Acetone blank residue concentration, g/g
C_{acf} = Concentration of particulate matter in gas stream at actual conditions, gr/acf
C_p = Pitot tube coefficient
C_s = Concentration of particulate matter in gas stream, dry basis, corrected to standard conditions, gr/dscf
IKV = Isokinetic sampling variance, must be 90.0 % ≤ IKV ≤ 110.0%
M_d = Dry molecular weight of gas, lb/lb-mole
M_s = Molecular weight of gas, wet basis, lb/lb-mole
M_w = Molecular weight of water, 18.0 lb/lb-mole
m_a = Mass of residue of acetone after evaporation, grams
P_{bar} = Barometric pressure at testing site, inches mercury
P_g = Static pressure of gas, inches mercury (inches water/13.6)
P_s = Absolute pressure of gas, inches mercury = $P_{bar} + P_g$
P_{std} = Standard absolute pressure, 29.92 inches mercury
Q_{acfm} = Actual volumetric gas flow rate, acfm
Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, dscfh
R = Ideal gas constant, 21.85 inches mercury cubic foot/°R-lb-mole
T_m = Dry gas meter temperature, °R
T_s = Gas temperature, °R
T_{std} = Absolute temperature, 528°R
V_a = Volume of acetone blank, ml
V_{aw} = Volume of acetone used in wash, ml
W_a = Weight of residue in acetone wash, grams
m_n = Total amount of particulate matter collected, grams
V_{1c} = Total volume of liquid collected in impingers and silica gel, ml
V_m = Volume of gas sample as measured by dry gas meter, dcf
$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, corrected to standard conditions, dscf
v_s = Gas velocity, ft/sec
$V_{w(std)}$ = Volume of water vapor in gas sample, corrected to standard conditions, scf
Y = Dry gas meter calibration factor
ΔH = Average pressure differential across the orifice meter, inches water
Δp = Velocity head of gas, inches water
ρ_a = Density of acetone, 0.7855 g/ml (average)
ρ_w = Density of water, 0.002201 lb/ml
θ = Total sampling time, minutes
K_1 = 17.647 °R/in. Hg
K_2 = 0.04707 ft^3/ml
K_4 = 0.09450/100 = 0.000945
K_p = Pitot tube constant, $85.49 \frac{\text{ft}}{\text{sec}} \left[\frac{(\text{lb/lb} - \text{mole})(\text{in.Hg})}{(°\text{R})(\text{in.H}_2\text{O})} \right]^{1/2}$
%EA = Percent excess air
$\%CO_2$ = Percent carbon dioxide by volume, dry basis
$\%O_2$ = Percent oxygen by volume, dry basis
%CO = Percent carbon monoxide by volume, dry basis
$\%N_2$ = Percent nitrogen by volume, dry basis
0.264 = Ratio of O_2 to N_2 in air, v/v
28 = Molecular weight of N_2 or CO
32 = Molecular weight of O_2
44 = Molecular weight of CO_2
13.6 = Specific gravity of mercury (Hg)

PLATT ENVIRONMENTAL SERVICES, INC.

Volumetric Air Flow Calculations

$$Vm\,(std) = 17.647 \times Vm \times \left[\frac{(P_{bar} + (\frac{DH}{13.6}))}{(460 + Tm)} \right] \times Y$$

$$Vw\,(std) = 0.0471 \times Vlc$$

$$Bws = \left[\frac{Vw\,(std)}{Vw\,(std) + Vm\,(std)} \right]$$

$$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (100 - \%CO_2 - \%O_2)]$$

$$Ms = Md \times (1 - Bws) + (18 \times Bws)$$

$$Vs = \sqrt{\frac{(Ts + 460)}{Ms \times Ps}} \times \sqrt{DP} \times Cp \times 85.49$$

$$Acfm = Vs \times Area\ (of\ stack\ or\ duct) \times 60$$

$$Scfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)} \right]$$

$$Scfh = Scfm \times 60 \frac{min}{hr}$$

acfm = actual cubic feet per minute
scfm = standard cubic feet per minute
scfh = standard cubic feet per hour

Cp = pitot tube correction factor
Ps = absolute flue gas pressure
Ms = molecular weight of gas (lb/lb mole)
Md = dry molecular weight of gas (lb/lb mole)
Bws = water vapor in gas stream proportion by volume

Project/Project Number: **We Energies Presque Isle Power Plant - Toxecon Inlet Duct**

Analysis Date: **7/2/2007** **Analyst:** **SWB**

Description			Initial Weight	Final Weight	Net Weight Gain
Test No. 1					
Filter No.	224		7.4560	7.4957	0.0397
Acetone Wash No.	311	33	1.2302	1.2380	0.0078
Acetone Blank					-0.0001
Total Weight					0.0474
Test No. 2					
Filter No.	217		7.3162	7.3752	0.0590
Acetone Wash No.	318	35	1.2366	1.2438	0.0072
Acetone Blank					-0.0001
Total Weight					0.0661
Test No. 3					
Filter No.	222		7.2282	7.3093	0.0811
Acetone Wash No.	316	40	1.2395	1.2469	0.0074
Acetone Blank					-0.0001
Total Weight					0.0884
Blank					
Acetone Wash No.	267	30	2.5056	2.5057	0.0001

Project/Project Number: **We Energies Presque Isle Power Plant - Toxecon Outlet Duct**

Analysis Date: **7/2/2007** **Analyst:** **SWB**

Description			Initial Weight (grams)	Final Weight (grams)	Net Weight Gain (grams)
Test No. 1					
Filter No.	205		7.3065	7.3126	0.0061
Acetone Wash No.	298	35	1.2343	1.2393	0.0050
Acetone Blank					-0.0001
Total Weight					0.0110
Test No. 2					
Filter No.	215		7.0729	7.0817	0.0088
Acetone Wash No.	299	30	1.2304	1.2349	0.0045
Acetone Blank					-0.0001
Total Weight					0.0132
Test No. 3					
Filter No.	219		7.4244	7.4314	0.0070
Acetone Wash No.	300	32	1.2485	1.2540	0.0055
Acetone Blank					-0.0001
Total Weight					0.0124
Blank					
Acetone Wash No.	267	30	2.5056	2.5057	0.0001

LABORATORY REPORT

TEI Analytical, Inc.
7177 N. Austin
Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 75041
Report Date: 7/25/2007
Sample Received:
7/2/07 12:44

M072505 Toxecon

TEI Number: 75041 Sample: Outlet Test #1 0.1N H2SO4

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	1.14	mg	7/18/2007
HCl (M26A)	2.08	mg	7/18/2007
Total Volume	490		7/3/2007

TEI Number: 75042 Sample: Outlet Test #2 0.1N H2SO4

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	1.81	mg	7/11/2007
HCl (M26A)	0.20	mg	7/18/2007
Total Volume	484		7/3/2007

TEI Number: 75043 Sample: Outlet Test #3 0.1N H2SO4

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	1.46	mg	7/11/2007
HCl (M26A)	0.31	mg	7/11/2007
Total Volume	478		7/3/2007

g. e. O'Neill
Gayle E. O'Neill, Ph.D.

This report may not be reproduced except in its entirety.

LABORATORY REPORT

TEI Analytical, Inc.
7177 N. Austin
Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 75041
Report Date: 7/25/2007
Sample Received:
7/2/07 12:44

M072505 Toxecon

TEI Number: 75044 Sample: Outlet Test #1 0.1N NaOH

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.2	mg	7/11/2007
Chlorine (M26A)	2.17	mg	7/18/2007
Total Volume	272		7/3/2007

TEI Number: 75045 Sample: Outlet Test #2 0.1N NaOH

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.02	mg	7/11/2007
Chlorine (M26A)	4.62	mg	7/18/2007
Total Volume	250		7/3/2007

TEI Number: 75046 Sample: Outlet Test #3 0.1N NaOH

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.02	mg	7/11/2007
Chlorine (M26A)	1.44	mg	7/11/2007
Total Volume	284		7/3/2007

Gayle E. O'Neill, Ph.D.

This report may not be reproduced except in its entirety.

LABORATORY REPORT

TEI Analytical, Inc.
7177 N. Austin
Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 75041
Report Date: 7/25/2007
Sample Received:
7/2/07 12:44

M072505 Toxecon

TEI Number: 75047 Sample: DI Blank

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	<0.02	mg	7/11/2007
Bromine (M26A)	<0.02	mg	7/11/2007
Chlorine (M26A)	0.024	mg	7/11/2007
HCl (M26A)	0.025	mg	7/11/2007
Total Volume	188		7/3/2007

Gayle E. O'Neill, Ph.D.

This report may not be reproduced except in its entirety.

Customer:	We Energies	
Plant:	PIPP	
Test Location:	Toxecon Outlet	
Test Engineer:	EO	
Temp ID:	CM9	
Meter ID:	CM9	
Pitot ID:	36	
Pitot Tube Coefficient:	0.840	
Probe Length:	18.0	ft
Probe Liner Material:	Glass	
Nozzle Diameter:	0.285/0.321	in.
Meter Calibration Factor:	1.005	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Rectangular	
Length	17	**ft**
Width	18	**ft**
Duct Area:	306.000	**Sq. Ft.**
Number of Ports Sampled:	6	
Number of Points per Port:	4	
Minutes per Point:	2.5	
otal Number of Traverse Points:	24	
Test Length:	60	**min.**
Train Type:	Anderson Box	
Source Condition:	High Load	
# of Runs	4	

CLEAR WORKBOOK

Customer: We Energies
Plant: PIPP
Location: Toxecon Outlet

Type of Fuel Firing:
Coal, Bituminous
Fuel Factor F_d (dscf/mmBtu):
9780

TEST RUN 1

	Filterable	Condensible
Sample ID:	205	
Item:	**Filter**	
PM, grams (net) collected:	0.0111	

TEST RUN 2

	Filterable	Condensible
Sample ID:	215	
Item:	**Filter**	
PM, grams (net) collected:	0.0136	

TEST RUN 3

	Filterable	Condensible
Sample ID:	219	
Item:	**Filter**	
PM, grams (net) collected:	0.0132	

Customer: **We Energies**
Plant: **PIPP**
Location: **Toxecon Outlet**

Number of Analytes: 4

		Run 1	Run 2	Run 3
Identify Analyte:	HCl			
Molecular Weight:	36.461			
mg (net) collected:		2.0148	0.1356	0.2464
Identify Analyte:	HBr			
Molecular Weight:	80.9817			
mg (net) collected:		1.14	1.81	1.46
Identify Analyte:	Br2			
Molecular Weight:	159.818			
mg (net) collected:	Not Detected	0.02	0.02	0.02
Identify Analyte:	Cl2			
Molecular Weight:	70.906			
mg (net) collected:		2.1353	4.5881	1.4037

Customer: We Energies
Plant: PIPP
Location: Toxecon Outlet

Date: 6/26/07
Start Time: 9:15
End Time: 10:29

DRY GAS METER CONDITIONS

ΔH:	5.29	in. H_2O
Meter Temperature, Tm:	81.9	°F
Sqrt ΔP:	0.986	in. H_2O
Stack Temperature, Ts:	356.8	°F
Meter Volume, Vm:	65.068	ft^3
Meter Volume, Vmstd:	63.266	dscf
Meter Volume, Vwstd:	8.238	wscf
Isokinetic Variance:	101.4	%I

Sample Train Leak Checks

Pre	0.002	ft3	@	15	in Hg.
Post	0.002	ft3	@	15	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.32	in. Hg.
Static Pressure:	3.50	in. H_2O
Flue Pressure (Ps):	29.58	in. Hg. abs.
Carbon Dioxide:	13.0	%
Oxygen:	6.0	%
Nitrogen:	81.0	%
Gas Weight dry, Md:	30.320	lb/lb mole
Gas Weight wet, Ms:	28.901	lb/lb mole
Excess Air:	39.002	%
	69.245	fps
Volumetric Flow:	1,271,345	acfm
Volumetric Flow:	718,826	dscfm
Volumetric Flow:	812,423	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	149.8	ml
Difference:	149.8	
Total Water Gain:	174.9	

Silica Initial Wt.	0	grams
Silica Final Wt.	25.1	grams
Difference:	25.1	
Moisture, Bws:	0.115	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	9:15:00	0.53	2.80	14.59	0.728	358	80	80	10.0	2.670	51.104
2	9:17:30	0.59	3.15	17.26	0.768	356	83	80	10.0	2.720	53.919
3	9:20:00	0.99	5.29	19.98	0.995	356	85	81	12.0	2.550	69.845
4	9:22:30	1.20	6.41	22.53	1.095	356	85	81	12.0	2.516	76.897
	9:25:00			25.05							
2-1	9:27:00	0.66	3.53	25.05	0.812	358	83	81	14.0	2.554	57.028
2	9:29:30	0.65	3.47	27.60	0.806	358	83	81	14	2.780	56.594
3	9:32:00	0.64	3.42	30.38	0.800	358	83	80	14	2.380	56.157
4	9:34:30	0.64	3.42	32.76	0.800	359	83	81	14	2.810	56.157
	9:37:00			35.57							
3-1	9:40:00	0.96	5.13	35.57	0.980	358	82	80	14	3.320	68.778
2	9:42:30	0.94	5.02	38.89	0.970	358	82	80	14	2.510	68.058
3	9:45:00	0.86	4.6	41.4	0.927	358	83	80	14	2.880	65.098
4	9:47:30	0.9	4.81	44.28	0.949	356	83	80	14	2.434	66.594
	9:50:00			46.714							
4-1	9:53:00	1	5.34	46.714	1.000	357	82	80	14	2.796	70.197
2	9:55:30	1.1	5.88	49.51	1.049	358	83	81	14	2.870	73.623
3	9:58:00	1.3	6.9	52.38	1.140	358	83	81	14	2.680	80.037
4	10:00:30	1.1	5.88	55.06	1.049	359	85	82	14	2.637	73.623
	10:03:00			57.697							
5-1	10:06:00	1.2	6.41	57.697	1.095	355	83	81	14	2.783	76.897
2	10:08:30	1.3	6.95	60.48	1.140	357	83	81	14	2.740	80.037
3	10:11:00	1.3	6.95	63.22	1.140	357	83	81	14	2.710	80.037
4	10:13:30	1.2	6.41	65.93	1.095	357	84	81	14	2.726	76.897
	10:16:00			68.656							
6-1	10:19:00	1.1	5.88	68.656	1.049	352	83	81	14	2.994	73.623
2	10:21::30	1.2	6.41	71.65	1.095	355	83	81	14	2.630	76.897
3	10:24:00	1.2	6.41	74.28	1.095	355	83	81	14	2.740	76.897
4	10:26:30	1.2	6.41	77.02	1.095	354	84	81	14	2.638	76.897
	10:29:00			79.658							

Test Run 1

T-36

Customer: We Energies
Plant: PIPP
Location: Toxecon Outlet

Date: 6/26/07
Start Time: 11:35
End Time: 12:43

DRY GAS METER CONDITIONS

ΔH:	6.23	In. H_2O
Meter Temperature, Tm:	83.8	°F
Sqrt ΔP:	1.066	In. H_2O
Stack Temperature, Ts:	357.9	°F
Meter Volume, Vm:	71.879	cf
Meter Volume, Vmstd:	69.806	dscf
Meter Volume, Vwstd:	8.892	wscf
Isokinetic Variance:	103.3	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	20	in Hg.
Post	0.001	ft3	@	20	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.32	in. Hg.
Static Pressure:	4.00	in. H_2O
Flue Pressure (Ps):	29.61	in. Hg. abs.
Carbon Dioxide:	12.9	%
Oxygen:	6.0	%
Nitrogen:	81.1	%
Gas Weight dry, Md:	30.304	lb/lb mole
Gas Weight wet, Ms:	28.914	lb/lb mole
Excess Air:	38.935	%
Gas Velocity, Vs:	74.816	fps
Volumetric Flow:	1,373,622	acfm
Volumetric Flow:	778,492	dscfm
Volumetric Flow:	877,663	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	166.8	ml
Difference:	166.8	
Total Water Gain:	188.8	

Silica Initial Wt.	0	grams
Silica Final Wt.	22	grams
Difference:	22	
Moisture, Bws:	0.113	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	11:35:00	1.30	6.90	87.39	1.140	354	82	81	15.0	2.965	80.024
2	11:37:30	1.30	6.90	90.35	1.140	355	82	81	15.0	2.990	80.024
3	11:40:00	1.10	5.90	93.34	1.049	356	83	81	15.0	2.710	73.611
4	11:43:00	1.00	5.30	96.05	1.000	355	83	81	15.0	2.845	70.186
	11:45:00			98.90							
2-1	11:47:00	0.99	5.30	98.90	0.995	356	84	81	15.0	2.995	69.834
2	11:49:30	0.83	4.40	101.89	0.911	358	84	81	15	2.780	63.942
3	11:52:00	0.75	4	104.67	0.866	358	85	81	15	2.910	60.782
4	11:54:30	0.7	3.7	107.58	0.837	357	86	81	15	2.708	58.721
	11:57:00			110.288							
3-1	11:58:00	0.66	3.5	110.288	0.812	355	85	82	14	2.792	57.019
2	12:00:30	0.65	3.5	113.08	0.806	360	86	82	14	2.840	56.585
3	12:03:00	0.63	3.4	115.92	0.794	359	88	82	13	2.660	55.708
4	12:05:30	0.64	3.4	118.58	0.800	359	88	82	14	2.691	56.148
	12:08:00			121.271							
4-1	12:09:00	1.3	6.9	121.271	1.140	356	88	83	15	2.889	80.024
2	12:11:30	1.5	8	124.16	1.225	360	88	83	15	2.890	85.959
3	12:14:00	1.2	6.4	127.05	1.095	360	87	83	15	2.850	76.884
4	12:16:30	1.2	6.4	129.9	1.095	359	86	83	15	2.861	76.884
	12:19:00			132.761							
5-1	12:22:00	1.2	6.4	132.761	1.095	356	85	83	15	3.129	76.884
2	12:24:30	1.3	6.9	135.89	1.140	360	85	83	15	2.790	80.024
3	12:27:00	1.3	6.9	138.68	1.140	360	85	83	15	2.880	80.024
4	12:29:30	1.3	6.9	141.56	1.140	360	86	83	15	2.801	80.024
	12:32:00			144.361							
6-1	12:33:00	1.6	8.6	144.361	1.265	359	86	83	15	2.979	88.779
2	12:35:30	1.7	9.1	147.34	1.304	359	86	83	15	3.120	91.511
3	12:38:00	1.9	10.2	150.46	1.378	359	86	83	15	4.370	96.744
4	12:40:30	2	10.7	154.83	1.414	360	87	83	15	4.434	99.257
	12:43:00			159.264							

Test Run 2

Customer: We Energies
Plant: PIPP
Location: Toxecon Outlet

Date: 6/26/07
Start Time: 13:15
End Time: 14:24

DRY GAS METER CONDITIONS

ΔH:	4.35	In. H_2O
Meter Temperature, Tm:	85.3	°F
Sqrt ΔP:	0.899	In. H_2O
Stack Temperature, Ts:	358.9	°F
Meter Volume, Vm:	70.714	cf
Meter Volume, Vmstd:	68.169	dscf
Meter Volume, Vwstd:	9.401	wscf
Isokinetic Variance:	95.1	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	20	in Hg.
Post	0.001	ft3	@	20	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.32	in. Hg.
Static Pressure:	4.00	in. H_2O
Flue Pressure (Ps):	29.61	in. Hg. abs.
Carbon Dioxide:	13.0	%
Oxygen:	6.0	%
Nitrogen:	81	%
Gas Weight dry, Md:	30.320	lb/lb mole
Gas Weight wet, Ms:	28.827	lb/lb mole
Excess Air:	39.002	%
Gas Velocity, Vs:	63.200	fps
Volumetric Flow:	1,160,352	acfm
Volumetric Flow:	650,780	dscfm
Volumetric Flow:	740,529	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	186	ml
Difference:	186	
Total Water Gain:	199.6	

Silica Initial Wt.	0	grams
Silica Final Wt.	13.6	grams
Difference:	13.6	
Moisture, Bws:	0.121	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	13:15:00	0.56	3.00	66.69	0.748	359	82	82	12.0	2.620	52.632
2	13:17:30	0.57	3.00	69.31	0.755	360	82	82	12.0	2.610	53.100
3	13:20:00	0.60	3.20	71.92	0.775	360	85	87	12.0	2.700	54.479
4	13:22:30	0.54	2.90	74.62	0.735	359	85	82	12.0	2.634	51.684
	13:25:00			77.25							
2-1	13:27:00	0.80	4.30	77.25	0.894	358	85	82	11.0	2.546	62.907
2	13:29:30	0.83	4.40	79.80	0.911	359	86	82	15	2.650	64.076
3	13:32:00	0.82	4.4	82.45	0.906	360	87	82	15	2.830	63.689
4	13:34:30	0.73	3.9	85.28	0.854	359	87	82	15	3.105	60.092
	13:37:00			88.385							
3-1	13:39:00	0.91	4.9	88.385	0.954	356	86	82	15	2.895	67.093
2	13:41:30	0.9	4.8	91.28	0.949	358	86	82	15	2.850	66.723
3	13:44:00	0.8	4.3	94.13	0.894	359	86	82	15	2.960	62.907
4	13:46:30	0.66	3.5	97.09	0.812	359	87	82	15	2.855	57.138
	13:49:00			99.945							
4-1	13:50:00	0.92	4.9	99.945	0.959	358	86	82	15	2.965	67.460
2	13:52:30	1	5.3	102.91	1.000	359	87	82	15	2.750	70.332
3	13:55:00	1	5.3	105.66	1.000	360	88	82	15	2.970	70.332
4	13:57:30	0.9	4.8	108.63	0.949	360	88	83	15	3.085	66.723
	14:00:00			111.715							
5-1	14:02:00	0.98	5.24	111.715	0.990	357	87	83	15	3.325	69.625
2	14:04:30	0.97	5.2	115.04	0.985	359	89	84	15	3.160	69.269
3	14:07:00	0.95	5.1	118.2	0.975	358	90	84	15	3.330	68.552
4	14:09:30	0.86	4.6	121.53	0.927	358	90	84	15	3.261	65.224
	14:12:00			124.791							
6-1	14:14:00	0.67	3.6	124.791	0.819	360	91	85	15	2.869	57.570
2	14:16:30	0.7	3.7	127.66	0.837	360	92	86	15	2.940	58.844
3	14:19:00	0.9	4.8	130.6	0.949	359	92	86	15	3.320	66.723
4	14:21:30	0.98	5.2	133.92	0.990	359	93	87	15	3.484	69.625
	14:24:00			137.404							

Test Run 3

T-38

Customer:	We Energies	
Plant:	Presque Isle Power Plant	
Test Location:	Toxecon Inlet	
Test Engineer:	MP	
Temp ID:	CM2	
Meter ID:	CM2	
Pitot ID:	029	
Pitot Tube Coefficient:	0.840	
Probe Length:	18.0	ft
Probe Liner Material:	Other	
Nozzle Diameter:	0.298	in.
Nozzle Kit ID Number:	4	
Meter Calibration Factor:	0.997	
Sample Plane:	Vertical	
Port Length:	43.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Rectangular	
Length	19.17	**ft**
Width	17.58	**ft**
Duct Area:	337.013	**Sq. Ft.**
Number of Ports Sampled:	6	
Number of Points per Port:	4	
Minutes per Point:	2.5	
otal Number of Traverse Points:	24	
Test Length:	60	**min.**
Train Type:	Other	
Source Condition:	Normal Full Load	
# of Runs	3	

Customer: We Energies
Plant: Presque Isle Power Plant
Location: Toxecon Inlet

Type of Fuel Firing:
Coal, Bituminous
Fuel Factor F_d (dscf/mmBtu):
9780

TEST RUN 1

	Filterable	Condensible
Sample ID:	224	
Item:	Filter	
PM, grams (net) collected:	0.0474	

TEST RUN 2

	Filterable	Condensible
Sample ID:	217	
Item:	Filter	
PM, grams (net) collected:	0.0661	

TEST RUN 3

	Filterable	Condensible
Sample ID:	222	
Item:	Filter	
PM, grams (net) collected:	0.0884	

Test 1

Customer: We Energies
Plant: Presque Isle Power Plant
Location: Toxecon Inlet

Date: 6/26/07
Start Time: 9:17
End Time: 10:27

DRY GAS METER CONDITIONS

Nozzle Diameter:	0.298	in.
ΔH:	2.29	in. H_2O
Meter Temperature, Tm:	98.0	°F
Sqrt ΔP:	0.700	in. H_2O
Stack Temperature, Ts:	351.1	°F
Meter Volume, Vm:	54.666	ft^3
Meter Volume, Vmstd:	50.605	dscf
Meter Volume, Vwstd:	5.303	wscf
Isokinetic Variance:	103.8	%I

Sample Train Leak Checks

Pre	0	ft3	@	10	in Hg.
Post	0	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.19	in. Hg.
Static Pressure:	-6.50	in. H_2O
Flue Pressure (Ps):	28.71	in. Hg. abs.
Carbon Dioxide:	13.2	%
Oxygen:	5.8	%
Nitrogen:	81.0	%
Gas Weight dry, Md:	30.344	lb/lb mole
Gas Weight wet, Ms:	29.173	lb/lb mole
Excess Air:	37.218	%
Gas Velocity, Vs:	49.478	fps
Volumetric Flow:	1,000,494	acfm
Volumetric Flow:	565,719	dscfm
Volumetric Flow:	625,006	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	200	ml	Silica Initial Wt.	200	grams
Final Impinger Content:	285	ml	Silica Final Wt.	227.6	grams
Difference:	85		Difference:	27.6	

Total Water Gain: 112.6 Moisture, Bws: 0.095

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	9:17:00	0.55	2.40	76.464	0.742	354	95	97	1.0	2.436	52.407
2	9:19:30	0.43	1.90	78.900	0.656	354	96	97	1.0	2.000	46.338
3	9:22:00	0.31	1.36	80.900	0.557	354	96	97	1.0	1.620	39.345
4	9:24:30	0.37	1.63	82.520	0.608	352	96	96	1.0	2.270	42.984
	9:27:00			84.790							
2-1	9:29:00	0.60	2.64	84.900	0.775	353	96	96	3.0	2.490	54.737
2	9:31:30	0.54	2.38	87.390	0.735	354	97	96	3.0	2.280	51.928
3	9:34:00	0.35	1.54	89.670	0.592	355	98	96	4.0	1.790	41.806
4	9:36:30	0.23	1.00	91.460	0.480	344	98	96	3.0	1.840	33.890
	9:39:00			93.300							
3-1	9:41:00	0.93	4.10	93.650	0.964	352	99	96	7.0	3.250	68.147
2	9:43:30	0.72	3.20	96.900	0.849	355	100	95	7.0	2.200	59.961
3	9:46:00	0.39	1.72	99.100	0.624	355	100	96	5.0	2.100	44.130
4	9:48:30	0.29	1.28	101.200	0.539	331	100	96	5.0	2.120	38.054
	9:51:00			103.320							
4-1	9:53:00	1.05	4.60	103.720	1.025	348	101	96	7.0	3.280	72.410
2	9:55:30	1.05	4.60	107.000	1.025	356	102	96	10.0	2.730	72.410
3	9:58:00	0.80	3.52	109.730	0.894	357	103	96	12.0	2.990	63.205
4	10:00:30	0.68	2.99	112.720	0.825	354	104	96	13.0	3.250	58.272
	10:03:00			115.970							
5-1	10:05:00	0.45	2.00	116.100	0.671	348	100	97	7.0	2.200	47.404
2	10:07:30	0.53	2.33	118.300	0.728	355	101	97	10.0	2.170	51.445
3	10:10:00	0.61	2.68	120.470	0.781	355	101	97	12.0	2.650	55.191
4	10:12:30	0.14	0.62	123.120	0.374	348	102	97	7.0	1.330	26.440
	10:15:00			124.450							
6-1	10:17:00	0.39	1.72	124.560	0.624	349	100	97	12.0	2.290	44.130
2	10:19:30	0.45	1.98	126.850	0.671	355	101	96	15.0	2.060	47.404
3	10:22:00	0.50	2.20	128.910	0.707	354	102	97	18.0	2.180	49.968
4	10:24:30	0.13	0.57	131.090	0.361	334	102	97	7.0	1.140	25.479
	10:27:00			132.230							
			2.290	54.666	0.700	351.083333	99.58333	96.375		54.666	

Test 2

Customer: We Energies
Plant: Presque Isle Power Plant
Location: Toxecon Inlet

Date: 6/26/07
Start Time: 11:35
End Time: 12:44

DRY GAS METER CONDITIONS

Nozzle Diameter:	0.298	in.
ΔH:	3.32	In. H_2O
Meter Temperature, Tm:	97.7	°F
Sqrt ΔP:	0.838	In. H_2O
Stack Temperature, Ts:	355.4	°F
Meter Volume, Vm:	57.568	cf
Meter Volume, Vmstd:	53.459	dscf
Meter Volume, Vwstd:	5.949	wscf
Isokinetic Variance:	92.3	%I

Sample Train Leak Checks

Pre	0	ft3	@	10	in Hg.
Post	0	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.19	in. Hg.
Static Pressure:	-6.50	in. H_2O
Flue Pressure (Ps):	28.71	in. Hg. abs.
Carbon Dioxide:	13.2	%
Oxygen:	5.6	%
Nitrogen:	81.2	%
Gas Weight dry, Md:	30.336	lb/lb mole
Gas Weight wet, Ms:	29.101	lb/lb mole
Excess Air:	35.361	%
Gas Velocity, Vs:	59.451	fps
Volumetric Flow:	1,202,147	acfm
Volumetric Flow:	672,188	dscfm
Volumetric Flow:	746,987	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	200	ml	Silica Initial Wt.	200	grams
Final Impinger Content:	295	ml	Silica Final Wt.	231.3	grams
Difference:	95		Difference:	31.3	

Total Water Gain: 126.3 Moisture, Bws: 0.100

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	11:35:00	0.45	1.98	35.290	0.671	353	97	97	1.0	2.630	47.589
2	11:37:30	0.46	2.02	37.920	0.678	355	95	96	1.0	1.550	48.115
3	11:40:00	0.46	2.02	39.470	0.678	355	95	96	1.0	1.730	48.115
4	11:42:30	0.15	1.66	41.200	0.387	354	96	96	2.0	2.019	27.476
	11:45:00			43.219							
2-1	11:46:00	0.45	1.98	43.349	0.671	350	96	95	2.0	2.181	47.589
2	11:48:30	0.55	2.42	45.530	0.742	357	97	95	3.0	2.279	52.612
3	11:51:00	0.60	2.64	47.809	0.775	358	99	95	4.0	2.521	54.951
4	11:53:30	0.15	0.66	50.330	0.387	350	99	95	6.0	0.889	27.476
	11:56:00			51.219							
3-1	11:57:00	1.10	4.84	51.279	1.049	356	102	95	12.0	3.577	74.404
2	11:59:30	1.10	4.84	54.856	1.049	357	102	95	12.0	3.214	74.404
3	12:02:00	0.75	3.30	58.070	0.866	357	103	96	14.0	2.161	61.437
4	12:04:30	0.60	2.64	60.231	0.775	354	103	96	13.0	2.459	54.951
	12:07:00			62.690							
4-1	12:08:30	1.40	6.16	63.356	1.183	357	102	97	16.0	3.457	83.939
2	12:11:00	1.20	5.28	66.813	1.095	357	102	97	17.0	2.417	77.712
3	12:13:30	0.81	3.56	69.230	0.900	357	102	97	17.0	3.500	63.847
4	12:16:00	0.55	2.42	72.730	0.742	357	101	97	17.0	1.610	52.612
	12:18:30			74.340							
5-1	12:20:00	1.20	5.28	74.840	1.095	356	98	97	18.0	1.940	77.712
2	12:22:30	1.10	4.84	76.780	1.049	357	99	97	18.0	2.334	74.404
3	12:25:00	0.75	3.30	79.114	0.866	357	99	97	18.0	1.342	61.437
4	12:27:30	0.45	1.98	80.456	0.671	353	99	97	18.0	3.022	47.589
	12:30:00			83.478							
6-1	12:34:00	1.05	4.62	83.885	1.025	355	98	97	19.0	1.747	72.693
2	12:36:30	0.90	3.96	85.632	0.949	356	98	97	19.0	2.808	67.301
3	12:39:00	0.79	3.48	88.440	0.889	356	98	97	19.0	2.120	63.054
4	12:41:30	0.85	3.74	90.560	0.922	356	98	96	20.0	4.061	65.405
	12:44:00			94.621							
			3.3175	57.568	0.838	355.416667	99.08333	96.25		57.568	

Test 3

Customer: We Energies
Plant: Presque Isle Power Plant
Location: Toxecon Inlet

Date: 6/26/07
Start Time: 13:!5
End Time: 14:25

DRY GAS METER CONDITIONS

Nozzle Diameter:	0.271	in.
ΔH:	2.16	In. H_2O
Meter Temperature, Tm:	99.8	°F
Sqrt ΔP:	0.831	In. H_2O
Stack Temperature, Ts:	354.8	°F
Meter Volume, Vm:	51.534	cf
Meter Volume, Vmstd:	47.504	dscf
Meter Volume, Vwstd:	6.085	wscf
Isokinetic Variance:	101.3	%I

Sample Train Leak Checks

Pre	0	ft3	@	10	in Hg.
Post	0	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-6.50	in. H_2O
Flue Pressure (Ps):	28.69	in. Hg. abs.
Carbon Dioxide:	13.3	%
Oxygen:	5.5	%
Nitrogen:	81.2	%
Gas Weight dry, Md:	30.348	lb/lb mole
Gas Weight wet, Ms:	28.946	lb/lb mole
Excess Air:	34.511	%
Gas Velocity, Vs:	59.084	fps
Volumetric Flow:	1,194,719	acfm
Volumetric Flow:	658,084	dscfm
Volumetric Flow:	742,385	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	200	ml	Silica Initial Wt.	200	grams
Final Impinger Content:	300	ml	Silica Final Wt.	229.2	grams
Difference:	100		Difference:	29.2	

Total Water Gain: 129.2 Moisture, Bws: 0.114

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	13:15:00	0.95	2.85	96.871	0.975	353	97	94	1.0	2.642	69.329
2	13:17:30	0.85	2.56	99.513	0.922	353	97	96	2.0	2.428	65.579
3	13:20:00	0.78	2.34	101.941	0.883	352	99	96	2.0	2.269	62.821
4	13:22:30	0.85	2.56	104.210	0.922	351	100	96	2.0	2.400	65.579
	13:25:00			106.610							
2-1	13:27:30	1.05	3.16	107.101	1.025	349	102	96	7.0	2.769	72.887
2	13:30:00	1.00	3.01	109.870	1.000	350	103	96	7.0	3.040	71.130
3	13:32:30	0.75	2.25	112.910	0.866	351	101	96	8.0	1.820	61.601
4	13:35:00	0.42	1.26	114.730	0.648	347	103	96	7.0	1.621	46.098
	13:37:30			116.351							
3-1	13:39:00	1.20	3.61	116.678	1.095	348	103	96	12.0	2.993	77.919
2	13:41:30	1.05	3.16	119.671	1.025	352	103	96	12.0	2.666	72.887
3	13:44:00	0.68	2.04	122.337	0.825	353	103	97	11.0	2.203	58.656
4	13:46:30	0.65	1.95	124.540	0.806	353	102	96	11.0	2.150	57.347
	13:49:00			126.690							
4-1	13:51:00	1.10	3.31	127.413	1.049	355	103	97	16.0	2.300	74.602
2	13:53:30	1.00	3.01	129.713	1.000	357	104	97	16.0	2.397	71.130
3	13:56:00	0.79	2.37	132.110	0.889	358	104	97	17.0	3.050	63.222
4	13:58:30	0.74	2.22	135.160	0.860	359	104	98	17.0	1.463	61.189
	14:01:00			136.623							
5-1	14:03:00	0.45	1.35	137.470	0.671	359	102	98	16.0	1.740	47.716
2	14:05:30	0.46	1.38	139.210	0.678	361	102	98	16.0	2.540	48.243
3	14:08:00	0.60	1.81	141.750	0.775	361	102	99	16.0	1.480	55.097
4	14:10:30	0.25	0.75	143.230	0.500	356	103	99	14.0	1.161	35.565
	14:13:00			144.391							
6-1	14:15:00	0.45	1.35	145.398	0.671	360	103	100	16.0	1.794	47.716
2	14:17:30	0.47	1.41	147.192	0.686	362	104	100	17.0	1.833	48.765
3	14:20:00	0.55	1.65	149.025	0.742	362	105	100	18.0	2.077	52.752
4	14:22:30	0.18	0.54	151.102	0.424	354	106	101	18.0	0.698	30.178
	14:25:00			151.800							
			2.1625	51.534	0.831	354.833333	102.2917	97.291667		51.534	

Test Run 3

PLATT ENVIRONMENTAL SERVICES, INC.

Procedures for Calibration

Nozzles

The nozzles are measured according to Method 5, Section 5.1.

Dry Gas Meters

The test meters are calibrated according to Method 5, Section 5.3 and "Procedures for Calibrating and Using Dry Gas Volume Meters as Calibration Standards" by P.R. Westlin and R.T. Shigehara, March 10, 1978.

Analytical Balance

The accuracy of the analytical balance is checked with Class S, Stainless Steel Type 303 weights manufactured by F. Hopken and Son, Jersey City, New Jersey.

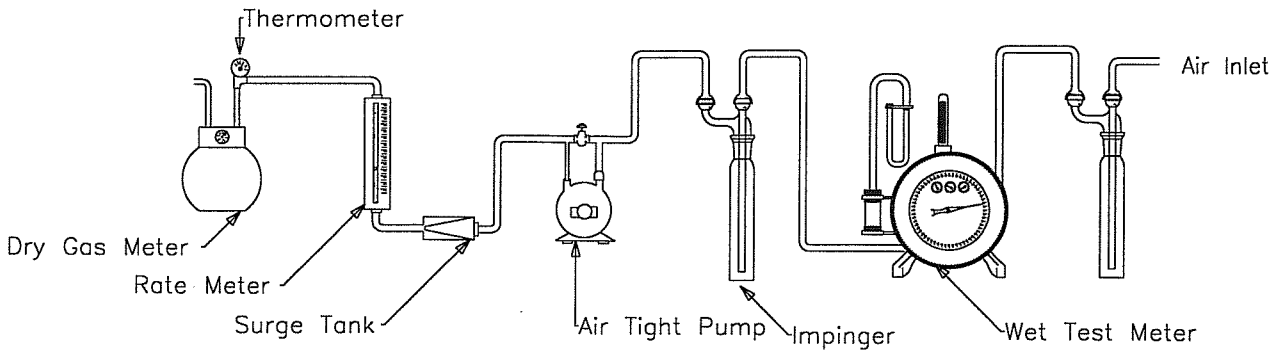
Temperature Sensing Devices

The potentiometer and thermocouples are calibrated utilizing a NBS traceable millivolt source.

Pitot Tubes

The pitot tubes utilized during this test program are manufactured according to specifications described and illustrated in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A, Methods 1 and 2. The pitot tubes comply with the alignment specifications in Method 2, Section 4; and the pitot tube assemblies are in compliance with specifications in the same section.

Dry Gas Meter Calibration Sample Train Diagram



Meter Box Calibration

Dry Gas Meter No.	CM9	Date:	May 24, 2007
Standard Meter No.	9605804	Calibrated By:	EO
Standard Meter (Y)	1.0054	Barometric Pressure:	29.42

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			23.561	53.029	79	81	80					
Initial			18.074	47.560	78	80	78					
Difference	1	0.20	5.487	5.469	79	81	79	80	19	17	1.005	1.429
Final			29.409	58.850	80	83	81					
Initial			23.838	53.289	79	81	80					
Difference	2	0.50	5.571	5.561	80	82	81	81	12	47	1.004	1.524
Final			37.150	66.548	81	85	82					
Initial			29.619	59.044	80	83	81					
Difference	3	0.70	7.531	7.504	81	84	82	83	14	46	1.006	1.560
Final			42.903	72.282	81	85	82					
Initial			37.390	66.790	81	85	82					
Difference	4	0.90	5.513	5.492	81	85	82	84	9	32	1.006	1.561
Final			54.740	84.040	82	87	83					
Initial			49.415	78.747	82	87	83					
Difference	5	1.20	5.325	5.293	82	87	83	85	8	4	1.009	1.598
Final			17.767	47.278	78	81	78					
Initial			11.872	41.424	78	78	77					
Difference	6	2.00	5.895	5.854	78	80	78	79	7	10	1.003	1.711
									Average		**1.005**	**1.564**

Stack Temperature Sensor Calibration

Meter Box # : CM9 *Name :* EO

Ambient Temperature : 77.8 °F *Date :* May 24, 2007

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	2	0.4
250	252	0.3
600	602	0.2
1200	1204	0.2

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

T-47

Meter Box Calibration

Dry Gas Meter No.	CM2	Date:	May 11, 2007
Standard Meter No.	9605804	Calibrated By:	S. Sands
Standard Meter (Y)	1.0054	Barometric Pressure:	29.45

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			970.916	1000.438	67	73	72					
Initial			965.882	995.342	68	72	72					
Difference	1	0.20	5.034	5.096	68	73	72	72	19	40	0.996	1.717
Final			937.947	967.156	68	73	71					
Initial			922.724	951.850	68	71	70					
Difference	2	0.50	15.223	15.306	68	72	71	71	35	55	0.999	1.571
Final			945.033	974.318	68	74	72					
Initial			937.947	967.156	70	73	72					
Difference	3	0.70	7.086	7.162	69	74	72	73	14	35	0.995	1.675
Final			952.327	981.648	68	72	73					
Initial			945.033	974.318	68	72	72					
Difference	4	0.90	7.294	7.330	68	72	73	72	12	53	1.001	1.582
Final			960.327	989.720	67	75	72					
Initial			952.327	981.648	68	72	72					
Difference	5	1.20	8.000	8.072	68	74	72	73	11	41	0.998	1.438
Final			965.882	995.342	67	75	72					
Initial			960.327	989.720	68	74	72					
Difference	6	2.00	5.555	5.622	68	75	72	73	6	54	0.994	1.732
										Average	**0.997**	**1.619**

Stack Temperature Sensor Calibration

Meter Box # : CM2 *Name :* S. Sands

Ambient Temperature : 71.7 °F *Date :* May 11, 2007

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	0	0.0
250	250	0.0
600	599	0.1
1200	1202	0.1

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

T-49

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? Y yes ____ no

Pitot tube openings damaged? ____ yes (explain below) N no

α_1 = 4 ° (<10°), α_2 = 3 ° (<10°) z = A sin γ = 0.016 (in.); (<0.125 in.)

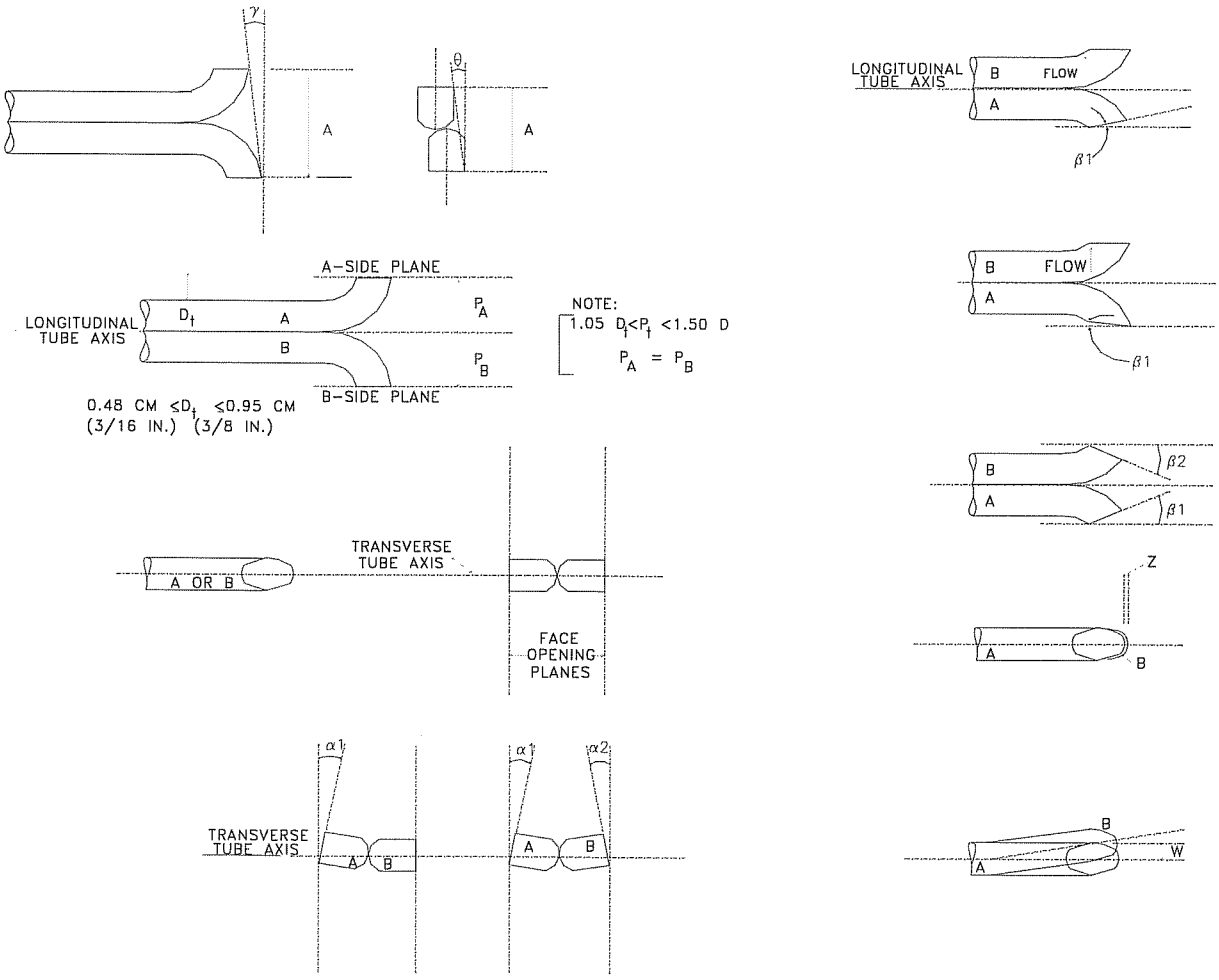
β_1 = 1 ° (<5°), β_2 = 0 ° (<5°) w = A sin θ = 0.016 (in.); (<0.03125 in.)

γ = 1 °, θ = 1 °, A = 0.942 (in.) P_A = 0.47 (in.), P_B = 0.47 (in.), D_t = 0.380 (in.)

Comments: _____

Calibration required? ____ yes N no

Pitot Tube No.: 29 Date: 12/28/2006 Name: AAS



TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? Y yes ____ no

Pitot tube openings damaged? ____ yes (explain below) N no

α_1 = 1 ° (<10°), α_2 = 0 ° (<10°) z = A sin γ = 0.000 (in.); (<0.125 in.)

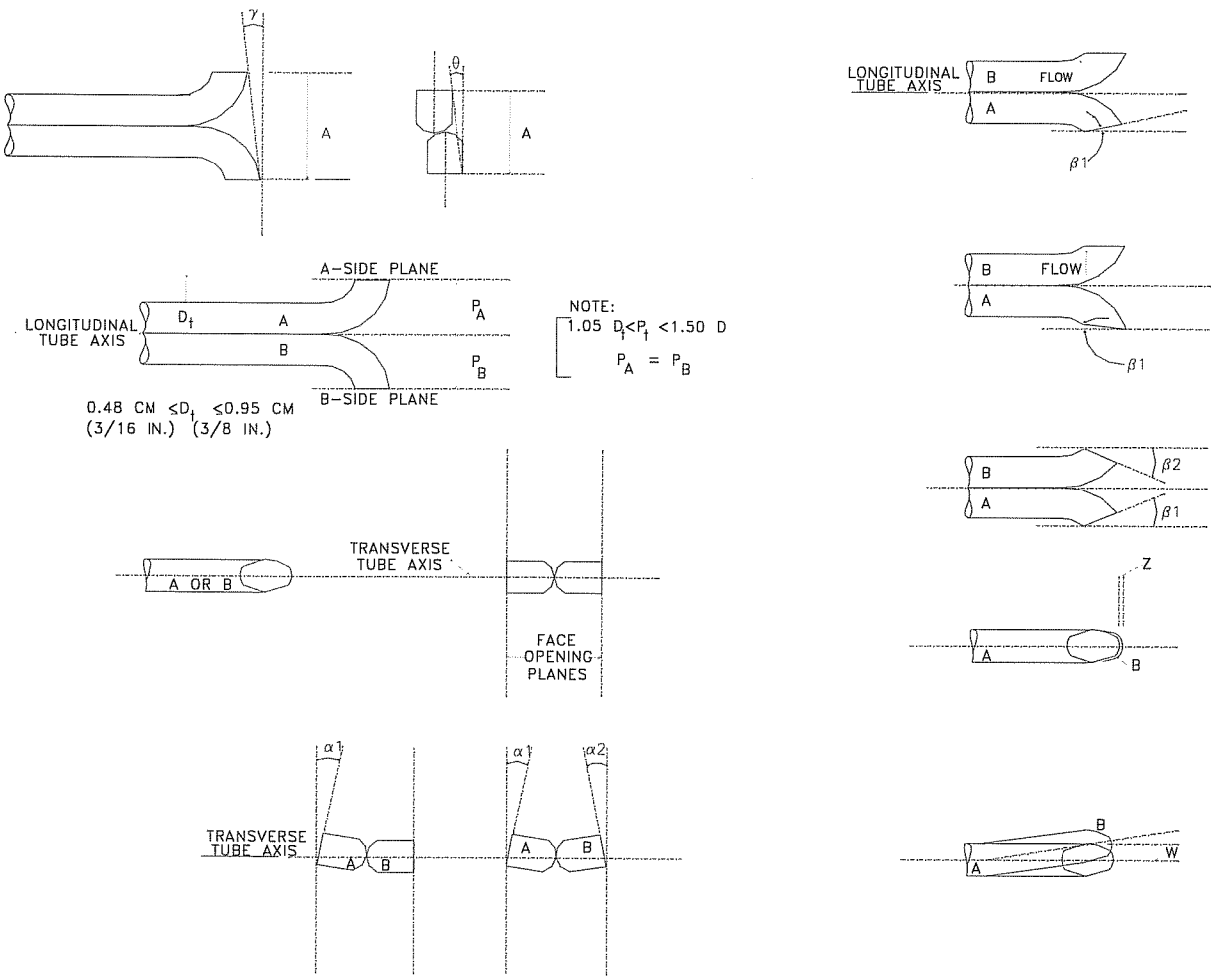
β_1 = 0 ° (<5°), β_2 = 0 ° (<5°) w = A sin θ = 0.016 (in.); (<0.03125 in.)

γ = 0 °, θ = 1 °, A = 0.930 (in.) P_A = 0.47 (in.), P_B = 0.47 (in.), D_t = 0.380 (in.)

Comments: _____

Calibration required? ____ yes N no

Pitot Tube No.: 36 Date: 12/28/2006 Name: AAS



Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Nozzle Calibration Sheet
Set No. 6

Nominal Diameter	0.120	0.175	0.230	0.250	0.275	0.300	0.310	0.375	0.425	0.500	Other
Nozzle Diameter		0.209	0.235		0.271	0.307		0.356		0.496	
Nozzle Identification Number		7	8		9	6		12		16	

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Nozzle Calibration Sheet
Set No. 4

Nominal Diameter	0.120	0.175	0.230	0.250	0.275	0.300	0.310	0.375	0.425	0.500	Other
Nozzle Diameter		.172	.220	.220	.	.298	.321	.366	.426	.515	
Nozzle Identification Number		6	8	8M	9	10M	10	12	14	16	

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Nozzle Calibration Sheet
Set No. 3

Nominal Diameter	0.120	0.175	0.230	0.250	0.275	0.300	0.310	0.375	0.425	0.500	Other
Nozzle Diameter		0.172	0.225		0.285			0.364		0.492	
Nozzle Identification Number		#6	#8		#10			#12		#16	

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 1
Date: 6/26/07
Project Number: M072505/6 M07224036
Test Location: Toxecon Outlet
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: 12 Width: 18 or
Diameter:
Source Condition:
Test Method: M17 26A
Flue Area: 306
Port Type: Flange
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: EO
Meter ID: CM9
Meter Y Value: 1.005
Pitot ID:
Pitot Coefficient: .840
Probe Length: 18'
Probe Liner: teflon
Nozzle Diameter: 0.285
Train Type: Gelmans
Filter Number/Weight: 205 7.3065
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: .002 @ 10 "Hg
Post-Test Nozzle Leak Check: 0.002 @ 15 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 4
Min./Point: 2.5
Total Points: 24
Total Test Time: 60 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.19
Static Pressure: +3.5
CO_2 %: 13
O_2 %: 6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

K = 1.396
K' = 5.295

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	6/26/07	Test Number:	1
Client:	APA	Test Location:	Toxecon Outlet	Operator:	EO
Plant:	PIPP	Test Method:	M17 26A	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	5.344 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	1.405 Meter Rate, Cubic Feet/ Min.	x2.5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	9:15	.53	2.8	14.59	.7280	1.123	2.56		358	80	80	10	N/A	N/A	58
-2	9:17.5	.59	3.15	17.26	.7681	1.079	2.70	17.15	356	83	80	10			58
-3	9:20	.99	5.29	19.98	.9950	1.398	3.49	19.96	356	85	81	10			58
-4	9:22.5	1.2	6.41	22.53	1.095	1.539	3.85	23.47	356	85	81	12			58
	9:25			25.046				26.38							
2-1	927	.66	3.53	25.046	.8124	1.141	2.85		358	83	81	14			58
-2	929.5	.65	3.47	27.60	.8062	1.133	2.83	27.90	358	83	81	14			58
-3	932	.64	3.42	30.38	.80	1.124	2.81	30.43	358	83	80	14			58
-4	934.5	.64	3.42	32.76	.80	1.124	2.81	33.19	359	83	81	14			58
	937			35.57				35.57							
3-1	9:40	.96	5.13	35.57	.9798	1.377	3.44		358	82	80	14			58
-2	9:42.5	.94	5.02	38.89	.9695	1.362	3.41	39.01	358	82	80	14			58
-3	9.45	.86	4.60	41.40	.9274	1.303	3.25	42.30	358	83	80	14			60
-4	9:47.5	.90	4.81	44.28	.9487	1.333	3.33	44.66	356	83	80	14			60
	9:50			46.714				47.61							
4-1	9:53	1.0	5.34	46.714	1.000	1.405	3.51		357	82	80	14			60
-2	9:55.5	1.1	5.88	49.51	1.049	1.474	3.70	50.23	358	83	81	14			60
-3	958	1.3	6.95	52.38	1.140	1.602	4.01	53.19	358	83	81	14			60
-4	10:00.5	1.1	5.88	55.06	1.049	1.474	3.70	56.38	359	85	82	14			61
	10:03			57.697				58.76							
5-1	10:06	1.2	6.41	57.697	1.095	1.539	3.85		355	83	81	14			62
-2	10:08.5	1.3	6.95	60.48	1.140	1.602	4.01	61.54	357	83	81	14			60
-3	10:11	1.3	6.95	63.22	1.140	1.602	4.01	64.49	357	83	81	14			61
-4	10:13.5	1.2	6.41	65.93	1.095	1.539	3.85	67.23	357	84	81	14			62
	10:16			68.656				69.78							
6-1	10:19	1.1	5.88	68.656	1.049	1.474	3.70		352	83	81	14			64
-2	10:21.5	1.2	6.41	71.65	1.095	1.539	3.85	72.356	355	83	81	14			61
-3	1024	1.2	6.41	74.28	1.095	1.539	3.85	75.50	355	83	81	14			62
-4	1026.5	1.2	6.41	77.02	1.095	1.539	3.85	78.13	354	84	81	14			62
	1029			79.658				80.87							

M072505B

Platt Environmental

T56

2185-226-8C

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 2
Date: 6/26/07
Project Number:
Test Location: Toxecon Outlet
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition:
Test Method: M17 26A
Flue Area:
Port Type:
Port Length:
Port Size:

Meter and Probe Data

Operator: Eo
Meter ID: CM 9
Meter Y Value: 1.005
Pitot ID:
Pitot Coefficient: .840
Probe Length: 18'
Probe Liner: teflon
Nozzle Diameter: 0.285
Train Type: Gelmans
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: 001 @ 20 "Hg
Post-Test Nozzle Leak Check: .001 @ 20 "Hg
Pre-Test Pitot Leak Check: ✓ "H_2O
Post-Test Pitot Leak Check: ✓ "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 4
Min./Point: 2.5
Total Points: 24
Total Test Time: 60 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.3
Static Pressure: +4
CO_2 %: 12.9
O_2 %: 6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	6/26/07	Test Number:	2
Client:	ADA	Test Location:	Toxecon Outlet	Operator:	EO
Plant:	PIPP	Test Method:	M17 26A	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	5.344 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	1.405 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	11:35	1.3	6.9	87.385	1.140	1.602	4.00		354	82	81	15	N/A	N/A	60
-2	11:37.5	1.3	6.9	90.35	1.140	1.602	4.00	91.39	355	82	81	15			60
-3	11:40	1.1	5.9	93.34	1.049	1.474	3.68	94.35	356	83	81	15			60
-4	11:42.5	1.0	5.3	96.05	1.00	1.405	3.51	97.02	355	83	81	15			60
	11:45			98.895				99.56							
2-1	11:47	.99	5.3	98.895	.9950	1.398	3.50		356	84	81	15			60
-2	11:49.5	.83	4.4	101.89	.9110	1.280	3.20	102.40	358	84	81	15			60
-3	11:52	.75	4.0	104.67	.8660	1.217	3.04	105.09	358	85	81	15			60
-4	11:54.5	.70	3.7	107.50	.8367	1.176	2.94	107.71	357	86	81	15			60
	11:57			110.288				110.44							
3-1	11:58	.66	3.5	110.288	.8124	1.141	2.85		355	85	82	14			61
-2	12:00.5	.65	3.5	113.08	.8062	1.133	2.83	113.14	360	86	82	14			61
-3	12:03	.63	3.4	115.92	.7937	1.115	2.79	115.91	359	88	82	13			61
-4	12:05.5	.64	3.4	118.58	.8000	1.124	2.81	118.71	359	88	82	14			61
	12:08			121.271				121.39							
4-1	12:09	1.3	6.9	121.271	1.140	1.602	4.00		356	88	83	15			62
-2	12:11.5	1.5	8.0	124.16	1.225	1.721	4.30	125.27	360	88	83	15			62
-3	12:14	1.2	6.4	127.05	1.095	1.539	3.85	128.46	360	87	83	15			62
-4	12:16.5	1.2	6.4	129.90	1.095	1.539	3.85	130.90	359	86	83	15			62
	12:19			132.761				133.75							
5-1	12:22	1.2	6.4	132.761	1.095	1.539	3.85		356	85	83	15			62
-2	12:24.5	1.3	6.9	135.89	1.140	1.602	4.00	136.61	360	85	83	15			62
-3	12:27	1.3	6.9	138.68	1.140	1.602	4.00	139.89	360	85	83	15			62
-4	12:29.5	1.3	6.9	141.56	1.140	1.602	4.00	142.68	360	86	83	15			62
	12:32			144.361				145.56							
6-1	12:33	1.6	8.6	144.361	1.265	1.778	4.44		359	86	83	15			63
-2	12:35.5	1.7	9.1	147.34	1.304	1.832	4.58	148.80	359	86	83	15			61
-3	12:38	1.9	10.2	150.46	1.378	1.937	4.84	151.92	359	86	83	15			62
-4	12:40.5	2.0	10.7	154.83	1.414	1.987	4.97	155.30	360	87	83	15			60
	12:43.			159.264				159.80							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 3
Date: 6/26/07
Project Number:
Test Location: Toxecon Outlet
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition:
Test Method: M17 26A
Flue Area:
Port Type:
Port Length:
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM9
Meter Y Value: 1.005
Pitot ID:
Pitot Coefficient: .840
Probe Length: 18'
Probe Liner: teflon
Nozzle Diameter: 0.321
Train Type: Gelmans
Filter Number/Weight: #219 / 7.4244
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: .001 @ 20 "Hg
Post-Test Nozzle Leak Check: .001 @ 20 "Hg
Pre-Test Pitot Leak Check: ✓ 3 "H_2O
Post-Test Pitot Leak Check: ✓ "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 4
Min./Point: 25
Total Points: 24
Total Test Time: 60 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.32
Static Pressure: 4
CO_2 %: 13
O_2 %: 6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	6/26/07	Test Number:	3
Client:	ADA	Test Location:	Toxecon outlet	Operator:	EO
Plant:	PIPP	Test Method:	M17 26A	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	5.344 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	1.405 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1315	.56	3.0	66.69	.7483	1.051	2.62		359	82	82	12	N/A	N/A	57
-2	1317.5	.57	3.0	69.31	.7550	1.061	2.65	69.31	360	82	82	12			57
-3	1320	.60	3.2	71.92	.7746	1.088	2.72	71.96	360	85	82	12			57
-4	1322.5	.54	2.9	74.62	.7348	1.032	2.58	74.64	359	85	82	12			57
	1325			77.254				77.20							
2-1	1327	.80	4.3	77.254	.8944	1.257	3.14		358	85	82	11			59
-2	1329.5	.83	4.4	79.80	.9110	1.280	3.20	80.40	359	86	82	15			56
-3	1332	.82	4.4	82.45	.9055	1.272	3.18	83.00	360	87	82	15			56
-4	13:34.5	.70	3.7	85.42	.8367	1.176	2.94	85.63	359	87	82	15			57
	13:37			88.385				88.36							
3-1	13:39	.91	4.9	88.385	.9539	1.340	3.35		356	86	82	15			59
-2	13:41.5	.90	4.8	91.28	.9487	1.333	3.33	91.74	358	86	82	15			57
-3	13:44	.80	4.3	94.13	.8944	1.257	3.14	94.61	359	86	82	15			58
-4	13:46.5	.66	3.5	97.09	.8124	1.141	2.85	97.27	359	87	82	15			59
	13:49			99.945				99.94							
4-1	13:50	.92	4.9	99.945	.9592	1.348	3.37		358	86	82	15			60
-2	13:52.5	1.0	5.3	102.91	1.000	1.405	3.51	103.31	359	87	82	15			59
-3	1355	1.0	5.3	105.66	1.000	1.405	3.51	106.42	360	88	82	15			59
-4	1357.5	.90	4.8	108.63	.9487	1.333	3.33	109.17	360	88	83	15			60
	1400			111.715				111.96							
5-1	1402	.98	5.2	111.715	.9899	1.391	3.48		357	87	83	15			63
-2	1404.5	.97	5.2	115.04	.9849	1.384	3.46	115.19	359	89	84	15			61
-3	1407	.95	5.1	118.20	.9745	1.369	3.42	118.50	358	90	84	15			61
-4	1409.5	.86	4.6	121.53	.9274	1.303	3.26	121.62	358	90	84	15			61
	1412			124.791				124.79							
6-1	1414	.67	3.6	124.791	.8185	1.150	2.88		360	91	85	15			64
-2	1416.5	.70	3.7	127.66	.8367	1.176	2.94	127.67	360	92	86	15			63
-3	1419	.90	4.8	130.60	.9487	1.333	3.33	130.60	359	92	86	15			64
-4	1421.5	.98	5.2	133.92	.9899	1.391	3.48	133.93	359	93	87	15			64
	1424			137.404				137.40							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 1
Test Location: Toxecon
Duct Shape: Circular or Rectangular
Source Condition:
Port Type: Frame60

Date: 6/26/07
Client Name: WE Energies
Length: 19.17 Width: 17.58 or
Test Method:
Port Length: 43'

Project Number: M072505
Plant Name: Presque Isle
Diameter:
Flue Area: 337.613
Port Size: 6"

Meter and Probe Data

Operator: MP
Pitot ID: 029
Probe Liner:
Filter Number/Weight: 224 / 7.4560

Meter ID: CM 2
Pitot Coefficient: 0.84
Nozzle Diameter: .298

Meter Y Value: .997
Probe Length: 17 ft
Train Type:
Thimble Number/Weight:

Pre-Test Nozzle Leak Check: 0.01 @ 12 "Hg
Pre-Test Pitot Leak Check: ✓ 5 "H_2O

Post-Test Nozzle Leak Check: 0.01 @ 12 "Hg
Post-Test Pitot Leak Check: ✓ 5 "H_2O

Traverse Data

Ports Sampled: 6
Total Points: 24

Points/Port: 4/6
Total Test Time: 60 mins

Min./Point: 2.5
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.19
CO_2 %: 13.2
Initial Imp. Volume or Weight: 200
Initial Silica Weight: 200.0

Static Pressure: -6.5
O_2 %: 5.8
Final Imp. Volume or Weight: 285
Final Silica Weight: 227.6

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain:
Silica Weight Gain:

Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:	M072304	Date:	6/26	Test Number:	1
Client:	ADA	Test Location:	Boiler Inlet	Operator:	SCM
Plant:	Weyerhaeuser Pulp	Test Method:	M17	Page Number:	of

Port-Point #.	Time	(ΔP)	4.4 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	1.3 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	917	0.55	2.40	76.464	0.742	0.94	2.41	78.874	354	95	97	1			<68
2	919.5	0.43	1.90	78.90	0.655	0.85	2.00	81.005	354	96	97	1			
3	922	0.31	1.36	80.90	0.557	0.72	1.81	82.814	354	95	97	1			
4	924.5	0.37	1.63	82.52	0.608	0.79	1.98	84.79	352	95	96	1			
	927			84.79											
2-1	929	0.60	2.64	84.90	0.774	1.00	2.52	[illegible]	353	96	96	3			
2	931.5	0.54	2.38	87.39	0.735	0.96	2.38	87.42	354	97	96	3			
3	934	0.35	1.54	89.67	0.592	0.77	1.92	89.81	355	98	96	4			
4	936.5	0.23	1.00	91.46	0.480	0.62	1.55	91.73	344	98	96	3			
	939			93.30				93.29							
3-1	941	0.93	4.1	93.65	0.964	1.25	3.13		352	99	96	7			
2	943.5	0.72	3.2	96.90	0.848	1.10	2.75	96.78	355	100	95	7			
3	946	0.39	1.72	99.10	0.624	0.81	2.03	99.51	355	100	96	5			
4	948.5	0.29	1.28	101.20	0.538	0.70	1.75	101.57	331	100	96	5			
	951			103.32				103.32							
4-1	953	1.05	4.6	103.72	1.025	1.33	3.33		348	101	96	7			
2	955.5	1.05	4.6	107.00	1.025	1.33	3.33	107.05	356	102	96	10			
3	958	0.80	3.52	109.73	0.894	1.16	2.91	110.38	357	103	96	12			
4	1000.5	0.68	2.99	112.72	0.825	1.07	2.68	113.29	354	104	96	13			
	1003			115.97				115.97							
5-1	1005	0.45	2.00	116.10	0.671	0.872	2.18		348	100	97	7			
2	1007.5	0.53	2.33	118.30	0.728	0.946	2.37	118.28	355	101	97	10			
3	1010	0.61	2.68	120.47	0.781	1.015	2.53	120.65	355	101	97	12			
4	1012.5	0.14	0.62	123.12	0.374	0.49	1.21	123.18	348	102	97	7			
	1015			124.45				124.40							
6-1	1017	0.39	1.72	124.56	0.625	0.81	2.03		349	100	97	12			
2	1019.5	0.45	1.98	126.85	0.671	0.87	2.18	126.59	355	101	96	15			
3	1022	0.50	2.20	128.91	0.707	0.92	2.30	128.77	354	102	97	18			
4	1024.5	0.23	0.57	131.09	0.361	0.47	1.17	131.07	334	102	97	7			
	1027			132.23				132.23							

M072505B

58

Platt Environmental

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 2
Test Location: Taxacon
Duct Shape: Circular or Rectangular
Source Condition:
Port Type: Flange

Date: 6/26/07
Client Name: ADA
Length: 19.17 Width: 17.58 or
Test Method:
Port Length: 43"

Project Number: M072505
Plant Name: WE Energies PIPP
Diameter:
Flue Area: 337.013
Port Size: 6"

Meter and Probe Data

Operator: MP
Pitot ID: 029
Probe Liner:
Filter Number/Weight: 217 / 7.3162
Pre-Test Nozzle Leak Check: ✓ 0.00 @ 12 "Hg
Pre-Test Pitot Leak Check: ✓ & 5 "H_2O

Meter ID: CM2
Pitot Coefficient: 0.84
Nozzle Diameter: .298

Meter Y Value: .997
Probe Length: 17ft
Train Type:
Thimble Number/Weight:
Post-Test Nozzle Leak Check: 0.01 @ 10 "Hg
Post-Test Pitot Leak Check: ✓ & 5 "H_2O

Traverse Data

Ports Sampled: 6
Total Points: 24

Points/Port: 4/6
Total Test Time: 60 mins

Min./Point: 2.5
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.19
CO_2 %: 13.2
Initial Imp. Volume or Weight: 200
Initial Silica Weight: 200.1

Static Pressure: -6.5
O_2 %: 5.6
Final Imp. Volume or Weight: 295
Final Silica Weight: 231.3

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain:
Silica Weight Gain:

Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M072304
Client: ADA
Plant: PIPP WE Energies

Date: 6/26/07
Test Location: Toxecon
Test Method: M17

Test Number: 2
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	×4.4 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	×1.3 Meter Rate, Cubic Feet/ Min.	×2.5 Theoretical Meter Volume, (V_m) ft^3, per point	←+ Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1135	.45	1.98	35.290	.671	.872	2.181		353	97	97	1	NA	NA	68
2	1137.5	.46	2.02	37.92	.678	.881	2.204	37.47	355	95	96	1			
3	1140	.46	2.02	39.47	.678	.881	2.204	40.12	355	95	96	1			
4	1142.5	.15	.66	41.20	.387	.503	1.257	42.324	354	96	96	2			
	1145			42.219				43.581							
2-1	1146	.45	1.98	43.349	.671	.872	2.18		350	96	95	2			
2	1148.5	.55	2.42	45.53	.742	.964	2.41	45.399	357	97	95	3			
3	1151	.60	2.64	47.809	.776	1.00	2.52	47.809	358	99	95	4			
4	1153.5	.15	.66	50.33	.387	.503	1.257	50.33	350	99	95	6			
	1156			51.219				51.59							
3-1	1157	1.1	4.84	51.279	1.05	1.36	3.408		356	102	95	12			
2	1159.5	1.1	4.84	54.856	1.05	1.36	3.408	54.62	357	102	95	12			
3	1202	.75	3.30	58.07	.866	1.13	2.813	58.04	357	103	96	14			
4	1204.5	.60	2.64	60.231	.774	1.00	2.517	60.85	354	103	96	13			
	1207			62.69				63.38							
4-1	1208.5	1.4	6.16	63.356	1.18	1.54	3.845		357	102	97	16			
2	1211	1.2	5.28	66.813	1.09	1.42	3.560	67.405	357	102	97	17			
3	1213.5	.81	3.56	69.23	.90	1.17	2.925	70.96	357	102	97	17			
4	1216	.55	2.42	72.73	.742	.964	2.41	73.87	357	101	97	17			
	1218.5			74.34				76.29							
5-1	1220	1.2	5.28	74.84	1.09	1.42	3.55		356	98	97	18			
2	1222.5	1.1	4.84	76.78	1.05	1.36	3.413	76.89	357	99	97	18			
3	1225	.75	3.30	79.114	.866	1.13	2.814	80.30	357	99	97	18			
4	1227.5	.45	1.98	80.456	.671	.872	2.18	83.11	353	99	97	18			
	1230			83.478				85.29							
6-1	1234	1.05	4.62	83.885	1.02	1.33	3.330		355	98	97	19			
2	1236.5	.90	3.96	85.632	.949	1.23	3.083	87.215	356	98	97	19			
3	1239	.79	3.48	88.44	.868	1.15	2.888	90.298	356	98	97	19			
4	1241.5	.85	3.74	90.56	.922	1.19	2.99	93.186	356	98	96	20			
	1244			94.621				96.182							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 3
Test Location: Toxecon
Duct Shape: Circular or Rectangular
Source Condition:
Port Type:

Date: 6/26/07
Client Name: ADA
Length: 19.17 Width: 17.58 or
Test Method: M17
Port Length: 43'

Project Number: M072304
Plant Name: WE Energies PIPP
Diameter:
Flue Area: 337.013
Port Size: 6"

Meter and Probe Data

Operator: MP
Pitot ID:
Probe Liner:
Filter Number/Weight: 2221 / 7.2282
Pre-Test Nozzle Leak Check: 0.01 @ 15 "Hg
Pre-Test Pitot Leak Check: "H_2O

Meter ID: CM2
Pitot Coefficient: .84
Nozzle Diameter: .271
Thimble Number/Weight:
Post-Test Nozzle Leak Check: 0.00 @ 12 "Hg
Post-Test Pitot Leak Check: "H_2O

Meter Y Value: .997
Probe Length: 17 ft
Train Type:

Traverse Data

Ports Sampled: 6
Total Points: 24

Points/Port: 4 / 6
Total Test Time: 60 mins

Min./Point: 2.5
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.19
CO_2 %: 13.3
Initial Imp. Volume or Weight: 200
Initial Silica Weight: 200

Static Pressure: -6.5
O_2 %: 5.5
Final Imp. Volume or Weight: 300
Final Silica Weight: 229.2

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain:
Silica Weight Gain:

Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:	M072304	Date:	6/26/07	Test Number:	3
Client:	ADA	Test Location:	Texcemm	Operator:	MP
Plant:	PIPP	Test Method:	M17	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	x3.01 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	x1.07 Meter Rate, Cubic Feet/ Min.	x2.5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1315	.95	2.85	96.871	.974	1.04	2.607		353	97	94	1	NA	NA	68
2	1317.5	.85	2.56	99.513	.921	.986	2.466	99.478	353	97	96	2			
3	1320	.78	2.34	101.941	.883	.945	2.362	101.94	352	99	96	2			
4	1322.5	.85	2.56	104.21	.921	.986	2.466	104.30	351	100	96	2			
	1325			106.61				106.76							
2-1	1327.5	1.05	3.16	107.101	1.02	1.09	2.73		349	102	96	7			
2	1330	1.0	3.01	108.87	1.00	1.07	2.67	109.82	350	103	96	7			
3	1332.5	.75	2.25	112.91	.866	.926	2.31	112.49	351	101	96	8			
4	1335	.42	1.26	114.73	.648	.693	1.73	114.80	347	103	96	7			
	1337.5			116.351				116.53							
3-1	1339	1.2	3.61	116.678	1.09	1.17	2.930		348	103	96	12			
2	1341.5	1.05	3.16	119.671	1.02	1.09	2.73	119.608	352	103	96	12			
3	1344	.68	2.04	122.337	.824	.882	2.205	122.338	353	103	97	11			
4	1346.5	.65	1.95	124.54	.806	.862	2.156	124.54	353	102	96	11			
	1349			126.69				126.69							
4-1	1351	1.1	3.31	127.413	1.04	1.12	2.805		355	103	97	16			
2	1353.5	1.0	3.01	129.713	1.00	1.07	2.67	130.218	357	104	97	16			
3	1356	.79	2.37	132.11	.888	.951	2.37	132.88	358	104	97	17			
4	1358.5	.74	2.22	135.16	.860	.920	2.30	135.17	359	104	98	17			
	1401			136.623				137.47							
5-1	1403	.45	1.35	137.47	.671	.717	1.794		359	102	98	16			
2	1405.5	.46	1.38	139.28	.678	.725	1.814	139.264	361	102	98	16			
3	1408	.60	1.81	141.75	.774	.828	2.072	141.078	361	102	99	16			
4	1410.5	.25	.752	143.23	.50	.535	1.337	143.150	356	103	99	14			
	1413			144.391				144.488							
6-1	1415	.45	1.35	145.398	.671	.717	1.794		360	103	100	16			
2	1417.5	.47	1.41	147.192	.685	.733	1.833	147.192	362	104	100	17			
3	1420	.55	1.65	149.025	.741	.793	1.983	149.025	362	105	100	18			
4	1422.5	.18	.541	151.102	.424	.453	1.134	151.008	354	106	101	18			
	1425			151.80				152.142							

M072505B

62

Platt Environmental

Appendix U. Platt – Mercury RATA 2007

Mercury Monitor Relative Accuracy Test Audit Test Report

We Energies
Presque Isle Power Plant
Flue 7 and 9 Stacks
Marquette, Michigan
June 19 through 28, 2007

Performed For
ADA-ES

Platt Environmental Services, Inc.

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Mercury Monitor Relative Accuracy Test Audit Test Report

We Energies
Presque Isle Power Plant
Flue 7 and 9 Stacks
Marquette, Michigan
June 19 through 28, 2007

Performed For
ADA-ES

Prepared By

Platt Environmental Services, Inc.

Report No. M072505A

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 EXECUTIVE SUMMARY 2

3.0 TEST METHODOLOGY 2
- 3.1 Method 1 Sample and Velocity Traverse Determination 3
- 3.2 Sulfur Dioxide (SO_2) Determination (Stratification Test) 3
- 3.3 Mercury Determination by the Ontario Hydro Mercury Speciation Method 3
- 3.4 Mercury Determination by the Sorbent Trap Method 4

4.0 TEST RESULT SUMMARIES 5

5.0 CEM DATA 8

6.0 CONCLUSION AND CERTIFICATION 9

APPENDIX
- Test Section Diagram 11
- Sample Train Diagrams 13
- Calculation Nomenclature and Formulas 16
- Laboratory Sample Analysis 22
- Reference Method Test Data (Hand and Computerized Sheets) 29
- Calibration Data 79
- Field Data Sheets 98

1.0 Introduction

PLATT ENVIRONMENTAL SERVICES, INC. (PES) conducted a mercury continuous emission monitoring relative accuracy test audit (RATA) for ADA-ES, Inc., on Flue7 and Flue 9 stacks at the Presque Isle Power Plant of We Energies in Marquette, Michigan on June 19 through 28, 2007. This report summarizes the results of the test program and test methods used.

The test locations, test dates and test parameters are summarized below, in Table 1.

Table 1

Test Overview

Test Locations	Test Dates	Test Parameters
Flue 7 and 9 Stacks	June 19 through 28, 2007	Ontario Hydro Mercury (OHM) and Proposed Method 30B

The identification of individuals associated with the test program, are summarized below.

Table 2

Contact Information

Location	Address	Contact
Test Facility	We Energies Presque Isle Power Plant Marquette, Michigan	Jon Konings (414) 221-2430 (phone) Jon.Konings@we-energies.com
Test Coordinator	ADA-ES 8100 SouthPark Way, Unit B Littleton, Colorado 80120-4525	Ms. Robin Stewart Manager of Contract R&D (303) 339-8863 robins@adaes.com
Testing Company Representative	Platt Environmental Services, Inc. 371 Balm Court Wood Dale, Illinois 60191	Eric L. Ehlers Senior Project Manager (630) 521-9400 (phone) (630) 521-9494 (fax) eehlers@plattenv.com

The test program was conducted by Ms. E. Osthus, and Messrs. M. Platt, J. Devereux, R. Savchenko, A. Sorce, S. Banach and E. Ehlers of PES. The purpose of this test program was to determine the relative accuracy of the mercury CEM system during specified operating conditions in terms of ug/wscm.

2.0 Executive Summary

Selected results of the test program are summarized below, in Table 3. A complete summary of emission test results follows the narrative portion of this report.

Table 3

Test Results

Test Location	Test Methodology	Average Concentration	Relative Accuracy*
Flue 7 Stack	30B - Sorbent Trap (6/19-21/07)	2.42 μg/scm	0.29 ug/scm
Flue 9 Stack	Ontario/ Hydro Method (6/19-21/07)	1.58 μg/scm	0.57 ug/scm
Flue 7 Stack	30B - Sorbent Trap (6/26-28/07)	0.52 μg/scm	0.12 ug/scm

*Based on alternative performance specification of 1ug/scm mean difference

The test results from this test program indicate that the CEM system meets the United States Environmental Protection Agency (USEPA) annual performance specification for relative accuracy as published in 40 CFR Part 75.

The test consisted of twelve (12) paired Hg sampling runs for each method the week of June 19, 2007. The week of June 26, 2007, ten (10) paired sample trains were run. The method 30B was performed under two different conditions. Each sample was extracted at a three test points for two hours using one port the first week, and three hour tests were performed the second week due to lower mercury concentrations in the stack gas. Three point, one port sampling was based on a sulfur dioxide (SO_2) stratification test that was performed on June 14, 2007, which passed the single test port criteria. The stratification test is appended.

3.0 Test Methodology

Emissions testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A and Ontario Hydro Method ASTM Method D6784-02 and proposed USEPA Method 30B and Appendix B, Performance Specification 12A. Schematics of the sampling trains used and copies of field data sheets for each test run are included in the Appendix.

The following methodologies were used during the test program:

3.1 Method 1 Sample and Velocity Traverse Determination

Test measurement points were selected in accordance with Method 1, 40 CFR, Part 60, Appendix A. The characteristics of each measurement location are summarized below, in Table 4.

Table 4

Sample Point Selection

Location	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points*
Flue 7 and 9 Stacks	> 2.0 Diameters	> 0.5 Diameters	Hg	3 test points

* Based on stratification test.

3.2 Sulfur Dioxide (SO_2) Determination (Stratification Test)

Method 6C, 40CFR60, was used to determine sulfur dioxide (SO_2) emissions from the source. A gas sample was continuously extracted from the stream through a dilution sampling probe gas conditioning system. A portion of the gas stream was conveyed to the gas analyzer for determination of SO_2 content. Method 1 test points were used for the SO_2 stratification test. A total of 12 points were performed.

Prior to sampling, the SO_2 analyzer was zeroed and calibrated with high-range, mid-range, and zero gases. After each test run, zero and mid-range calibration gases were introduced to check calibration.

3.3 Mercury Determination by the Ontario Hydro Mercury Speciation Method

Stack gas mercury concentrations and emission rates were determined in accordance with the Ontario Hydro Mercury Speciation Method, ASTM D6784-02. This method allows for speciation of total vapor phase mercury collected during sampling into two categories. First, the oxidized mercury, which is collected in the aqueous potassium chloride (KCl) impinger solution in its mercuric oxidation states (also referred to as ionic mercury). Second is the elemental mercury, which is collected in both the acidified hydrogen peroxide (HNO_3-H_2O_2) and potassium permanganate (H_2SO_4-$KmnO_4$) impinger solutions. Elemental mercury refers to mercury in its zero oxidation state. An Environmental Science Corporation sampling train was used to sample stack gas, in the manner specified in the Method. Analysis of the samples collected was conducted by PES in accordance with the method. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix.

3.4 Mercury Determination by the Sorbent Trap Method

Paired trains were utilized using three (3) test points at the Flue 7 Stack.

Per Proposed Method 30B sampling, each sample was collected on the paired in-situ sorbent traps. A tube of silica was used to capture remaining moisture prior to the sample reaching the gas metering system.

The sample train used for this test program was designed by APEX, Inc. and meet all requirements for Method 30B sampling. Samples were analyzed onsite utilizing an Ohio Lumex, Inc. analyzer for total mercury analysis.

4.0 Test Result Summaries

Client: ADA-ES **Location:** Flue 9 Stack
Plant: We Energies - Presque Isle Power Plant **Date:** 6/19/07-6/21/07
Project #: M072505 **Test Method:** OH Hg

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM Hg ug/wscm	CEM Hg ug/wscm	(RM-CEM) Difference (di)	Difference^2 (di^2)
1	1	06/19/07	07:25	09:25	1.95	2.10	-0.15	0.023
1	2	06/19/07	10:15	12:15	1.12	1.46	-0.34	0.116
1	3	06/19/07	12:50	14:50	2.18	2.08	0.10	0.010
1	4	06/19/07	15:25	17:25	1.05	1.65	-0.60	0.360
0	5	06/20/07	07:40	10:10	1.95	3.10	-1.15	1.323
1	6	06/20/07	10:40	12:40	1.28	2.01	-0.73	0.533
1	7	06/20/07	13:10	15:10	1.92	2.85	-0.93	0.865
1	8	06/20/07	15:40	17:40	2.03	2.82	-0.79	0.624
1	9	06/21/07	07:20	09:20	1.40	2.30	-0.90	0.810
0	10	06/21/07	09:50	11:50	1.15	2.08	-0.93	0.865
0	11	06/21/07	12:20	14:20	1.12	2.29	-1.17	1.369
1	12	06/21/07	14:50	16:50	1.30	2.13	-0.83	0.689

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**1.581**	**RM avg**
Mean CEM Value	**2.156**	**CEM avg**
Sum of Differences	**-5.170**	**di**
Mean Difference	**-0.574**	**d**
Sum of Differences Squared	**4.029**	**di^2**
Standard Deviation	**0.364**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.280**	**cc**
Relative Accuracy	**54.02**	**RA**

Client: ADA-ES **Location:** Flue 7 Stack
Plant: We Energies - Presque Isle Power Plan **Date:** 6/19/07-6/21/07
Project #: M072505 **Test Method:** Sorbent Hg (30B)

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM ug/wscm	CEM ug/wscm	(RM-CEM) Difference (di)	Difference^2 (di^2)
1	1	06/19/07	07:25	09:25	1.97	2.10	-0.13	0.017
1	2	06/19/07	10:15	12:15	1.86	1.46	0.40	0.160
1	3	06/19/07	12:50	14:50	2.40	2.08	0.32	0.102
1	4	06/19/07	15:25	17:25	2.20	1.65	0.55	0.303
1	5	06/20/07	07:40	10:10	3.34	3.10	0.24	0.058
0	6	06/20/07	10:40	12:40	2.79	2.01	0.78	0.608
0	7	06/20/07	13:10	15:10	3.78	2.85	0.93	0.865
0	8	06/20/07	15:40	17:40	3.91	2.82	1.09	1.188
1	9	06/21/07	07:20	09:20	2.42	2.30	0.12	0.014
1	10	06/21/07	09:50	11:50	2.47	2.08	0.39	0.152
1	11	06/21/07	12:20	14:20	2.68	2.29	0.39	0.152
1	12	06/21/07	14:50	16:50	2.46	2.13	0.33	0.109

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**2.422**	**RM avg**
Mean CEM Value	**2.132**	**CEM avg**
Sum of Differences	**2.610**	**di**
Mean Difference	**0.290**	**d**
Sum of Differences Squared	**1.067**	**di^2**
Standard Deviation	**0.197**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.151**	**cc**
Relative Accuracy	**18.22**	**RA**

Client:	ADA-ES	**Location:**	Flue 7 Stack
Plant:	We Energies - Presque Isle Power Plan	**Date:**	6/26/07-6/28/07
Project #:	M072505	**Test Method:**	Sorbent Hg (30B)

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM Hg ug/wscm	CEM Hg ug/wscm	(RM-CEM) Difference (di)	Difference^2 (di^2)
0	1	06/26/07	08:30	11:30	0.55	0.45	0.10	0.010
1	2	06/26/07	11:50	14:50	0.74	0.56	0.18	0.032
1	3	06/26/07	15:00	18:00	0.80	0.65	0.15	0.023
1	4	06/27/07	07:10	10:10	0.44	0.40	0.04	0.002
1	5	06/27/07	10:30	13:30	0.55	0.40	0.15	0.023
1	6	06/27/07	13:50	16:50	0.44	0.32	0.12	0.014
1	7	06/27/07	17:10	20:10	0.35	0.29	0.06	0.004
1	8	06/28/07	07:00	10:00	0.46	0.33	0.13	0.017
1	9	06/28/07	10:30	13:30	0.45	0.32	0.13	0.017
1	10	06/28/07	13:55	16:55	0.41	0.31	0.10	0.010

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**0.516**	**RM avg**
Mean CEM Value	**0.398**	**CEM avg**
Sum of Differences	**1.060**	**di**
Mean Difference	**0.118**	**d**
Sum of Differences Squared	**0.141**	**di^2**
Standard Deviation	**0.045**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.034**	**cc**
Relative Accuracy	**29.50**	**RA**

5.0 CEM Data

CEM data was recorded by We Energies and ADA personnel during each test run, in order to correlate mercury emissions to the CEM data for each run in accordance with applicable regulations. The CEM data is found in the Appendix.

6.0 Conclusion and Certification

PLATT ENVIRONMENTAL SERVICES is pleased to have been of service to ADA-ES. If you have any questions regarding this test report, please do not hesitate to contact us at 630-521-9400.

CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with those methods specified in this test report.

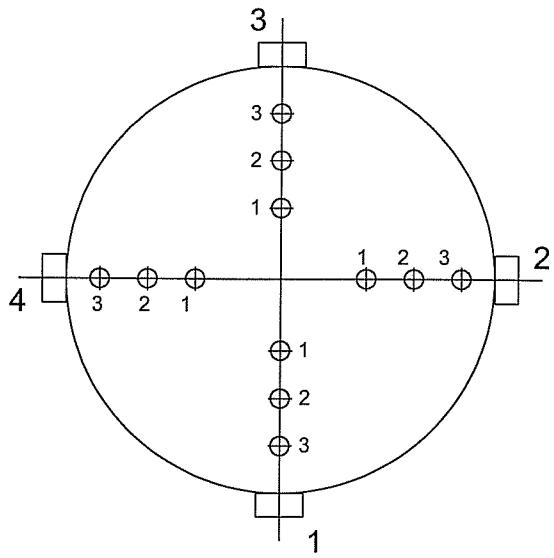
PLATT ENVIRONMENTAL SERVICES

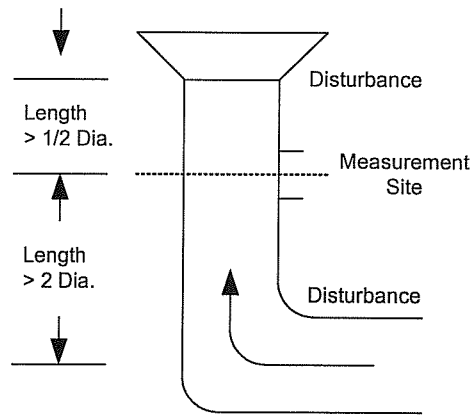
Eric L. Ehlers — Project Manager

Scott W. Banach — Quality Assurance

Appendix

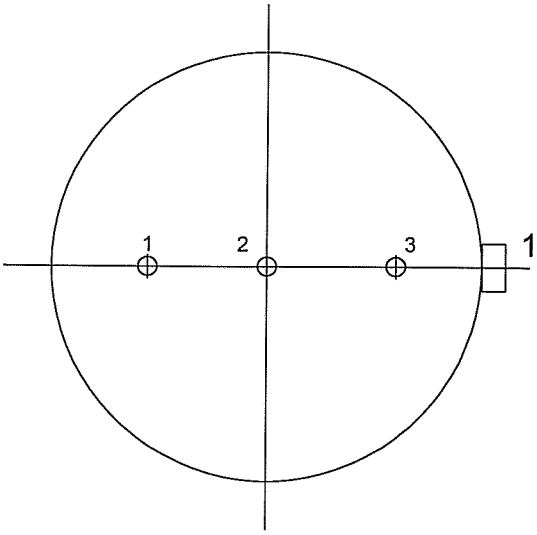
GASEOUS TRAVERSE FOR ROUND DUCTS

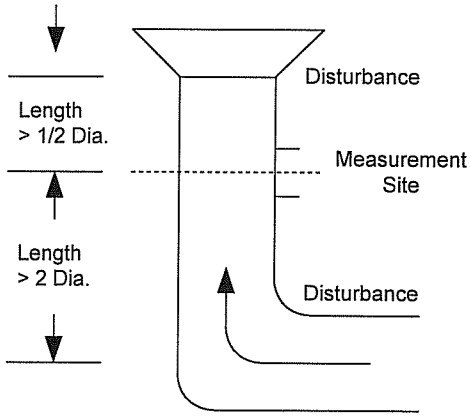




Job:	We Energies –Presque Isle Power Plant
Date:	June 14, 2007
Flue No:	9
Test Location:	Stack
Stack Diameter:	9.5 Feet
Stack Area:	70.882 Square Feet
No. Points Across Diameter:	6
No. of Ports:	4

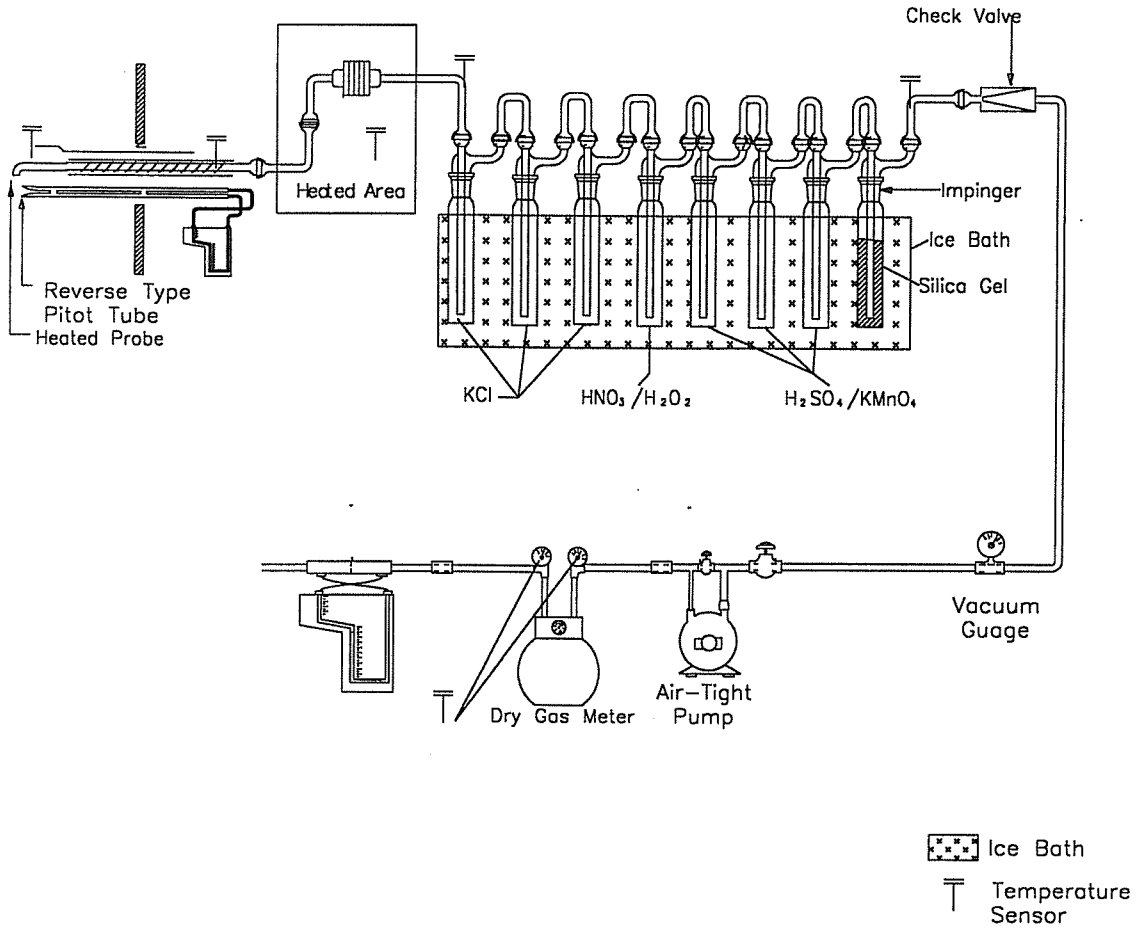
SINGLE PORT TESTING FOR ROUND DUCTS



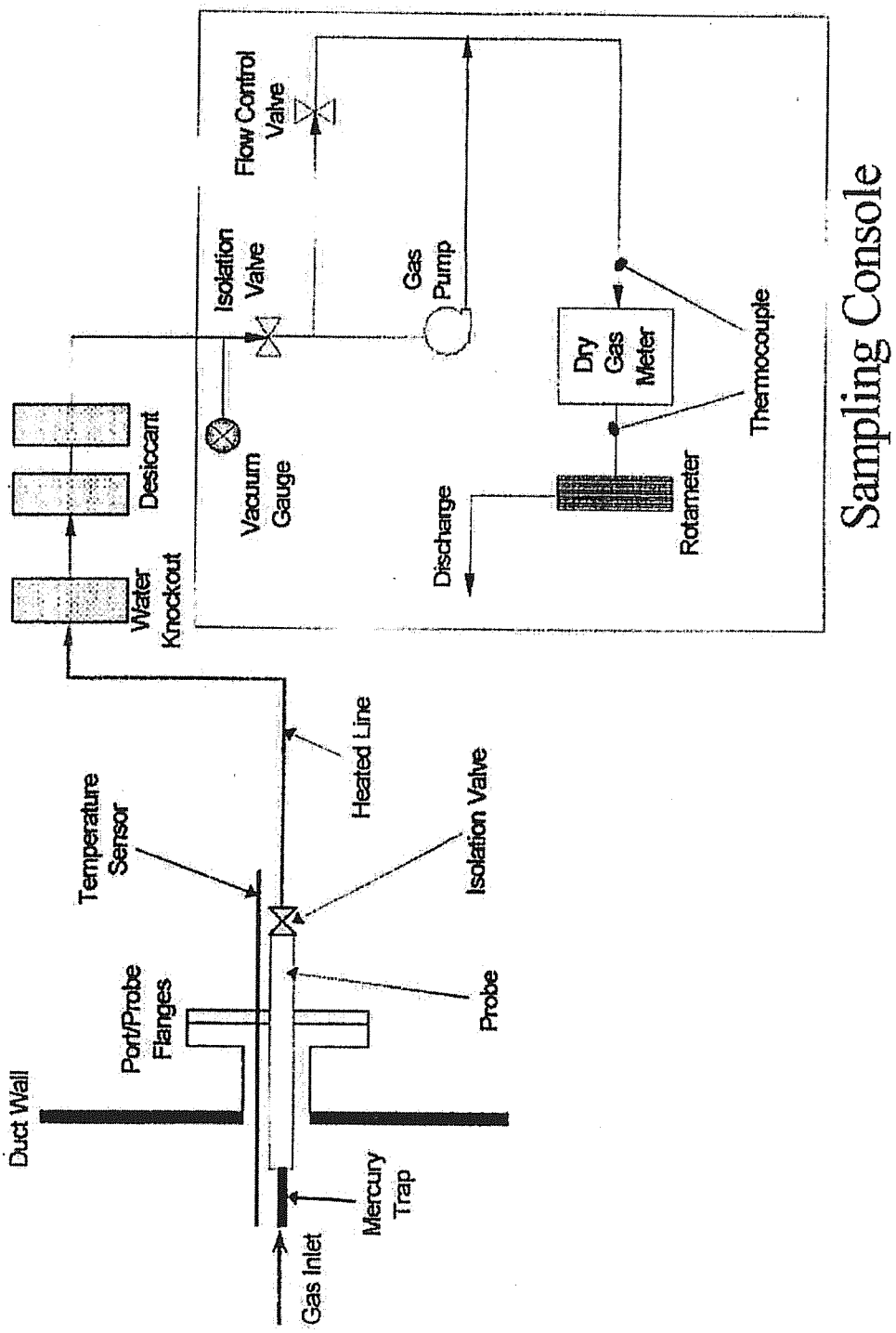


Job:	We Energies –Presque Isle Power Plant
Date:	June 19-28, 2007
Flue Nos:	7 and 9
Test Location:	Stacks (Identical)
Stack Diameter:	9.5 Feet
Stack Area:	70.882 Square Feet
No. Points Across Diameter:	3
No. of Ports:	4

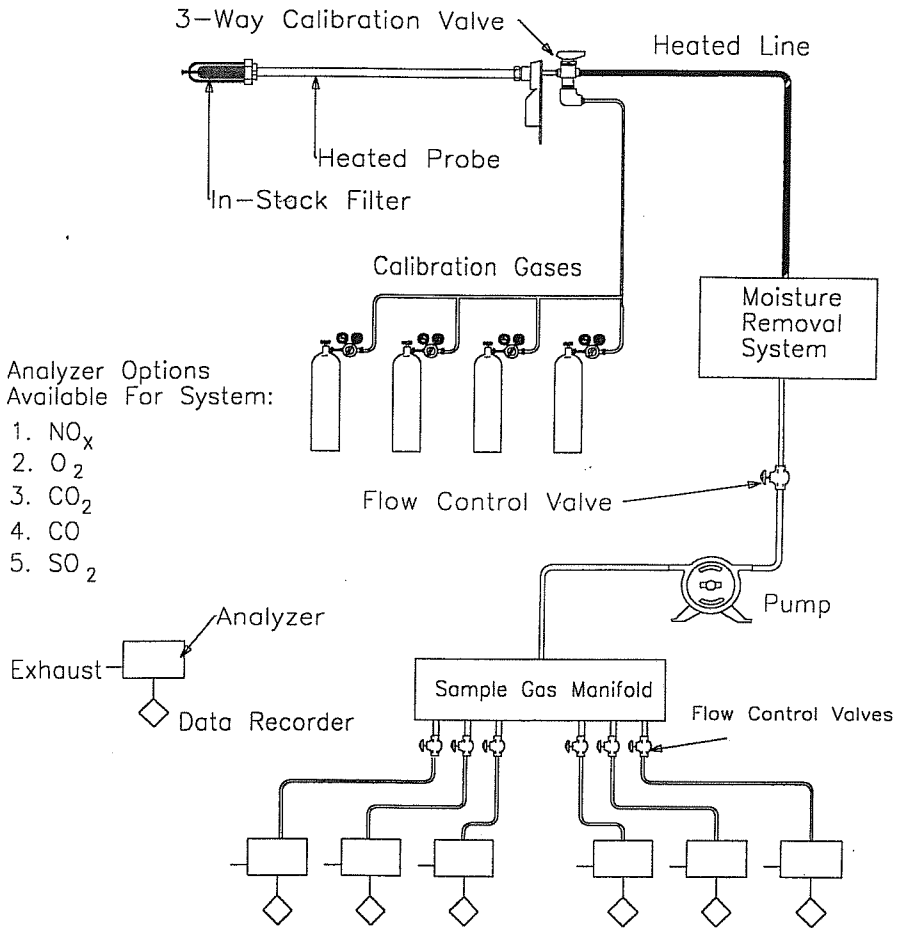
ASTM D6784-02 (Ontario Hydro)- Speciated Mercury Sample Train



Proposed Method 30B – Mercury Sampling by Sorbent Tube



USEPA Method 3A Extractive Gaseous Sampling Diagram



PLATT ENVIRONMENTAL SERVICES, INC.

Relative Accuracy Test Audit (RATA) Calculations and Bias Adjustment Factor Calculation

Mean Difference

$$\bar{d} = \frac{1}{n}\sum_{i=1}^{n} di$$

Standard Deviation

$$Sd = \left[\frac{\sum_{i=1}^{n} d_i^2 - \frac{\left[\sum_{i=1}^{n} d_i\right]^2}{n}}{n-1}\right]^{1/2}$$

Confidence Coefficient

$$CC = t_{0.025}\frac{Sd}{\sqrt{n}}$$

Relative Accuracy

$$RA = \frac{|\bar{d}| + |CC|}{RM\ avg} \times 100$$

Bias Adjustment Factor

$$BAF = 1 + \frac{|\bar{d}|}{CEM\ avg}$$

Coal Emission Rate Calculations

A pollutant emission rate (E), expressed as pounds of pollutant per million Btu heat input from the fuel combusted can be calculated by several methods as follows:

A. $C = C_s/7000$ where, C = pollutant concentration, lb/dscf
c_s = pollutant concentration, grains/dscf

B. If fuel flow is monitored and the fuel combusted during the test is sampled and analyzed for gross calorific value, then:

$$E = \frac{Q_{sd}C}{\text{fuel flow rate (lb/hr) GCV}} \times 10^6$$

where, E = lbs per million Btu
GCV = gross calorific value, Btu / lb
Q_{sd} = dry volumetric gas flow at standard conditions, dscf / hr

C. If an integrated gas sample is taken during the test and analyzed for $\%CO_2$ or $\%O_2$, dry basis by volume, with an approved USEPA Method 3 or 3A gas analyzer, then

$$E = C\,F_c \frac{100}{(\%CO_2)} \text{ or, } E = C\,F \frac{20.9}{(20.9 - \%O_2)} \quad \text{where,}$$

$\%CO_2$ and $\%O_2$ are expressed as percent values:

F_c = a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the fuel combusted, 1800 scf CO_2/million Btu.

F = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted, 9780 dscf/million Btu.

D. If fuel sample increments are taken and composited during the test and an ultimate analysis is performed and the GCV is determined, then

$$F_c = \frac{321 \times 10^3 (\%C)}{GCV} \text{ where, } \%C = \text{carbon content by weight expressed as percent}$$

$$F = \frac{[3.64(\%H) + 1.53(\%C) + 0.57(\%S) + 0.14(\%N) - 0.46(\%O_2)]}{GCV} \times 10^6$$

1. H = Hydrogen, percent
2. C = Carbon, percent
3. S = Sulfur, percent
4. N = Nitrogen, percent
5. O = Oxygen, percent

PLATT ENVIRONMENTAL SERVICES, INC.

Mercury Sample Calculations

Concentration

$$\frac{\mu g}{m^3} = \frac{\mu g \text{ of } mercury}{\text{dscf volume sampled} \times 0.02832 \frac{m^3}{ft^3}}$$

Emission Rate

$$\frac{\mu g \text{ of sample} \times \frac{1 \times 10^{-6} \text{ grams}}{\mu g}}{453.6 gr/lb} = \text{lbs of mercury}$$

$$\frac{\text{lbs of mercury}}{Vm(std)sample} \times dscfm \times 60 \frac{min}{hr} = \text{lbs of mercury/hr}$$

PLATT ENVIRONMENTAL SERVICES, INC.

Particulates Calculation Formulas

1. $V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2 V_{lc}$

2. $V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{P_{std}}\right) = K_1\ V_m\ Y \frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{T_m}$

3. $B_{ws} = \frac{V_{w(std)}}{(V_{m(std)} + V_{w(std)})}$

4. $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$

5. $M_s = M_d(1 - B_{ws}) + 18.0(B_{ws})$

6. $C_a = \frac{m_a}{V_a \rho_a}$

7. $W_a = C_a V_{aw} \rho_a$

8. $C_{acf} = 15.43 K_i \left(\frac{m_n P_s}{V_{w(std)} + V_{m(std)}\ T_s}\right)$

9. $C_S = (15.43\ \text{grains/gram})\ (m_n / V_{m(std)})$

10. $v_s = K_p C_p \sqrt{\frac{\Delta P\ T_s}{P_s M_s}}$

11. $Q_{acfm} = v_s A(60_{sec/min})$

12. $Q_{sd} = (3600_{sec/hr})(1 - B_{ws})\ v_s \left(\frac{T_{std} P_s}{T_s P_{std}}\right) A$

13. E (emission rate, lbs/hr) $= Q_{std}(C_s / 7000\ \text{grains/lb})$

14. $IKV = \frac{T_s V_{m(std)} P_{std}}{T_{std} v_s \theta A_n P_s 60(1 - B_{ws})} = K_4 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$

15. $\%EA = \left(\frac{\%O_2 - (0.5\ \%CO)}{0.264\ \%N_2 - (\%O_2 - 0.5\ \%CO)}\right) \times 100$

PLATT ENVIRONMENTAL SERVICES, INC.

Particulate Nomenclature

A = Cross-sectional area of stack or duct, square feet
A_n = Cross-sectional area of nozzle, square feet
B_{ws} = Water vapor in gas stream, by volume
C_a = Acetone blank residue concentration, g/g
C_{acf} = Concentration of particulate matter in gas stream at actual conditions, gr/acf
C_p = Pitot tube coefficient
C_s = Concentration of particulate matter in gas stream, dry basis, corrected to standard conditions, gr/dscf
IKV = Isokinetic sampling variance, must be 90.0 % ≤ IKV ≤ 110.0%
M_d = Dry molecular weight of gas, lb/lb-mole
M_s = Molecular weight of gas, wet basis, lb/lb-mole
M_w = Molecular weight of water, 18.0 lb/lb-mole
m_a = Mass of residue of acetone after evaporation, grams
P_{bar} = Barometric pressure at testing site, inches mercury
P_g = Static pressure of gas, inches mercury (inches water/13.6)
P_s = Absolute pressure of gas, inches mercury = $P_{bar} + P_g$
P_{std} = Standard absolute pressure, 29.92 inches mercury
Q_{acfm} = Actual volumetric gas flow rate, acfm
Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, dscfh
R = Ideal gas constant, 21.85 inches mercury cubic foot/°R-lb-mole
T_m = Dry gas meter temperature, °R
T_s = Gas temperature, °R
T_{std} = Absolute temperature, 528°R
V_a = Volume of acetone blank, ml
V_{aw} = Volume of acetone used in wash, ml
W_a = Weight of residue in acetone wash, grams
m_n = Total amount of particulate matter collected, grams
V_{1c} = Total volume of liquid collected in impingers and silica gel, ml
V_m = Volume of gas sample as measured by dry gas meter, dcf
$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, corrected to standard conditions, dscf
v_s = Gas velocity, ft/sec
$V_{w(std)}$ = Volume of water vapor in gas sample, corrected to standard conditions, scf
Y = Dry gas meter calibration factor
ΔH = Average pressure differential across the orifice meter, inches water
Δp = Velocity head of gas, inches water
ρ_a = Density of acetone, 0.7855 g/ml (average)
ρ_w = Density of water, 0.002201 lb/ml
θ = Total sampling time, minutes
K_1 = 17.647 °R/in. Hg
K_2 = 0.04707 ft^3/ml
K_4 = 0.09450/100 = 0.000945
K_p = Pitot tube constant, $85.49 \frac{ft}{sec}\left[\frac{(lb/lb-mole)(in.Hg)}{(°R)(in.H_2O)}\right]^{1/2}$
%EA = Percent excess air
$\%CO_2$ = Percent carbon dioxide by volume, dry basis
$\%O_2$ = Percent oxygen by volume, dry basis
%CO = Percent carbon monoxide by volume, dry basis
$\%N_2$ = Percent nitrogen by volume, dry basis
0.264 = Ratio of O_2 to N_2 in air, v/v
28 = Molecular weight of N_2 or CO
32 = Molecular weight of O_2
44 = Molecular weight of CO_2
13.6 = Specific gravity of mercury (Hg)

PLATT ENVIRONMENTAL SERVICES, INC.

Volumetric Air Flow Calculations

$$Vm\,(std) = 17.647 \times Vm \times \left[\frac{(P_{bar} + (\frac{DH}{13.6}))}{(460 + Tm)} \right] \times Y$$

$$Vw\,(std) = 0.0471 \times Vlc$$

$$Bws = \left[\frac{Vw\,(std)}{Vw\,(std) + Vm\,(std)} \right]$$

$$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (100 - \%CO_2 - \%O_2)]$$

$$Ms = Md \times (1 - Bws) + (18 \times Bws)$$

$$Vs = \sqrt{\frac{(Ts + 460)}{Ms \times Ps}} \times \sqrt{DP} \times Cp \times 85.49$$

$$Acfm = Vs \times \text{Area (of stack or duct)} \times 60$$

$$Scfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)} \right]$$

$$Scfh = Scfm \times 60 \frac{min}{hr}$$

acfm = actual cubic feet per minute
scfm = standard cubic feet per minute
scfh = standard cubic feet per hour

Cp = pitot tube correction factor
Ps = absolute flue gas pressure
Ms = molecular weight of gas (lb/lb mole)
Md = dry molecular weight of gas (lb/lb mole)
Bws = water vapor in gas stream proportion by volume

Fraction	Test #	Date	Time	Vmstd	Bws	mls	Va	H_2SO_4	HNO_3	$KMnO_4$	HCl	Persulfate	Hydrox	DF	ug/l	ug/sample	ug/dscm	ug/scm	Average	% diff
KCl	1A			68.863	0.127	585.2	10	0.5	0.25	10	0	0.75	10	3.15	1.9525	3.599199	1.846	1.611		
HNO_3/H_2O_2	1A			68.863	0.127	127.4	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	1A	6/19/2007	7:25-9:25	68.863	0.127	445.4	10	0	0.5	10	0	0.75	10	3.125	0.3625	0.504555	0.259	0.226	**Test 1**	
Total																	**2.104**	**1.837**	**1.954**	**-5.99**
KCl	1B			70.384	0.132	583.8	10	0.5	0.25	10	0	0.75	10	3.15	0.6767	1.244431	0.624	0.542		
HNO_3/H_2O_2	1B			70.384	0.132	117.6	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	1B	6/19/2007	7:25-9:25	70.384	0.132	424	10	0	0.5	10	0	0.75	10	3.125	2.6503	3.511648	1.762	1.529		
Total																	**2.386**	**2.071**		
KCl	2A			69.842	0.118	607.4	10	0.5	0.25	10	0	0.75	10	3.15	0.9705	1.856867	0.939	0.828		
HNO_3/H_2O_2	2A			69.842	0.118	125.2	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	2A	6/19/2007	10:15-12:15	69.842	0.118	437.8	10	0	0.5	10	0	0.75	10	3.125	0.3186	0.435885	0.220	0.194	**Test 2**	
Total																	**1.159**	**1.022**	**1.122**	**-8.91**
KCl	2B			63.533	0.129	579.2	10	0.5	0.25	10	0	0.75	10	3.15	1.1018	2.010212	1.117	0.973		
HNO_3/H_2O_2	2B			63.533	0.129	125	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	2B	6/19/2007	10:15-12:15	63.533	0.129	461.8	10	0	0.5	10	0	0.75	10	3.125	0.3567	0.514763	0.286	0.249		
Total																	**1.403**	**1.222**		
KCl	3A			70.426	0.121	686.2	10	0.5	0.25	10	0	0.75	10	3.15	1.8663	4.034063	2.023	1.778		
HNO_3/H_2O_2	3A			70.426	0.121	112.2	5	0.25	0	12	0.25	0.75	10	5.65	0.0132	0.008368	0.004	0.004		
$H_2SO_4/KMnO_4$	3A	6/19/2007	12:50-14:50	70.426	0.121	448.2	10	0	0.5	10	0	0.75	10	3.125	0.3728	0.522153	0.262	0.230	**Test 3**	
Total																	**2.289**	**2.012**	**2.184**	**-7.86**
KCl	3B			63.881	0.13	576.6	10	0.5	0.25	10	0	0.75	10	3.15	0.4772	0.866734	0.479	0.417		
HNO_3/H_2O_2	3B			63.881	0.13	122.4	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	3B	6/19/2007	12:50-14:50	63.881	0.13	483.6	10	0	0.5	10	0	0.75	10	3.125	2.667	4.030504	2.228	1.938		
Total																	**2.707**	**2.355**		
KCl	4A			69.401	0.126	576.2	10	0.5	0.25	10	0	0.75	10	3.15	1.262	2.290568	1.166	1.019		
HNO_3/H_2O_2	4A			69.401	0.126	113	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	4A	6/19/2007	15:25-17:25	69.401	0.126	574.2	10	0	0.5	10	0	0.75	10	3.125	0	0	0.000	0.000	**Test 4**	
Total																	**1.166**	**1.019**	**1.054**	**-3.37**
KCl	4B			63.31	0.151	592.2	10	0.5	0.25	10	0	0.75	10	3.15	1.1721	2.186471	1.220	1.035		
HNO_3/H_2O_2	4B			63.31	0.151	121.4	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	4B	6/19/2007	15:25-17:25	63.31	0.151	429.6	10	0	0.5	10	0	0.75	10	3.125	0.0855	0.114784	0.064	0.054		
Total																	**1.284**	**1.090**		
KCl	5A			70.99	0.12	592.2	10	0.5	0.25	10	0	0.75	10	3.15	2.453	4.5759	2.276	2.003		
HNO_3/H_2O_2	5A			70.99	0.12	126	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	5A	6/20/2007	07:40-10:10	70.99	0.12	472.6	10	0	0.5	10	0	0.75	10	3.125	0.1218	0.179883	0.089	0.079	**Test 5**	
Total																	**2.366**	**2.082**	**1.953**	**6.62**
KCl	5B			61.274	0.135	532.4	10	0.5	0.25	10	0	0.75	10	3.15	1.6261	2.727067	1.572	1.360		
HNO_3/H_2O_2	5B			61.274	0.135	123.2	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	5B	6/20/2007	07:40-10:10	61.274	0.135	458	10	0	0.5	10	0	0.75	10	3.125	0.65	0.930313	0.536	0.464		
Total																	**2.108**	**1.823**		
KCl	6A			69.43	0.122	588.8	10	0.5	0.25	10	0	0.75	10	3.15	1.4026	2.60143	1.323	1.162		
HNO_3/H_2O_2	6A			69.43	0.122	120.8	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	6A	6/20/2007	10:40-12:40	69.43	0.122	391.2	10	0	0.5	10	0	0.75	10	3.125	0	0	0.000	0.000	**Test 6**	
Total																	**1.323**	**1.162**	**1.276**	**-8.97**
KCl	6B			62.807	0.093	553	10	0.5	0.25	10	0	0.75	10	3.15	1.1281	1.965094	1.105	1.002		
HNO_3/H_2O_2	6B			62.807	0.093	118	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	6B	6/20/2007	10:40-12:40	62.807	0.093	424	10	0	0.5	10	0	0.75	10	3.125	0.5752	0.76214	0.429	0.389		
Total																	**1.533**	**1.391**		

KCl	7A			69.333	0.125	637.2	10	0.5	0.25	10	0	0.75	10	3.15	1.9321	3.878072	1.975	1.728		
HNO_3/H_2O_2	7A			69.333	0.125	118	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	7A	6/20/2007	13:10-15:10	69.333	0.125	463	10	0	0.5	10	0	0.75	10	3.125	0.1347	0.194894	0.099	0.087	Test 7	
Total																	**2.075**	**1.815**	**1.917**	**-5.31**
KCl	7B			63.021	0.121	554.4	10	0.5	0.25	10	0	0.75	10	3.15	1.3203	2.305719	1.292	1.136		
HNO_3/H_2O_2	7B			63.021	0.121	130.4	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	7B	6/20/2007	13:10-15:10	63.021	0.121	454	10	0	0.5	10	0	0.75	10	3.125	1.2638	1.793016	1.005	0.883		
Total																	**2.297**	**2.019**		
KCl	8A			69.235	0.106	633.6	10	0.5	0.25	10	0	0.75	10	3.15	2.0976	4.186474	2.135	1.909		
HNO_3/H_2O_2	8A			69.235	0.106	139.2	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	8A	6/20/2007	15:40-17:40	69.235	0.106	424.2	10	0	0.5	10	0	0.75	10	3.125	0.07916	0.104936	0.054	0.048	Test 8	
Total																	**2.189**	**1.957**	**2.026**	**-3.39**
KCl	8B			63.201	0.119	585.4	10	0.5	0.25	10	0	0.75	10	3.15	1.7391	3.206918	1.792	1.579		
HNO_3/H_2O_2	8B			63.201	0.119	118	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	8B	6/20/2007	15:40-17:40	63.201	0.119	418.8	10	0	0.5	10	0	0.75	10	3.125	0.8003	1.047393	0.585	0.516		
Total																	**2.377**	**2.094**		
KCl	9A			70.02	0.113	622.2	10	0.5	0.2	10	0	0.75	10	3.145	1.5658	3.063987	1.545	1.371		
HNO_3/H_2O_2	9A			70.02	0.113	121	5	0.25	0	8	0.25	0.75	10	4.85	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	9A	6/21/2007	7:20-9:20	70.02	0.113	488.8	10	0	0.5	10	0	0.75	10	3.125	0.1398	0.213545	0.108	0.096	Test 9	
Total																	**1.653**	**1.466**	**1.404**	**4.43**
KCl	9B			62.677	0.105	564.2	10	0.5	0.25	10	0	0.75	10	3.15	1.4877	2.643985	1.490	1.333		
HNO_3/H_2O_2	9B			62.677	0.105	135.2	5	0.25	0	8	0.25	0.75	10	4.85	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	9B	6/21/2007	7:20-9:20	62.677	0.105	473.6	10	0	0.5	10	0	0.75	10	3.125	0.0116	0.017168	0.010	0.009		
Total																	**1.499**	**1.342**		
KCl	10A			69.682	0.113	679.2	10	0.5	0.25	10	0	0.75	10	3.15	0.9151	1.957838	0.992	0.880		
HNO_3/H_2O_2	10A			69.682	0.113	118.2	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	10A	6/21/2007	9:50-11:50	69.682	0.113	552.8	10	0	0.5	10	0	0.75	10	3.125	0.1416	0.244614	0.124	0.110	Test 10	
Total																	**1.116**	**0.990**	**1.151**	**-14.01**
KCl	10B			61.352	0.118	556.2	10	0.5	0.25	10	0	0.75	10	3.15	1.3463	2.358758	1.358	1.198		
HNO_3/H_2O_2	10B			61.352	0.118	130.2	5	0.25	0	12	0.25	0.75	10	5.65	0.0395	0.029057	0.017	0.015		
$H_2SO_4/KMnO_4$	10B	6/21/2007	9:50-11:50	61.352	0.118	453	10	0	5	10	0	0.75	10	3.575	0.1223	0.198062	0.114	0.101		
Total																	**1.488**	**1.313**		
KCl	11A			68.381	0.116	625.2	10	0.5	0.25	10	0	0.75	10	3.15	1.2611	2.483585	1.283	1.134		
HNO_3/H_2O_2	11A			68.381	0.116	115.6	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	11A	6/21/2007	12:20-14:20	68.381	0.116	526	10	0	0.5	10	0	0.75	10	3.125	0.0328	0.053915	0.028	0.025	Test 11	
Total																	**1.310**	**1.158**	**1.125**	**3.02**
KCl	11B			60.643	0.116	570.4	10	0.5	0.25	10	0	0.75	10	3.15	1.1791	2.11856	1.234	1.091		
HNO_3/H_2O_2	11B			60.643	0.116	124.4	5	0.25	0	12	0.25	0.75	10	5.65	0	0	0.000	0.000		
$H_2SO_4/KMnO_4$	11B	6/21/2007	12:20-14:20	60.643	0.116	551.8	10	0	0.5	10	0	0.75	10	3.125	0	0	0.000	0.000		
Total																	**1.234**	**1.091**		
KCl	12A			69.344	0.113	723.4	10	0.5	0.25	10	0	0.75	15	3.65	0.7797	2.058728	1.048	0.930		
HNO_3/H_2O_2	12A			69.344	0.113	121.8	5	0.25	0	10	0.25	0.75	10	5.25	0.017	0.010871	0.006	0.005		
$H_2SO_4/KMnO_4$	12A	6/21/2007	14:50-16:50	69.344	0.113	520.2	10	0	0.5	10	0	0.75	15	3.625	0.3093	0.583255	0.297	0.263	Test 12	
Total																	**1.351**	**1.198**	**1.301**	**-7.88**
KCl	12B			61.217	0.109	535.6	10	0.5	0.25	10	0	0.75	10	3.15	1.5294	2.580312	1.489	1.326		
HNO_3/H_2O_2	12B			61.217	0.109	129.4	5	0.25	0	10	0.25	0.75	10	5.25	0.0571	0.038791	0.022	0.020		
$H_2SO_4/KMnO_4$	12B	6/21/2007	14:50-16:50	61.217	0.109	461.6	10	0	0.5	10	0	0.75	10	3.125	0.0769	0.110928	0.064	0.057		
Total																	**1.575**	**1.403**		

No	Description	M, ı C, ng/g		Area	Maximum	Time	Total ng
1	Std__1000 Std__	1		-100000	2	3:33:02 PM	
2	Std__100	1		-11000	0	3:49:06 PM	
3		1					
	Average						
1	Average Std__	10					
	Average						
1	Std__100	1		10300	927	3:57:20 PM	
2	Std__1000	1		82900	5450	4:00:35 PM	
3	Std__500	1		-3	0	4:04:25 PM	
4	Std__500	1		51100	4930	4:10:07 PM	
5	Std__250	1		29000	2700	4:14:33 PM	
6	Std__250	1		20900	1210	4:23:53 PM	
7	Std__750	1		84200	6150	4:26:59 PM	
8	Std__750	1		65700	7460	4:32:42 PM	
9	Std__1000	1		103000	11200	4:34:48 PM	
10	Test 3A Section 1	1	253	26900	1580	4:54:35 PM	
11	Test 3A Section 2	1	1.2	131	8	5:02:11 PM	254.2
12	Test 3B Section 1	1	248	26400	1350	5:12:08 PM	
13	Test 3B Section 2	1	2.2	230	13	5:16:48 PM	250.2
14	Test 2A Section 1	1	199	21200	2000	5:24:49 PM	
15	Test 2A Section 2	1	2.8	293	10	5:30:55 PM	201.8
16	Test 2B Section 1	1	188	20000	1350	5:37:52 PM	
17	Test 2B Section 2	1	0.2	21	6	5:43:02 PM	188.2
18	Test 1A Section 1	1	203	21600	996	5:53:10 PM	
19	Test 1A Section 2	1	0.8	80	8	5:57:10 PM	203.8
20	Test 1B Section 1	1	212	22500	491	6:02:35 PM	
21	Test 1B Section 2	1	2.4	255	9	6:09:27 PM	214.4
22	Test 4A Section 1	1	229	24300	1400	7:08:32 PM	
23	Test 4A Section 2	1	4.6	490	164	7:14:11 PM	233.6
24	Test 4B Section 1	1	235	25000	2550	7:22:39 PM	
25	Test 4B Section 2	1	-0.9	-100	8	7:29:30 PM	234.1
26	Cal Check 250 ng	1	246	26200	2400	7:37:29 PM	
27	Cal Check 250 ng	1	279	29600	1880	7:40:49 PM	
28	Manual Integration	1	264	28100	1870	7:45:57 PM	

	6/20/2007						
	Test 5A Section 1	1	363	11400	774	12:46	
	Test 5A Section 2	1	3.5	110	20	12:53	366.5
	Test 5B Section 1	1	386	12100	1200	13:00	
	Test 5B Section 2	1	0	110	20	12:53	386
	Test 6A Section 1	1	45	1410	110	15:21	
	Test 6A Section 2	1	-0.2	-7	5	15:27	45
	Test 6B Section 1	1	277	8690	511	15:36	
	Test 6B Section 2	1	3.5	111	7	15:40	280.5
	Test 7A Section 1	1	110	3450	207	17:31	
	Test 7A Section 2	1	3.5	109	13	17:38	113.5
	Test 7B Section 1	1	322	10100	1090	17:47	
	Test 7B Section 2	1	4.2	133	10	17:54	326.2
	Test 8A Section 1	1	117	3670	125	20:03	
	Test 8A Section 2	1	2	64	8	20:09	119
	Test 8B Section 1	1	344	10800	626	20:13	
	Test 8B Section 2	1	2.5	78	8	20:18	346.5
	6/21/2007						
	Test 9A Section 1	1	149	5170	420	11:39	
	Test 9A Section 2	1	0	-91	4	11:44	149
	Test 9B Section 1	1	166	5750	491	11:49	
	Test 9B Section 2	1	0	-101	5	12:07	166
	Test 10A Section 1	1	175	6090	310	14:06	
	Test 10A Section 2	1	5.1	178	9	14:12	180.1
	Test 10B Section 1	1	179	6220	484	14:19	
	Test 10B Section 2	1	0.7	24	7	14:25	179.7
	Test 11A Section 1	1	184	6380	696	16:54	
	Test 11A Section 2	1	4.1	143	12	17:00	188.1
Spike	Test 11B Section 1	1	191			17:08	
	Test 11B Section 2	1	2.9	101	7	17:17	193.9
	Test 12A Section 1	1	183	6350	366	18:33	
	Test 12A Section 2	1	6.2	215	7	18:41	189.2
Spike	Test 12B Section 1	1	186			18:51	
	Test 12B Section 2	1	4.5	155	9	18:57	190.5

No	Description (C:\Documents and	M, r C, ng/g		Area	Maximum	Time
1	Cal Check 250 ng 1	10		-17000	25	5:28:47 PM
2	Cal Check 250 ng 2	1		35200	2280	5:31:41 PM
3	Cal Check 250 ng 2	1	243	28100	1590	5:36:27 PM
4	Cal Check 250 ng 1	1	291	33700	2680	5:39:30 PM
5	Cal Check 250 ng 3	1	232	26900	2180	5:43:09 PM
6	Cal Check 250 ng 1	1	251	29000	2200	5:50:16 PM
7	Std__250 ng	1		27200	1880	5:54:37 PM
8	Std__500 ng	1		58600	4090	6:00:30 PM
9	Section 2 Test 12	1	0.5	60	7	6:22:40 PM
10	Std__500 ng	1	492	56200	5430	8:35:33 AM
11	Std__250 ng	1	261	29900	2690	11:56:00 AM
12	Std__100 ng	1	101	11600	924	12:00:54 PM
13	Std__75 ng	1	83	9490	445	12:06:09 PM
14	Std__10 ng	1	10	1230	61	12:12:53 PM
15	Cal Check 100 ng	1	112	12800	673	1:31:36 PM
16	Test 1A Section 1	1	71	8110	319	1:37:48 PM
17	Test 1A Section 2	1	6.8	774	17	1:42:26 PM
18	Test 1B Section 1	1	100	11500	550	1:48:58 PM
19	Test 1B Section 2	1	0.7	83	6	1:55:53 PM
20	Spike Section 1	1	344	39300	1320	2:02:44 PM
21	Spike Section 2	1	2.9	333	10	2:06:20 PM
22	Cal Check 100 ng	1	105	12000	719	5:00:26 PM
23	Test 2A Section 1	1	122	14000	818	5:10:08 PM
24	Test 2A Section 2	1	1.6	186	13	5:14:15 PM
25	Test 2B Section 1	1	115	13200	851	5:19:31 PM
26	Test 2B Section 2	1	1.8	204	10	5:23:34 PM
27	CalCheck 100 ng	1		5080	567	5:03:11 AM
28	Std__250 ng	1		-4200	6	5:10:53 AM
29	Std__250 ng	1	251	10100	715	7:35:52 AM
30	Std__100 ng	1	99	3990	515	7:38:44 AM
31	Std__10 ng	1	8.4	336	36	7:43:39 AM
32	Std__150 ng	1	146	5900	534	7:48:16 AM
33	Std__75 ng	1	78	3150	434	7:50:48 AM
34	Test 3A Section 1	1	126	5080	392	7:57:04 AM
35	Test 3A Section 2	1		-12	1	8:03:41 AM
36	Test 3A Section 2	1		-190	5	8:06:56 AM
37	Test 3B Section 1	1	124	5010	437	8:12:51 AM
38	Test 3B Section 2	1		-56	4	8:16:43 AM

39	Cal Check 150 ng	1	135	5460	545	11:54:25 AM
40	Test 4A Section 1	1	61	2490	138	11:58:34 AM
41	Test 4A Section 2	1	-2.7	-110	3	12:03:31 PM
42	Test 4B Section 1	1	75	3020	195	12:09:39 PM
43	Test 4B Section 2	1	1.1	43	6	12:13:16 PM
44	Cal Check 150 ng			5670	893	5:20:55 PM
45	Cal Check 150 ng	1	141	5670	893	5:20:55 PM
46	Test 5B Section 1	1				
47		1				
48	Test 5A Section 1	1	76	3060	171	5:31:39 PM
49	Test 5A Section 2	1	-0.3	-14	5	5:36:13 PM
50	Test 5B Section 1	1	87	3520	199	5:42:07 PM
51	Test 5B Section 2	1	6.7	268	12	5:52:00 PM
52	Test 6A Section 1	1	62	2510	204	6:26:02 PM
53	Test 6A Section 2	1	3.4	135	6	6:29:06 PM
54	Test 6B Section 1	1	149	6000	762	6:34:49 PM
55	Test 6B Section 2	1	-6.5	-260	4	6:39:33 PM
56		1				

No	Description	M, n	C, ng/g	Area	Maximum	Time
1	Check	1	252	41800	4100	5:46:15 AM
2	Std__250 ng	1	254	42100	3720	5:49:47 AM
3	Std__150 ng	1	144	24000	2590	5:53:07 AM
4	Std__75 ng	1	70	11700	1540	5:55:31 AM
5	Std__10 ng	1	9.5	1570	216	6:01:08 AM
6	Cal Check 150 ng	1	151	25000	2280	7:59:58 AM
7	Test 7A Section 1	1	46	7700	465	8:04:34 AM
8	Test 7A Section 2	1	0.8	127	11	8:09:55 AM
9	Test 7B Section 1 Spike 80 ng	1	132	22000	1800	8:16:36 AM
10	Test 7B Section 2	1	1.0	170	31	8:22:53 AM
11	150 ng Cal Check	1	153	25400	2800	2:44:38 PM
12	Test 8A Section 1	1	64	10600	1290	2:51:49 PM
13	Test 8A Section 2	1	1.4	236	26	2:56:44 PM
14	Test 8B Section 1	1	152	25300	1150	3:01:55 PM
15	Test 8B Section 2	1	0.7	111	9	3:07:37 PM
16	Test 9A Section 1	1	66	11000	843	3:15:09 PM
17	Test 9A Section 2	1	0.1	17	16	3:22:54 PM
18	Test 9B Section 1	1	66	11000	1010	3:27:45 PM
19	Test 9B Section 2	1	2.5	422	19	3:36:09 PM
20	80 ng spike check section 1	1	83	13800	908	3:41:54 PM
21	80 ng spike check section 2	1	0.0	1	10	3:48:22 PM
22	150 ng cal check	1	152	25300	1910	6:01:41 PM
23	Test 10A Section 1	1	62	10300	1230	6:07:28 PM
24	Test 10A Section 2	1	1.7	275	24	6:10:44 PM
25	Test 10B Section 1	1	40	6710	1320	6:17:01 PM
26	Test 10B Section 2	1	2.5	411	22	6:19:51 PM
	Average					

Company: ADA-ES
Plant: We Energies - Preque Isle Power Plant
Test Location: Flue 9 Stack
Train "A"

Source Condition	High Load												
Date	6/19/07				6/20/07				6/21/07				
Start Time	7:25	10:15	12:50	15:25	7:40	10:40	13:10	15:40	7:20	9:50	12:20	14:50	
End Time	9:25	12:15	14:50	17:25	10:10	12:40	15:10	17:40	9:20	11:50	14:20	16:50	
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Run 11	Run 12	Average
Stack Conditions													
Average Gas Temperature, °F	341.1	333.3	337.1	335.8	336.0	333.3	337.9	340.8	335.5	333.0	333.3	332.6	335.8
Flue Gas Moisture, percent by volume	12.7%	11.8%	12.1%	12.6%	12.0%	12.2%	12.5%	10.6%	11.3%	11.3%	11.6%	12.0%	11.9%
Average Flue Pressure, in. Hg	28.64	28.65	28.62	28.64	29.06	29.06	29.05	29.07	29.12	29.10	29.09	29.10	28.93
Gas Sample Volume, dscf	68.863	69.842	70.426	69.401	70.990	69.430	69.333	69.235	70.020	69.682	68.381	69.344	69.579
Average Gas Velocity, ft/sec	98.911	98.246	99.852	98.952	97.055	96.960	97.631	97.532	97.190	96.666	96.151	95.763	97.576
Gas Volumetric Flow Rate, acfm	420,662	417,833	424,666	420,836	412,768	412,365	415,217	414,799	413,342	411,113	408,924	407,276	414,983
Gas Volumetric Flow Rate, dscfm	231,774	234,960	236,413	233,739	234,098	234,096	233,298	237,593	236,945	236,130	234,065	232,187	234,608
Average $\%CO_2$ by volume, dry basis	12.8	12.7	12.8	12.9	12.8	12.9	12.5	12.7	13.0	13.0	12.8	12.8	12.8
Average $\%O_2$ by volume, dry basis	6.2	6.4	6.3	6.4	6.5	6.5	6.7	6.6	6.6	6.6	6.9	6.9	6.6
Isokinetic Variance	103.9	104.0	104.2	103.9	106.1	103.8	104.0	101.9	103.4	103.2	102.2	104.5	103.8
Oxidized Mercury													
ppb	0.22	0.11	0.24	0.14	0.27	0.16	0.24	0.26	0.19	0.12	0.15	0.13	0.19
µg/dscm	1.85	0.94	2.02	1.17	2.28	1.32	1.98	2.14	1.55	0.99	1.28	1.05	1.55
ug/wscm	1.61	0.83	1.78	1.02	2.00	1.16	1.73	1.91	1.37	0.88	1.13	0.92	1.36
lb/hr	0.0016	0.0008	0.0018	0.0010	0.0020	0.0012	0.0017	0.0019	0.0014	0.0009	0.0011	0.0009	0.0014
lb/tBtu	1.6022	0.8262	1.7680	1.0257	2.0171	1.1725	1.7750	1.9055	1.3789	0.8854	1.1690	0.9556	1.3734
Elemental Mercury													
ppb	0.03	0.03	0.03	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.04	0.02
µg/dscm	0.26	0.22	0.27	0.00	0.09	0.00	0.10	0.05	0.11	0.12	0.03	0.30	0.13
ug/wscm	0.23	0.19	0.23	0.00	0.08	0.00	0.09	0.05	0.10	0.11	0.02	0.27	0.11
lb/hr	0.0002	0.0002	0.0002	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000	0.0003	0.0001
lb/tBtu	0.2246	0.1940	0.2325	0.0000	0.0793	0.0000	0.0892	0.0478	0.0961	0.1106	0.0254	0.2758	0.1146
Total Mercury													
ppb	0.25	0.14	0.27	0.14	0.28	0.16	0.25	0.26	0.20	0.13	0.16	0.16	0.20
µg/dscm	2.10	1.16	2.29	1.17	2.37	1.32	2.07	2.19	1.65	1.12	1.31	1.35	1.68
ug/wscm	1.84	1.02	2.01	1.02	2.08	1.16	1.81	1.96	1.47	0.99	1.16	1.19	1.48
lb/hr	0.0018	0.0010	0.0020	0.0010	0.0021	0.0012	0.0018	0.0019	0.0015	0.0010	0.0011	0.0012	0.0015
lb/tBtu	1.8268	1.0202	2.0005	1.0257	2.0964	1.1725	1.8642	1.9532	1.4750	0.9960	1.1944	1.2314	1.4880

Analyte Summary

Company: ADA-ES
Plant: We Energies - Presque Isle Power Plant
Test Location: Flue 9 Stack
Train "B"

Source Condition						High Load							
Date	6/19/07	6/19/07	6/19/07	6/19/07	6/20/07	6/20/07	6/20/07	6/20/07	6/21/07	6/21/07	6/21/07	6/21/07	
Start Time	7:25	10:15	12:50	15:25	7:40	10:40	12:50	15:40	7:20	9:50	12:20	14:50	
End Time	9:25	12:15	14:50	17:25	10:00	12:40	14:50	17:40	9:20	11:50	14:20	16:50	
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Run 11	Run 12	Average
Stack Conditions													
Average Gas Temperature, °F	331.3	333.3	336.6	334.7	335.9	333.3	337.7	340.4	335.4	333.0	333.4	332.7	334.8
Flue Gas Moisture, percent by volume	13.2%	12.9%	13.0%	15.1%	13.5%	9.3%	12.1%	11.9%	10.5%	11.8%	11.6%	11.5%	12.2%
Average Flue Pressure, in. Hg	28.64	28.65	28.62	28.64	29.06	29.06	29.05	29.07	29.12	29.10	29.09	29.10	28.93
Gas Sample Volume, dscf	70.384	63.533	63.881	63.310	61.274	62.807	63.021	63.201	62.677	61.352	60.643	61.217	63.108
Average Gas Velocity, ft/sec	96.190	94.070	94.865	95.562	89.226	92.753	94.087	94.569	91.228	90.034	89.139	90.218	92.662
Gas Volumetric Flow Rate, acfm	409,089	400,074	403,454	406,420	379,474	394,473	400,145	402,197	387,984	382,910	379,104	383,692	394,085
Gas Volumetric Flow Rate, dscfm	226,847	221,973	222,554	219,393	211,495	231,234	226,067	227,202	224,350	218,662	216,793	219,860	222,203
Average %CO_2 by volume, dry basis	12.8	12.7	12.8	12.9	12.8	12.9	12.5	12.7	13.0	13.0	12.8	12.8	12.8
Average %O_2 by volume, dry basis	6.2	6.4	6.3	6.4	6.5	6.5	6.7	6.6	6.6	6.6	6.9	6.9	6.6
Isokinetic Variance	104.9	96.8	97.1	97.6	98.0	91.9	94.3	94.1	94.5	94.9	94.6	94.2	96.1
Oxidized Mercury													
ppb	0.07	0.13	0.06	0.15	0.19	0.13	0.15	0.21	0.18	0.16	0.15	0.18	0.15
µg/dscm	0.62	1.12	0.48	1.22	1.57	1.10	1.29	1.79	1.49	1.36	1.23	1.49	1.23
ug/wscm	0.54	0.97	0.42	1.04	1.36	1.00	1.14	1.58	1.33	1.20	1.09	1.32	1.08
lb/hr	0.0005	0.0009	0.0004	0.0010	0.0012	0.0009	0.0011	0.0015	0.0013	0.0011	0.0010	0.0012	0.0010
lb/tBtu	0.5420	0.9833	0.4188	1.0733	1.3927	0.9791	1.1610	1.5990	1.3293	1.2115	1.1245	1.3567	1.0976
Elemental Mercury													
ppb	0.21	0.03	0.27	0.01	0.06	0.05	0.12	0.07	0.00	0.02	0.00	0.01	0.07
µg/dscm	1.76	0.29	2.23	0.06	0.54	0.43	1.00	0.59	0.01	0.13	0.00	0.09	0.59
ug/wscm	1.53	0.25	1.94	0.05	0.46	0.39	0.88	0.52	0.01	0.12	0.00	0.08	0.52
lb/hr	0.0015	0.0002	0.0019	0.0001	0.0004	0.0003	0.0009	0.0005	0.0000	0.0001	0.0000	0.0001	0.0005
lb/tBtu	1.5295	0.2518	1.9474	0.0563	0.4751	0.3797	0.9029	0.5222	0.0086	0.1166	0.0000	0.0787	0.5224
Total Mercury													
ppb	0.29	0.17	0.32	0.15	0.25	0.18	0.28	0.28	0.18	0.18	0.15	0.19	0.22
µg/dscm	2.39	1.40	2.71	1.28	2.11	1.53	2.30	2.38	1.50	1.49	1.23	1.57	1.82
ug/wscm	2.07	1.22	2.36	1.09	1.82	1.39	2.02	2.10	1.34	1.31	1.09	1.39	1.60
lb/hr	0.0020	0.0012	0.0023	0.0011	0.0017	0.0012	0.0019	0.0020	0.0013	0.0013	0.0010	0.0013	0.0015
lb/tBtu	2.0715	1.2351	2.3662	1.1296	1.8679	1.3588	2.0639	2.1212	1.3380	1.3282	1.1245	1.4354	1.6200

Analyte Summary

Customer:	We Energies	
Plant:	PIPP	
Test Location:	Flue 9 Stack	
Test Engineer:	EO	
Temp ID:	CM2	
Meter ID:	CM2	
Pitot ID:	019A	
Pitot Tube Coefficient:	0.840	
Probe Length:	4.0	ft
Probe Liner Material:	Glass	
Nozzle Diameter:	0.176	in.
Meter Calibration Factor:	0.997	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	9.5	**ft**
Duct Area:	70.882	**Sq. Ft.**
Number of Ports Sampled:	1	
Number of Points per Port:	1	
Minutes per Point:	120.0	
otal Number of Traverse Points:	1	
Test Length:	120	**min.**
Train Type:	Anderson Box	
Source Condition:	High Load	
# of Runs	4	

CLEAR WORKBOOK

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 7:25
End Time: 9:25

DRY GAS METER CONDITIONS

ΔH:	1.05	in. H_2O
Meter Temperature, Tm:	90.3	°F
Sqrt ΔP:	1.396	in. H_2O
Stack Temperature, Ts:	341.1	°F
Meter Volume, Vm:	74.774	ft^3
Meter Volume, Vmstd:	68.863	dscf
Meter Volume, Vwstd:	9.995	wscf
Isokinetic Variance:	103.9	%I

Sample Train Leak Checks

Pre	0.002	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.20	in. H_2O
Flue Pressure (Ps):	28.64	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.2	%
Nitrogen:	81.0	%
Gas Weight dry, Md:	30.296	lb/lb mole
Gas Weight wet, Ms:	28.738	lb/lb mole
Excess Air:	40.832	%
	98.911	fps
Volumetric Flow:	420,662	acfm
Volumetric Flow:	231,774	dscfm
Volumetric Flow:	265,413	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	194.8	ml
Difference:	194.8	
Total Water Gain:	212.2	

Silica Initial Wt.	785.8	grams
Silica Final Wt.	803.2	grams
Difference:	17.4	
Moisture, Bws:	0.127	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	7:25:00	2.00	1.10	49.35	1.414	340	86	86	4.0	6.154	100.190
1-1	7:35:00	1.80	0.96	55.50	1.342	340	87	86	4.0	5.880	95.049
1-1	7:45:00	2.10	1.10	61.38	1.449	341	90	87	5.0	6.520	102.664
1-1	7:55:00	2.00	1.10	67.90	1.414	34`	93	88	4.0	6.400	100.190
1-1	8:05:00	2.00	1.10	74.30	1.414	342	92	89	4.0	6.360	100.190
1-1	8:15:00	2.00	1.10	80.66	1.414	343	93	90	4.0	6.420	100.190
1-1	8:25:00	2.00	1.10	87.08	1.414	343	94	91	4	6.320	100.190
1-1	8:35:00	1.9	1	93.4	1.378	342	95	92	4	6.140	97.653
1-1	8:45:00	1.9	1	99.54	1.378	342	92	91	4	6.130	97.653
1-1	8:55:00	1.9	1	105.67	1.378	340	91	91	4	6.130	97.653
1-1	9:05:00	1.9	1	111.8	1.378	340	90	90	4	6.200	97.653
1-1	9:15:00	1.9	1	118	1.378	339	92	92	4	6.120	97.653
	9:25:00			124.12							

Test Run 1

U-36

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 10:15
End Time: 12:15

DRY GAS METER CONDITIONS

ΔH:	1.05	In. H_2O
Meter Temperature, Tm:	88.4	°F
Sqrt ΔP:	1.396	In. H_2O
Stack Temperature, Ts:	333.3	°F
Meter Volume, Vm:	75.572	cf
Meter Volume, Vmstd:	69.842	dscf
Meter Volume, Vwstd:	9.316	wscf
Isokinetic Variance:	104.0	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.10	in. H_2O
Flue Pressure (Ps):	28.65	in. Hg. abs.
Carbon Dioxide:	12.7	%
Oxygen:	6.4	%
Nitrogen:	80.9	%
Gas Weight dry, Md:	30.288	lb/lb mole
Gas Weight wet, Ms:	28.842	lb/lb mole
Excess Air:	42.788	%
Gas Velocity, Vs:	98.246	fps
Volumetric Flow:	417,833	acfm
Volumetric Flow:	234,960	dscfm
Volumetric Flow:	266,302	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	176.8	ml
Difference:	176.8	
Total Water Gain:	197.8	

Silica Initial Wt.	803.2	grams
Silica Final Wt.	824.2	grams
Difference:	21	
Moisture, Bws:	0.118	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	10:15:00	2.00	1.10	39.01	1.414	336	86	86	5.0	6.192	99.506
1-1	10:25:00	2.00	1.10	45.20	1.414	335	85	85	5.0	6.410	99.506
1-1	10:35:00	2.00	1.10	51.61	1.414	335	86	84	5.0	6.380	99.506
1-1	10:45:00	1.90	1.00	57.99	1.378	334	89	85	5.0	6.160	96.986
1-1	10:55:00	1.90	1.00	64.15	1.378	333	90	86	5.0	6.240	96.986
1-1	11:05:00	2.00	1.10	70.39	1.414	333	90	88	5.0	6.380	99.506
1-1	11:15:00	1.90	1.00	76.77	1.378	332	91	88	5	6.430	96.986
1-1	11:25:00	1.9	1	83.2	1.378	332	93	89	5	6.300	96.986
1-1	11:35:00	2	1.1	89.5	1.414	332	93	89	5	6.350	99.506
1-1	11:45:00	2	1.1	95.85	1.414	332	93	90	5	6.350	99.506
1-1	11:55:00	1.9	1	102.2	1.378	333	90	90	5	6.180	96.986
1-1	12:05:00	1.9	1	108.38	1.378	332	88	88	5	6.200	96.986
	12:15:00			114.58							

Test Run 2

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 12:50
End Time: 14:50

DRY GAS METER CONDITIONS

ΔH:	1.09	In. H_2O
Meter Temperature, Tm:	90.3	°F
Sqrt ΔP:	1.414	In. H_2O
Stack Temperature, Ts:	337.1	°F
Meter Volume, Vm:	76.462	cf
Meter Volume, Vmstd:	70.426	dscf
Meter Volume, Vwstd:	9.731	wscf
Isokinetic Variance:	104.2	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	8	in Hg.
Post	0.001	ft3	@	8	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	28.62	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.3	%
Nitrogen:	80.9	%
Gas Weight dry, Md:	30.300	lb/lb mole
Gas Weight wet, Ms:	28.807	lb/lb mole
Excess Air:	41.839	%
Gas Velocity, Vs:	99.852	fps
Volumetric Flow:	424,666	acfm
Volumetric Flow:	236,413	dscfm
Volumetric Flow:	269,079	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	191.6	ml
Difference:	191.6	
Total Water Gain:	206.6	

Silica Initial Wt.	803.8	grams
Silica Final Wt.	818.8	grams
Difference:	15	
Moisture, Bws:	0.121	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	12:50:00	2.00	1.10	117.19	1.414	335	87	87	4.0	6.350	99.858
1--1	13:00:00	2.00	1.10	123.54	1.414	335	87	88	4.0	6.360	99.858
1-1	13:10:00	2.00	1.10	129.90	1.414	336	92	88	4.0	6.460	99.858
1-1	13:20:00	2.00	1.10	136.36	1.414	336	93	89	4.0	6.270	99.858
1-1	13:30:00	1.90	1.00	142.63	1.378	336	90	89	4.0	6.380	97.329
1-1	13:40:00	2.00	1.10	149.01	1.414	336	93	89	4.0	6.350	99.858
1-1	13:50:00	2.00	1.10	155.36	1.414	338	92	90	4	6.220	99.858
1-1	14:00:00	2	1.1	161.58	1.414	338	92	90	4	6.370	99.858
1-1	14:10:00	2	1.1	167.95	1.414	338	92	90	4	6.350	99.858
1-1	14:20:00	2.1	1.1	174.3	1.449	339	93	90	4	6.530	102.324
1-1	14:30:00	2	1.1	180.83	1.414	339	93	91	5	6.350	99.858
1-1	14:40:00	2	1.1	187.18	1.414	339	92	91	5	6.472	99.858
	14:50:00			193.652							

Test Run 3

U-38

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 15:25
End Time: 17:25

DRY GAS METER CONDITIONS

ΔH:	1.07	In. H_2O
Meter Temperature, Tm:	95.4	°F
Sqrt ΔP:	1.402	In. H_2O
Stack Temperature, Ts:	335.8	°F
Meter Volume, Vm:	76.050	cf
Meter Volume, Vmstd:	69.401	dscf
Meter Volume, Vwstd:	9.966	wscf
Isokinetic Variance:	103.9	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.20	in. H_2O
Flue Pressure (Ps):	28.64	in. Hg. abs.
Carbon Dioxide:	12.9	%
Oxygen:	6.4	%
Nitrogen:	80.7	%
Gas Weight dry, Md:	30.320	lb/lb mole
Gas Weight wet, Ms:	28.773	lb/lb mole
Excess Air:	42.939	%
Gas Velocity, Vs:	98.952	fps
Volumetric Flow:	420,836	acfm
Volumetric Flow:	233,739	dscfm
Volumetric Flow:	267,305	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	197.6	ml
Difference:	197.6	
Total Water Gain:	211.6	

Silica Initial Wt.	810.4	grams
Silica Final Wt.	824.4	grams
Difference:	14	
Moisture, Bws:	0.126	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	15:25:00	2.00	1.10	93.80	1.414	340	92	93	4.0	6.350	99.794
1-1	15:35:00	1.90	1.00	100.15	1.378	338	94	92	4.0	6.240	97.267
1-1	15:45:00	2.00	1.10	106.39	1.414	338	96	93	4.0	6.310	99.794
1-1	15:55:00	1.90	1.00	112.70	1.378	337	97	94	4.0	6.200	97.267
1-1	16:05:00	1.90	1.00	118.90	1.378	336	97	94	4.0	6.200	97.267
1-1	16:15:00	1.90	1.00	125.10	1.378	335	98	94	4.0	6.200	97.267
1-1	16:25:00	2.00	1.10	131.30	1.414	335	98	95	4	6.500	99.794
1-1	16:35:00	2	1.1	137.8	1.414	334	98	95	4	6.300	99.794
1-1	16:45:00	2	1.1	144.1	1.414	334	98	95	4	6.300	99.794
1-1	16:55:00	2	1.1	150.4	1.414	334	96	94	5	6.350	99.794
1-1	17:05:00	2	1.1	156.75	1.414	334	98	95	5	6.750	99.794
1-1	17:15:00	2	1.1	163.5	1.414	334	99	95	5	6.350	99.794
	17:25:00			169.85							

Test Run 4

Customer:	We Energies	
Plant:	PIPP	
Test Location:	Flue 9 Stack	
Test Engineer:	EO	
Temp ID:	CM2	
Meter ID:	CM2	
Pitot ID:	019A	
Pitot Tube Coefficient:	0.840	
Probe Length:	4.0	ft
Probe Liner Material:	Glass	
Nozzle Diameter:	0.176	in.
Meter Calibration Factor:	0.997	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	9.5	**ft**
Duct Area:	70.882	**Sq. Ft.**
Number of Ports Sampled:	1	
Number of Points per Port:	1	
Minutes per Point:	120.0	
otal Number of Traverse Points:	1	
Test Length:	120	**min.**
Train Type:	Anderson Box	
Source Condition:	High Load	
# of Runs	4	

CLEAR WORKBOOK

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 7:40
End Time: 10:10

DRY GAS METER CONDITIONS

ΔH:	0.99	in. H_2O
Meter Temperature, Tm:	80.8	°F
Sqrt ΔP:	1.387	in. H_2O
Stack Temperature, Ts:	336.0	°F
Meter Volume, Vm:	74.625	ft^3
Meter Volume, Vmstd:	70.990	dscf
Meter Volume, Vwstd:	9.651	wscf
Isokinetic Variance:	106.1	%I

Sample Train Leak Checks

Pre	0	ft3	@	10	in Hg.
Post	0	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	29.06	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.5	%
Nitrogen:	80.7	%
Gas Weight dry, Md:	30.308	lb/lb mole
Gas Weight wet, Ms:	28.835	lb/lb mole
Excess Air:	43.905	%
	97.055	fps
Volumetric Flow:	412,768	acfm
Volumetric Flow:	234,098	dscfm
Volumetric Flow:	265,923	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	188.3	ml
Difference:	188.3	
Total Water Gain:	204.9	

Silica Initial Wt.	815.4	grams
Silica Final Wt.	832	grams
Difference:	16.6	
Moisture, Bws:	0.120	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	7:40:00	1.90	0.99	70.23	1.378	331	75	75	5.0	6.115	96.477
1-1	7:50:00	1.90	0.99	76.34	1.378	332	77	76	5.0	6.100	96.477
1-1	8:00:00	1.90	0.99	82.44	1.378	332	78	77	5.0	0.000	96.477
1-1	8:30:00	1.90	0.99	82.44	1.378	334	77	77	5.0	7.090	96.477
1-1	8:40:00	1.90	0.99	89.53	1.378	335	80	78	5.0	6.050	96.477
1-1	8:50:00	1.90	0.99	95.58	1.378	336	82	79	5.0	6.080	96.477
1-1	9:00:00	2.00	1.00	101.66	1.414	337	83	80	5	6.250	98.983
1-1	9:10:00	2	1	107.91	1.414	337	83	80	5	6.290	98.983
1-1	9:20:00	1.9	0.99	114.2	1.378	338	84	81	5	6.130	96.477
1-1	9:30:00	1.9	0.99	120.33	1.378	338	86	82	4	6.070	96.477
1-1	9:40:00	2	1	126.4	1.414	339	86	83	4	6.180	98.983
1-1	9:50:00	1.9	0.99	132.58	1.378	339	87	84	5	6.170	96.477
1-1	10:00:00	1.9	0.99	138.75	1.378	340	88	84	5	6.100	96.477
	10:10:00			144.85							

Test Run 5

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 10:40
End Time: 12:40

DRY GAS METER CONDITIONS

ΔH:	0.99	In. H_2O
Meter Temperature, Tm:	89.1	°F
Sqrt ΔP:	1.387	In. H_2O
Stack Temperature, Ts:	333.3	°F
Meter Volume, Vm:	74.102	cf
Meter Volume, Vmstd:	69.430	dscf
Meter Volume, Vwstd:	9.627	wscf
Isokinetic Variance:	103.8	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	29.06	in. Hg. abs.
Carbon Dioxide:	12.9	%
Oxygen:	6.5	%
Nitrogen:	80.6	%
Gas Weight dry, Md:	30.324	lb/lb mole
Gas Weight wet, Ms:	28.823	lb/lb mole
Excess Air:	43.983	%
Gas Velocity, Vs:	96.960	fps
Volumetric Flow:	412,365	acfm
Volumetric Flow:	234,096	dscfm
Volumetric Flow:	266,556	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	194.6	ml
Difference:	194.6	
Total Water Gain:	204.4	

Silica Initial Wt.	818.4	grams
Silica Final Wt.	828.2	grams
Difference:	9.8	
Moisture, Bws:	0.122	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	10:40:00	2.00	1.00	50.12	1.414	340	90	88	4.0	6.276	98.837
1-1	10:50:00	1.90	0.99	56.40	1.378	338	90	88	4.0	6.150	96.335
1-1	11:00:00	2.00	1.00	62.55	1.414	336	90	89	4.0	6.260	98.837
1-1	11:10:00	1.90	0.99	68.81	1.378	335	89	88	4.0	6.090	96.335
1-1	11:20:00	1.90	0.99	74.90	1.378	334	90	88	4.0	6.140	96.335
1-1	11:30:00	2.00	1.00	81.04	1.414	333	90	88	4.0	6.290	98.837
1-1	11:40:00	1.90	0.99	87.33	1.378	332	90	87	4	6.090	96.335
1-1	11:50:00	1.9	0.99	93.42	1.378	332	91	88	4	6.160	96.335
1-1	12:00:00	1.9	0.99	99.58	1.378	331	91	88	4	6.120	96.335
1-1	12:10:00	1.9	0.99	105.7	1.378	329	90	87	4	6.080	96.335
1-1	12:20:00	1.9	0.99	111.78	1.378	330	91	88	4	6.120	96.335
1-1	12:30:00	1.9	0.99	117.9	1.378	330	92	88	4	6.326	96.335
	12:40:00			124.226							

Test Run 6

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 13:10
End Time: 15:10

DRY GAS METER CONDITIONS

ΔH:	0.99	In. H_2O
Meter Temperature, Tm:	89.2	°F
Sqrt ΔP:	1.390	In. H_2O
Stack Temperature, Ts:	337.9	°F
Meter Volume, Vm:	74.010	cf
Meter Volume, Vmstd:	69.333	dscf
Meter Volume, Vwstd:	9.933	wscf
Isokinetic Variance:	104.0	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.70	in. H_2O
Flue Pressure (Ps):	29.05	in. Hg. abs.
Carbon Dioxide:	12.5	%
Oxygen:	6.7	%
Nitrogen:	80.8	%
Gas Weight dry, Md:	30.268	lb/lb mole
Gas Weight wet, Ms:	28.731	lb/lb mole
Excess Air:	45.793	%
Gas Velocity, Vs:	97.631	fps
Volumetric Flow:	415,217	acfm
Volumetric Flow:	233,298	dscfm
Volumetric Flow:	266,722	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	193.9	ml
Difference:	193.9	
Total Water Gain:	210.9	

Silica Initial Wt.	832	grams
Silica Final Wt.	849	grams
Difference:	17	
Moisture, Bws:	0.125	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	13:10:00	1.90	0.99	26.98	1.378	332	88	88	5.0	6.200	96.793
1--1	13:20:00	1.90	0.99	33.18	1.378	334	88	88	5.0	6.120	96.793
1-1	13:30:00	1.90	0.99	39.30	1.378	337	89	88	4.0	6.110	96.793
1-1	13:40:00	1.90	0.99	45.41	1.378	338	88	90	4.0	6.190	96.793
1-1	13:50:00	2.00	1.00	51.60	1.414	340	88	91	4.0	6.300	99.307
1-1	14:00:00	1.90	0.99	57.90	1.378	340	88	91	4.0	6.080	96.793
1-1	14:10:00	1.90	0.99	63.98	1.378	340	90	89	5	6.120	96.793
1-1	14:20:00	2	1	70.1	1.414	339	91	88	4	6.260	99.307
1-1	14:30:00	2	1	76.36	1.414	339	90	88	4	6.220	99.307
1-1	14:40:00	1.9	0.99	82.58	1.378	338	90	88	4	6.010	96.793
1-1	14:50:00	1.9	0.99	88.59	1.378	339	92	89	4	6.140	96.793
1-1	15:00:00	2	1	94.73	1.414	339	92	89	4	6.260	99.307
	15:10:00			100.99							

Test Run 7

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 15:40
End Time: 17:40

DRY GAS METER CONDITIONS

ΔH:	0.99	In. H_2O
Meter Temperature, Tm:	90.3	°F
Sqrt ΔP:	1.393	In. H_2O
Stack Temperature, Ts:	340.8	°F
Meter Volume, Vm:	74.056	cf
Meter Volume, Vmstd:	69.235	dscf
Meter Volume, Vwstd:	8.186	wscf
Isokinetic Variance:	101.9	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.40	in. H_2O
Flue Pressure (Ps):	29.07	in. Hg. abs.
Carbon Dioxide:	12.7	%
Oxygen:	6.6	%
Nitrogen:	80.7	%
Gas Weight dry, Md:	30.296	lb/lb mole
Gas Weight wet, Ms:	28.996	lb/lb mole
Excess Air:	44.883	%
Gas Velocity, Vs:	97.532	fps
Volumetric Flow:	414,799	acfm
Volumetric Flow:	237,593	dscfm
Volumetric Flow:	265,685	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	168.8	ml
Difference:	168.8	
Total Water Gain:	173.8	

Silica Initial Wt.	828.6	grams
Silica Final Wt.	833.6	grams
Difference:	5	
Moisture, Bws:	0.106	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	15:40:00	2.00	1.00	1.15	1.414	341	88	88	4.0	6.296	98.995
1-1	15:50:00	2.00	1.00	7.45	1.414	340	90	88	3.0	6.240	98.995
1-1	16:00:00	1.90	0.99	13.69	1.378	340	92	89	3.0	6.110	96.488
1-1	16:10:00	1.90	0.99	19.80	1.378	340	93	89	3.0	6.090	96.488
1-1	16:20:00	1.90	0.99	25.89	1.378	341	93	90	3.0	6.010	96.488
1-1	16:30:00	1.90	0.99	31.90	1.378	341	93	90	3.0	6.150	96.488
1-1	16:40:00	1.90	0.99	38.05	1.378	341	93	90	3	6.150	96.488
1-1	16:50:00	2	1	44.2	1.414	341	92	89	3	6.110	98.995
1-1	17:00:00	1.9	0.99	50.31	1.378	341	92	90	3	6.160	96.488
1-1	17:10:00	2	1	56.47	1.414	341	91	89	3	6.330	98.995
1-1	17:20:00	2	1	62.8	1.414	341	91	89	3	6.300	98.995
1-1	17:30:00	1.9	0.99	69.1	1.378	342	91	88	3	6.110	96.488
	17:40:00			75.21							

Test Run 8

Customer:	We Energies	
Plant:	PIPP	
Test Location:	Flue 9 Stack	
Test Engineer:	EO	
Temp ID:	CM2	
Meter ID:	CM2	
Pitot ID:	019A	
Pitot Tube Coefficient:	0.840	
Probe Length:	4.0	ft
Probe Liner Material:	Glass	
Nozzle Diameter:	0.176	in.
Meter Calibration Factor:	0.997	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	9.5	**ft**
Duct Area:	70.882	**Sq. Ft.**
Number of Ports Sampled:	1	
Number of Points per Port:	1	
Minutes per Point:	120.0	
otal Number of Traverse Points:	1	
Test Length:	120	**min.**
Train Type:	Anderson Box	
Source Condition:	High Load	
# of Runs	4	

CLEAR WORKBOOK

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 7:20
End Time: 9:20

DRY GAS METER CONDITIONS

ΔH:	1.04	in. H_2O
Meter Temperature, Tm:	84.3	°F
Sqrt ΔP:	1.393	in. H_2O
Stack Temperature, Ts:	335.5	°F
Meter Volume, Vm:	73.990	ft^3
Meter Volume, Vmstd:	70.020	dscf
Meter Volume, Vwstd:	8.883	wscf
Isokinetic Variance:	103.4	%I

Sample Train Leak Checks

Pre	0	ft3	@	10	in Hg.
Post	0	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.10	in. H_2O
Flue Pressure (Ps):	29.12	in. Hg. abs.
Carbon Dioxide:	13.0	%
Oxygen:	6.6	%
Nitrogen:	80.4	%
Gas Weight dry, Md:	30.344	lb/lb mole
Gas Weight wet, Ms:	28.954	lb/lb mole
Excess Air:	45.126	%
	97.190	fps
Volumetric Flow:	413,342	acfm
Volumetric Flow:	236,945	dscfm
Volumetric Flow:	267,005	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	174.4	ml
Difference:	174.4	
Total Water Gain:	188.6	

Silica Initial Wt.	0	grams
Silica Final Wt.	14.2	grams
Difference:	14.2	
Moisture, Bws:	0.113	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	7:20:00	1.90	0.99	77.30	1.378	333	81	81	3.0	6.100	96.149
1-1	7:30:00	2.00	1.10	83.40	1.414	334	83	82	3.0	6.230	98.647
1-1	7:40:00	1.90	0.99	89.63	1.378	334	84	82	3.0	6.170	96.149
1-1	7:50:00	1.90	0.99	95.80	1.378	335	85	82	3.0	6.090	96.149
1-1	8:00:00	1.90	0.99	101.89	1.378	335	85	83	3.0	6.080	96.149
1-1	8:10:00	2.00	1.10	107.97	1.414	336	86	83	3.0	6.130	98.647
1-1	8:20:00	2.00	1.10	114.10	1.414	337	86	83	3	6.270	98.647
1-1	8:30:00	2	1.1	120.37	1.414	337	86	84	3	6.310	98.647
1-1	8:40:00	1.9	0.99	126.68	1.378	337	87	85	3	6.140	96.149
1-1	8:50:00	2	1.1	132.82	1.414	336	87	85	3	6.270	98.647
1-1	9:00:00	1.9	0.99	139.09	1.378	336	87	85	3	6.110	96.149
1-1	9:10:00	1.9	0.99	145.2	1.378	336	86	85	2	6.090	96.149
	9:20:00			151.29							

Test Run 9

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 9:50
End Time: 11:50

DRY GAS METER CONDITIONS

ΔH:	0.99	In. H_2O
Meter Temperature, Tm:	80.1	°F
Sqrt ΔP:	1.387	In. H_2O
Stack Temperature, Ts:	333.0	°F
Meter Volume, Vm:	73.072	cf
Meter Volume, Vmstd:	69.682	dscf
Meter Volume, Vwstd:	8.874	wscf
Isokinetic Variance:	103.2	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.40	in. H_2O
Flue Pressure (Ps):	29.10	in. Hg. abs.
Carbon Dioxide:	13.0	%
Oxygen:	6.6	%
Nitrogen:	80.4	%
Gas Weight dry, Md:	30.344	lb/lb mole
Gas Weight wet, Ms:	28.950	lb/lb mole
Excess Air:	45.126	%
Gas Velocity, Vs:	96.666	fps
Volumetric Flow:	411,113	acfm
Volumetric Flow:	236,130	dscfm
Volumetric Flow:	266,200	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	176.6	ml
Difference:	176.6	
Total Water Gain:	188.4	

Silica Initial Wt.	0	grams
Silica Final Wt.	11.8	grams
Difference:	11.8	

Moisture, Bws: 0.113

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	9:50:00	1.90	0.99	51.57	1.378	335	77	79	4.0	6.092	96.042
1-1	10:00:00	2.00	1.00	57.66	1.414	334	79	78	4.0	6.190	98.537
1-1	10:10:00	2.00	1.00	63.85	1.414	334	81	79	4.0	6.180	98.537
1-1	10:20:00	2.00	1.00	70.03	1.414	334	83	80	4.0	5.970	98.537
1-1	10:30:00	1.90	0.99	76.00	1.378	335	83	81	6.0	6.200	96.042
1-1	10:40:00	1.90	0.99	82.20	1.378	334	83	81	5.0	6.100	96.042
1-1	10:50:00	1.90	0.99	88.30	1.378	333	83	81	4	6.100	96.042
1-1	11:00:00	1.9	0.99	94.4	1.378	333	82	81	4	6.100	96.042
1-1	11:10:00	1.9	0.99	100.5	1.378	332	80	79	4	6.040	96.042
1-1	11:20:00	1.9	0.99	106.54	1.378	331	79	78	4	6.040	96.042
1-1	11:30:00	1.9	0.99	112.58	1.378	331	79	77	4	6.020	96.042
1-1	11:40:00	1.9	0.99	118.6	1.378	330	81	78	4	6.040	96.042
	11:50:00			124.64							

Test Run 10

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 12:20
End Time: 14:20

DRY GAS METER CONDITIONS

ΔH:	0.99	In. H_2O
Meter Temperature, Tm:	86.5	°F
Sqrt ΔP:	1.378	In. H_2O
Stack Temperature, Ts:	333.3	°F
Meter Volume, Vm:	72.560	cf
Meter Volume, Vmstd:	68.381	dscf
Meter Volume, Vwstd:	8.930	wscf
Isokinetic Variance:	102.2	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	29.09	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.9	%
Nitrogen:	80.3	%
Gas Weight dry, Md:	30.324	lb/lb mole
Gas Weight wet, Ms:	28.900	lb/lb mole
Excess Air:	48.254	%
Gas Velocity, Vs:	96.151	fps
Volumetric Flow:	408,924	acfm
Volumetric Flow:	234,065	dscfm
Volumetric Flow:	264,632	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	179.6	ml
Difference:	179.6	
Total Water Gain:	189.6	

Silica Initial Wt.	0	grams
Silica Final Wt.	10	grams
Difference:	10	
Moisture, Bws:	0.116	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	12:20:00	1.90	0.99	24.94	1.378	332	82	82	4.0	6.060	96.151
1--1	12:30:00	1.90	0.99	31.00	1.378	332	84	82	3.0	6.010	96.151
1-1	12:40:00	1.90	0.99	37.01	1.378	332	86	83	3.0	6.060	96.151
1-1	12:50:00	1.90	0.99	43.07	1.378	332	88	84	3.0	6.040	96.151
1-1	13:00:00	1.90	0.99	49.11	1.378	332	89	85	3.0	6.090	96.151
1-1	13:10:00	1.90	0.99	55.20	1.378	333	89	86	3.0	6.020	96.151
1-1	13:20:00	1.90	0.99	61.22	1.378	334	89	86	3	6.140	96.151
1-1	13:30:00	1.9	0.99	67.36	1.378	334	89	86	3	6.040	96.151
1-1	13:40:00	1.9	0.99	73.4	1.378	334	89	86	3	6.000	96.151
1-1	13:50:00	1.9	0.99	79.4	1.378	334	89	87	3	5.990	96.151
1-1	14:00:00	1.9	0.99	85.39	1.378	335	90	87	3	6.110	96.151
1-1	14:10:00	1.9	0.99	91.5	1.378	335	91	87	3	6.000	96.151
	14:20:00			97.5							

Test Run 11

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 14:50
End Time: 16:50

DRY GAS METER CONDITIONS

ΔH:	0.98	In. H_2O
Meter Temperature, Tm:	84.8	°F
Sqrt ΔP:	1.372	In. H_2O
Stack Temperature, Ts:	332.6	°F
Meter Volume, Vm:	73.359	cf
Meter Volume, Vmstd:	69.344	dscf
Meter Volume, Vwstd:	9.458	wscf
Isokinetic Variance:	104.5	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.40	in. H_2O
Flue Pressure (Ps):	29.10	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.9	%
Nitrogen:	80.3	%
Gas Weight dry, Md:	30.324	lb/lb mole
Gas Weight wet, Ms:	28.845	lb/lb mole
Excess Air:	48.254	%
Gas Velocity, Vs:	95.763	fps
Volumetric Flow:	407,276	acfm
Volumetric Flow:	232,187	dscfm
Volumetric Flow:	263,854	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	188	ml
Difference:	188	

Silica Initial Wt.	0	grams
Silica Final Wt.	12.8	grams
Difference:	12.8	

Total Water Gain: 200.8

Moisture, Bws: 0.120

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	14:50:00	1.90	0.99	1.78	1.378	334	85	86	3.0	6.019	96.191
1-1	15:00:00	1.80	0.94	7.80	1.342	333	85	85	3.0	5.850	93.626
1-1	15:10:00	1.90	0.99	13.65	1.378	333	87	85	3.0	6.080	96.191
1-1	15:20:00	1.90	0.99	19.73	1.378	333	85	85	3.0	6.120	96.191
1-1	15:30:00	1.90	0.99	25.85	1.378	333	87	85	3.0	5.990	96.191
1-1	15:40:00	1.90	0.99	31.84	1.378	333	87	85	3.0	7.160	96.191
1-1	15:50:00	1.90	0.99	39.00	1.378	332	87	84	3	6.100	96.191
1-1	16:00:00	1.9	0.99	45.1	1.378	332	85	83	3	6.100	96.191
1-1	16:10:00	1.8	0.94	51.2	1.342	332	85	83	3	5.880	93.626
1-1	16:20:00	1.9	0.99	57.08	1.378	332	84	83	4	5.940	96.191
1-1	16:30:00	1.9	0.99	63.02	1.378	332	85	83	4	6.080	96.191
1-1	16:40:00	1.9	0.99	69.1	1.378	332	85	82	4	6.040	96.191
	16:50:00			75.14							

Test Run 12

Customer:	We Energies	
Plant:	PIPP	
Test Location:	Flue 9 Stack	
Test Engineer:	Mplatt	
Temp ID:	CM8	
Meter ID:	CM8	
Pitot ID:	45	
Pitot Tube Coefficient:	0.840	
Probe Length:	4.0	ft
Probe Liner Material:	Glass	
Nozzle Diameter:	0.179	in.
Meter Calibration Factor:	1.000	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	9.5	**ft**
Duct Area:	70.882	**Sq. Ft.**
Number of Ports Sampled:	1	
Number of Points per Port:	1	
Minutes per Point:	120.0	
otal Number of Traverse Points:	1	
Test Length:	120	**min.**
Train Type:	Anderson Box	
Source Condition:	High Load	
# of Runs	4	

CLEAR WORKBOOK

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 7:25
End Time: 9:25

DRY GAS METER CONDITIONS

ΔH:	0.98	in. H_2O
Meter Temperature, Tm:	88.6	°F
Sqrt ΔP:	1.365	in. H_2O
Stack Temperature, Ts:	331.3	°F
Meter Volume, Vm:	75.966	ft^3
Meter Volume, Vmstd:	70.384	dscf
Meter Volume, Vwstd:	10.696	wscf
Isokinetic Variance:	104.9	%I

Sample Train Leak Checks

Pre	0.002	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.20	in. H_2O
Flue Pressure (Ps):	28.64	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.2	%
Nitrogen:	81.0	%
Gas Weight dry, Md:	30.296	lb/lb mole
Gas Weight wet, Ms:	28.674	lb/lb mole
Excess Air:	40.832	%
	96.190	fps
Volumetric Flow:	409,089	acfm
Volumetric Flow:	226,847	dscfm
Volumetric Flow:	261,321	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	209.3	ml
Difference:	209.3	
Total Water Gain:	227.1	

Silica Initial Wt.	791.6	grams
Silica Final Wt.	809.4	grams
Difference:	17.8	
Moisture, Bws:	0.132	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	7:25:00	1.90	1.00	74.26	1.378	339	84	84	4.0	5.969	97.160
1-1	7:35:00	1.85	0.97	80.23	1.360	339	87	85	4.0	5.949	95.873
1-1	7:45:00	1.90	1.00	86.18	1.378	340	91	85	4.0	7.179	97.160
1-1	7:55:00	1.90	1.00	93.36	1.378	341	95	87	4.0	6.516	97.160
1-1	8:05:00	1.90	1.00	99.87	1.378	341	91	87	4.0	6.323	97.160
1-1	8:15:00	1.90	1.00	106.20	1.378	342	92	87	4.0	6.016	97.160
1-1	8:25:00	1.85	0.97	112.21	1.360	342	93	88	4	6.635	95.873
1-1	8:35:00	1.85	0.97	118.848	1.360	342	93	88	5	6.311	95.873
1-1	8:45:00	1.9	1	125.159	1.378	342	91	88	5	6.397	97.160
1-1	8:55:00	1.8	0.948	131.556	1.342	230	90	87	5	6.345	94.568
1-1	9:05:00	1.8	0.948	137.901	1.342	339	89	86	4	6.720	94.568
1-1	9:15:00	1.8	0.948	144.621	1.342	338	92	86	4	5.606	94.568
	9:25:00			150.227							

Test Run 1

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 10:15
End Time: 12:15

DRY GAS METER CONDITIONS

ΔH:	0.79	In. H_2O
Meter Temperature, Tm:	86.4	°F
Sqrt ΔP:	1.334	In. H_2O
Stack Temperature, Ts:	333.3	°F
Meter Volume, Vm:	68.328	cf
Meter Volume, Vmstd:	63.533	dscf
Meter Volume, Vwstd:	9.448	wscf
Isokinetic Variance:	96.8	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.10	in. H_2O
Flue Pressure (Ps):	28.65	in. Hg. abs.
Carbon Dioxide:	12.7	%
Oxygen:	6.4	%
Nitrogen:	80.9	%
Gas Weight dry, Md:	30.288	lb/lb mole
Gas Weight wet, Ms:	28.697	lb/lb mole
Excess Air:	42.788	%
Gas Velocity, Vs:	94.070	fps
Volumetric Flow:	400,074	acfm
Volumetric Flow:	221,973	dscfm
Volumetric Flow:	254,983	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	195.8	ml
Difference:	195.8	
Total Water Gain:	200.6	

Silica Initial Wt.	791.4	grams
Silica Final Wt.	796.2	grams
Difference:	4.8	
Moisture, Bws:	0.129	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	10:15:00	1.75	0.79	151.65	1.323	336	83	83	5.0	8.310	93.313
1-1	10:25:00	1.90	0.85	159.96	1.378	336	85	82	4.0	3.850	97.230
1-1	10:35:00	1.80	0.81	163.81	1.342	335	83	82	3.0	5.140	94.637
1-1	10:45:00	1.80	0.81	168.95	1.342	334	87	83	4.0	5.366	94.637
1-1	10:55:00	1.70	0.76	174.32	1.304	333	89	84	4.0	5.951	91.971
1-1	11:05:00	1.90	0.81	180.27	1.378	333	89	85	4.0	5.748	97.230
1-1	11:15:00	1.70	0.76	186.02	1.304	332	90	89	3	5.577	91.971
1-1	11:25:00	1.8	0.808	191.592	1.342	332	91	86	3	5.742	94.637
1-1	11:35:00	1.7	0.763	197.334	1.304	332	91	86	4	5.476	91.971
1-1	11:45:00	1.8	0.808	202.81	1.342	332	91	87	4	5.850	94.637
1-1	11:55:00	1.7	0.763	208.66	1.304	332	88	87	4	5.590	91.971
1-1	12:05:00	1.8	0.808	214.25	1.342	332	87	85	4	5.728	94.637
	12:15:00			219.978							

Test Run 2

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 12:50
End Time: 14:50

DRY GAS METER CONDITIONS

ΔH:	0.81	In. H_2O
Meter Temperature, Tm:	87.9	°F
Sqrt ΔP:	1.341	In. H_2O
Stack Temperature, Ts:	336.6	°F
Meter Volume, Vm:	68.894	cf
Meter Volume, Vmstd:	63.881	dscf
Meter Volume, Vwstd:	9.542	wscf
Isokinetic Variance:	97.1	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	8	in Hg.
Post	0.001	ft3	@	8	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	28.62	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.3	%
Nitrogen:	80.9	%
Gas Weight dry, Md:	30.300	lb/lb mole
Gas Weight wet, Ms:	28.701	lb/lb mole
Excess Air:	41.839	%
Gas Velocity, Vs:	94.865	fps
Volumetric Flow:	403,454	acfm
Volumetric Flow:	222,554	dscfm
Volumetric Flow:	255,799	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	192.8	ml
Difference:	192.8	
Total Water Gain:	202.6	

Silica Initial Wt.	808.6	grams
Silica Final Wt.	818.4	grams
Difference:	9.8	
Moisture, Bws:	0.130	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	12:50:00	1.80	0.81	220.30	1.342	335	84	84	4.0	6.491	94.877
1-1	13:00:00	1.90	0.85	226.79	1.378	335	89	84	4.0	5.251	97.477
1-1	13:10:00	1.80	0.81	232.04	1.342	335	90	85	3.0	5.641	94.877
1-1	13:20:00	1.80	0.81	237.68	1.342	336	91	86	3.0	5.742	94.877
1-1	13:30:00	1.90	0.85	243.42	1.378	336	88	86	3.0	5.899	97.477
1-1	13:40:00	1.80	0.81	249.32	1.342	336	91	86	4.0	5.742	94.877
1-1	13:50:00	1.80	0.81	255.07	1.342	337	90	87	4	5.742	94.877
1-1	14:00:00	1.8	0.808	260.807	1.342	336	91	86	4	5.742	94.877
1-1	14:10:00	1.8	0.808	266.549	1.342	338	91	86	4	6.122	94.877
1-1	14:20:00	1.8	0.808	272.671	1.342	338	91	87	4	5.362	94.877
1-1	14:30:00	1.7	0.763	278.033	1.304	339	91	87	4	5.762	92.204
1-1	14:40:00	1.7	0.763	283.795	1.304	338	92	87	3	5.398	92.204
	14:50:00			289.193							

Test Run 3

U-53

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/19/07
Start Time: 15:25
End Time: 17:25

DRY GAS METER CONDITIONS

ΔH:	0.82	In. H_2O
Meter Temperature, Tm:	92.9	°F
Sqrt ΔP:	1.348	In. H_2O
Stack Temperature, Ts:	334.7	°F
Meter Volume, Vm:	68.895	cf
Meter Volume, Vmstd:	63.310	dscf
Meter Volume, Vwstd:	11.285	wscf
Isokinetic Variance:	97.6	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	28.73	in. Hg.
Static Pressure:	-1.20	in. H_2O
Flue Pressure (Ps):	28.64	in. Hg. abs.
Carbon Dioxide:	12.9	%
Oxygen:	6.4	%
Nitrogen:	80.7	%
Gas Weight dry, Md:	30.320	lb/lb mole
Gas Weight wet, Ms:	28.456	lb/lb mole
Excess Air:	42.939	%
Gas Velocity, Vs:	95.562	fps
Volumetric Flow:	406,420	acfm
Volumetric Flow:	219,393	dscfm
Volumetric Flow:	258,500	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	215.4	ml
Difference:	215.4	
Total Water Gain:	239.6	

Silica Initial Wt.	777	grams
Silica Final Wt.	801.2	grams
Difference:	24.2	
Moisture, Bws:	0.151	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	15:25:00	1.90	0.85	289.51	1.378	339	89	89	5.0	6.000	97.741
1-1	15:35:00	1.80	0.81	295.51	1.342	337	93	89	4.0	6.000	95.134
1-1	15:45:00	1.80	0.81	301.51	1.342	337	95	90	5.0	5.380	95.134
1-1	15:55:00	1.80	0.81	306.89	1.342	336	95	90	5.0	5.560	95.134
1-1	16:05:00	1.80	0.81	312.45	1.342	335	95	91	5.0	5.760	95.134
1-1	16:15:00	1.70	0.76	318.21	1.304	334	96	91	5.0	5.750	92.454
1-1	16:25:00	1.90	0.85	323.96	1.378	334	97	92	5	5.940	97.741
1-1	16:35:00	1.8	0.808	329.9	1.342	333	96	92	5	5.950	95.134
1-1	16:45:00	1.8	0.808	335.85	1.342	333	96	92	5	5.490	95.134
1-1	16:55:00	1.8	0.808	341.34	1.342	333	95	91	5	5.810	95.134
1-1	17:05:00	1.9	0.853	347.15	1.378	333	96	91	4	5.510	97.741
1-1	17:15:00	1.8	0.808	352.66	1.342	332	96	92	4	5.745	95.134
	17:25:00			358.405							

Test Run 4

Customer:	We Energies	
Plant:	PIPP	
Test Location:	Flue 9 Stack	
Test Engineer:	Mplatt	
Temp ID:	CM8	
Meter ID:	CM8	
Pitot ID:	45	
Pitot Tube Coefficient:	0.840	
Probe Length:	4.0	ft
Probe Liner Material:	Glass	
Nozzle Diameter:	0.179	in.
Meter Calibration Factor:	1.000	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	9.5	**ft**
Duct Area:	70.882	**Sq. Ft.**
Number of Ports Sampled:	1	
Number of Points per Port:	1	
Minutes per Point:	120.0	
otal Number of Traverse Points:	1	
Test Length:	120	**min.**
Train Type:	Anderson Box	
Source Condition:	High Load	
# of Runs	4	

CLEAR WORKBOOK

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 7:40
End Time: 10:00

DRY GAS METER CONDITIONS

ΔH:	0.71	in. H_2O
Meter Temperature, Tm:	79.2	°F
Sqrt ΔP:	1.271	in. H_2O
Stack Temperature, Ts:	335.9	°F
Meter Volume, Vm:	64.062	ft^3
Meter Volume, Vmstd:	61.274	dscf
Meter Volume, Vwstd:	9.561	wscf
Isokinetic Variance:	98.0	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	29.06	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.5	%
Nitrogen:	80.7	%
Gas Weight dry, Md:	30.308	lb/lb mole
Gas Weight wet, Ms:	28.647	lb/lb mole
Excess Air:	43.905	%
	89.226	fps
Volumetric Flow:	379,474	acfm
Volumetric Flow:	211,495	dscfm
Volumetric Flow:	244,497	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	170.4	ml
Difference:	170.4	
Total Water Gain:	203	

Silica Initial Wt.	773	grams
Silica Final Wt.	805.6	grams
Difference:	32.6	
Moisture, Bws:	0.135	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	7:40:00	1.70	0.75	60.55	1.304	331	73	73	4.0	5.476	91.553
1-1	7:50:00	1.60	0.71	66.02	1.265	332	75	74	4.0	5.312	88.819
1-1	8:00:00	1.70	0.75	71.33	1.304	332	77	74	4.0	0.000	91.553
1-1	8:30:00	1.60	0.71	71.33	1.265	334	76	75	4.0	5.378	88.819
1-1	8:40:00	1.60	0.71	76.71	1.265	335	79	76	4.0	5.349	88.819
1-1	8:50:00	1.70	0.75	82.06	1.304	336	81	77	4.0	5.530	91.553
1-1	9:00:00	1.60	0.71	87.59	1.265	336	82	78	5	5.321	88.819
1-1	9:10:00	1.7	0.75	92.911	1.304	338	83	79	4	5.630	91.553
1-1	9:20:00	1.6	0.71	98.541	1.265	338	83	80	4	5.156	88.819
1-1	9:30:00	1.5	0.662	103.697	1.225	338	84	80	3	4.756	85.999
1-1	9:40:00	1.6	0.71	108.453	1.265	338	84	81	4	5.560	88.819
1-1	9:50:00	1.5	0.662	114.013	1.225	339	85	81	4	5.272	85.999
1-1	10:00:00	1.6	0.71	119.285	1.265	340	86	82	4	5.322	88.819
	10:10:00			124.607							

Test Run 5

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 10:40
End Time: 12:40

DRY GAS METER CONDITIONS

ΔH:	0.78	In. H_2O
Meter Temperature, Tm:	88.7	°F
Sqrt ΔP:	1.335	In. H_2O
Stack Temperature, Ts:	333.3	°F
Meter Volume, Vm:	66.818	cf
Meter Volume, Vmstd:	62.807	dscf
Meter Volume, Vwstd:	6.453	wscf
Isokinetic Variance:	91.9	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	29.06	in. Hg. abs.
Carbon Dioxide:	12.9	%
Oxygen:	6.5	%
Nitrogen:	80.6	%
Gas Weight dry, Md:	30.324	lb/lb mole
Gas Weight wet, Ms:	29.176	lb/lb mole
Excess Air:	43.983	%
Gas Velocity, Vs:	92.753	fps
Volumetric Flow:	394,473	acfm
Volumetric Flow:	231,234	dscfm
Volumetric Flow:	254,991	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	128.8	ml
Difference:	128.8	
Total Water Gain:	137	

Silica Initial Wt.	819.2	grams
Silica Final Wt.	827.4	grams
Difference:	8.2	
Moisture, Bws:	0.093	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	10:40:00	1.80	0.79	128.02	1.342	339	86	86	3.0	5.494	93.197
1-1	10:50:00	1.80	0.79	133.51	1.342	337	90	86	3.0	5.930	93.197
1-1	11:00:00	1.70	0.75	139.44	1.304	335	91	87	4.0	5.181	90.571
1-1	11:10:00	1.80	0.79	144.62	1.342	335	90	87	3.0	6.210	93.197
1-1	11:20:00	1.80	0.79	150.83	1.342	335	91	87	3.0	4.297	93.197
1-1	11:30:00	1.80	0.70	155.13	1.342	333	91	86	4.0	5.759	93.197
1-1	11:40:00	1.80	0.79	160.89	1.342	332	91	87	3	6.140	93.197
1-1	11:50:00	1.8	0.794	167.03	1.342	332	92	87	4	5.468	93.197
1-1	12:00:00	1.8	0.794	172.498	1.342	331	91	87	4	5.717	93.197
1-1	12:10:00	1.9	0.837	178.215	1.378	331	91	87	4	5.199	95.751
1-1	12:20:00	1.7	0.749	183.414	1.304	330	92	87	4	5.986	90.571
1-1	12:30:00	1.7	0.749	189.4	1.304	330	92	87	4	5.437	90.571
	12:40:00			194.837							

Test Run 6

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 12:50
End Time: 14:50

DRY GAS METER CONDITIONS

ΔH:	0.84	In. H_2O
Meter Temperature, Tm:	89.4	°F
Sqrt ΔP:	1.341	In. H_2O
Stack Temperature, Ts:	337.7	°F
Meter Volume, Vm:	67.117	cf
Meter Volume, Vmstd:	63.021	dscf
Meter Volume, Vwstd:	8.657	wscf
Isokinetic Variance:	94.3	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.70	in. H_2O
Flue Pressure (Ps):	29.05	in. Hg. abs.
Carbon Dioxide:	12.5	%
Oxygen:	6.7	%
Nitrogen:	80.8	%
Gas Weight dry, Md:	30.268	lb/lb mole
Gas Weight wet, Ms:	28.786	lb/lb mole
Excess Air:	45.793	%
Gas Velocity, Vs:	94.087	fps
Volumetric Flow:	400,145	acfm
Volumetric Flow:	226,067	dscfm
Volumetric Flow:	257,121	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	164	ml
Difference:	164	
Total Water Gain:	183.8	

Silica Initial Wt.	834.8	grams
Silica Final Wt.	854.6	grams
Difference:	19.8	
Moisture, Bws:	0.121	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft³	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft³	Point Vel ft/sec
1-1	13:10:00	1.90	0.84	195.06	1.378	332	87	87	4.0	5.719	96.684
1-1	13:20:00	1.80	0.79	200.78	1.342	334	90	87	4.0	5.438	94.105
1-1	13:30:00	1.90	0.84	206.22	1.378	336	91	87	4.0	5.920	96.684
1-1	13:40:00	1.70	0.75	212.14	1.304	338	92	88	4.0	5.440	91.454
1-1	13:50:00	1.80	0.79	217.58	1.342	339	92	88	4.0	5.603	94.105
1-1	14:00:00	1.70	0.75	223.18	1.304	339	92	88	4.0	5.462	91.454
1-1	14:10:00	1.80	0.79	228.64	1.342	340	91	88	4	5.643	94.105
1-1	14:20:00	1.8	0.794	234.284	1.342	339	92	88	4	5.727	94.105
1-1	14:30:00	1.8	0.794	240.011	1.342	339	92	88	4	5.387	94.105
1-1	14:40:00	1.7	0.749	245.398	1.304	338	91	87	4	5.437	91.454
1-1	14:50:00	1.8	0.794	250.835	1.342	339	91	88	4	5.594	94.105
1-1	15:00:00	1.9	1.37	256.429	1.378	339	92	88	4	5.747	96.684
	15:10:00			262.176							

Test Run 7

U-58

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/20/07
Start Time: 15:40
End Time: 17:40

DRY GAS METER CONDITIONS

ΔH:	0.80	In. H_2O
Meter Temperature, Tm:	90.3	°F
Sqrt ΔP:	1.348	In. H_2O
Stack Temperature, Ts:	340.4	°F
Meter Volume, Vm:	67.422	cf
Meter Volume, Vmstd:	63.201	dscf
Meter Volume, Vwstd:	8.497	wscf
Isokinetic Variance:	94.1	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.17	in. Hg.
Static Pressure:	-1.40	in. H_2O
Flue Pressure (Ps):	29.07	in. Hg. abs.
Carbon Dioxide:	12.7	%
Oxygen:	6.6	%
Nitrogen:	80.7	%
Gas Weight dry, Md:	30.296	lb/lb mole
Gas Weight wet, Ms:	28.839	lb/lb mole
Excess Air:	44.883	%
Gas Velocity, Vs:	94.569	fps
Volumetric Flow:	402,197	acfm
Volumetric Flow:	227,202	dscfm
Volumetric Flow:	257,748	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	168.6	ml
Difference:	168.6	
Total Water Gain:	180.4	

Silica Initial Wt.	826.2	grams
Silica Final Wt.	838	grams
Difference:	11.8	
Moisture, Bws:	0.119	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	15:40:00	1.90	0.84	261.54	1.378	340	87	87	4.0	5.667	96.725
1-1	15:50:00	1.80	0.79	267.20	1.342	340	91	87	4.0	5.809	94.146
1-1	16:00:00	1.80	0.79	273.01	1.342	339	92	87	4.0	5.959	94.146
1-1	16:10:00	1.80	0.79	278.97	1.342	340	94	89	4.0	5.100	94.146
1-1	16:20:00	1.80	0.79	284.07	1.342	341	92	89	4.0	5.592	94.146
1-1	16:30:00	1.90	0.84	289.66	1.378	340	93	89	4.0	5.747	96.725
1-1	16:40:00	1.70	0.75	295.41	1.304	340	93	89	4	5.421	91.493
1-1	16:50:00	1.8	0.794	300.83	1.342	340	93	89	4	5.595	94.146
1-1	17:00:00	1.9	0.837	306.425	1.378	341	92	89	4	5.885	96.725
1-1	17:10:00	1.8	0.794	312.31	1.342	341	93	89	4	5.701	94.146
1-1	17:20:00	1.8	0.794	318.011	1.342	341	92	89	4	5.352	94.146
1-1	17:30:00	1.8	0.794	323.363	1.342	342	92	89	4	5.594	94.146
	17:40:00			328.957							

Test Run 8

Customer:	We Energies	
Plant:	PIPP	
Test Location:	Flue 9 Stack	
Test Engineer:	Mplatt	
Temp ID:	CM8	
Meter ID:	CM8	
Pitot ID:	45	
Pitot Tube Coefficient:	0.840	
Probe Length:	4.0	ft
Probe Liner Material:	Glass	
Nozzle Diameter:	0.179	in.
Meter Calibration Factor:	1.000	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	9.5	**ft**
Duct Area:	70.882	**Sq. Ft.**
Number of Ports Sampled:	1	
Number of Points per Port:	1	
Minutes per Point:	120.0	
otal Number of Traverse Points:	1	
Test Length:	120	**min.**
Train Type:	Anderson Box	
Source Condition:	High Load	
# of Runs	4	

CLEAR WORKBOOK

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 7:20
End Time: 9:20

DRY GAS METER CONDITIONS

ΔH:	0.76	in. H_2O
Meter Temperature, Tm:	85.2	°F
Sqrt ΔP:	1.310	in. H_2O
Stack Temperature, Ts:	335.4	°F
Meter Volume, Vm:	66.183	ft^3
Meter Volume, Vmstd:	62.677	dscf
Meter Volume, Vwstd:	7.348	wscf
Isokinetic Variance:	94.5	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.10	in. H_2O
Flue Pressure (Ps):	29.12	in. Hg. abs.
Carbon Dioxide:	13.0	%
Oxygen:	6.6	%
Nitrogen:	80.4	%
Gas Weight dry, Md:	30.344	lb/lb mole
Gas Weight wet, Ms:	29.049	lb/lb mole
Excess Air:	45.126	%
	91.228	fps
Volumetric Flow:	387,984	acfm
Volumetric Flow:	224,350	dscfm
Volumetric Flow:	250,650	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	142.8	ml
Difference:	142.8	
Total Water Gain:	156	

Silica Initial Wt.	0	grams
Silica Final Wt.	13.2	grams
Difference:	13.2	
Moisture, Bws:	0.105	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	7:40:00	1.70	0.76	29.42	1.304	333	81	81	4.0	5.493	90.795
1-1	7:50:00	1.80	0.80	34.91	1.342	334	85	85	3.0	5.650	93.428
1-1	8:00:00	1.70	0.76	40.56	1.304	334	85	82	3.0	5.490	90.795
1-1	8:10:00	1.70	0.76	46.05	1.304	334	87	83	4.0	5.480	90.795
1-1	8:20:00	1.70	0.76	51.53	1.304	335	87	83	4.0	5.760	90.795
1-1	8:30:00	1.70	0.76	57.29	1.304	336	87	83	4.0	5.420	90.795
1-1	8:40:00	1.70	0.76	62.71	1.304	337	87	84	4	5.300	90.795
1-1	8:50:00	1.8	0.801	68.01	1.342	337	88	84	4	6.890	93.428
1-1	9:00:00	1.7	0.757	74.9	1.304	337	88	84	4	3.510	90.795
1-1	9:10:00	1.8	0.801	78.41	1.342	336	89	85	3	5.800	93.428
1-1	9:20:00	1.6	0.712	84.21	1.265	336	88	85	4	5.340	88.084
1-1	9:30:00	1.7	0.757	89.55	1.304	336	88	85	4	6.050	90.795
	9:40:00			95.6							

Test Run 9

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 9:50
End Time: 11:50

DRY GAS METER CONDITIONS

ΔH:	0.73	In. H_2O
Meter Temperature, Tm:	83.3	°F
Sqrt ΔP:	1.291	In. H_2O
Stack Temperature, Ts:	333.0	°F
Meter Volume, Vm:	64.561	cf
Meter Volume, Vmstd:	61.352	dscf
Meter Volume, Vwstd:	8.214	wscf
Isokinetic Variance:	94.9	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.40	in. H_2O
Flue Pressure (Ps):	29.10	in. Hg. abs.
Carbon Dioxide:	13.0	%
Oxygen:	6.6	%
Nitrogen:	80.4	%
Gas Weight dry, Md:	30.344	lb/lb mole
Gas Weight wet, Ms:	28.886	lb/lb mole
Excess Air:	45.126	%
Gas Velocity, Vs:	90.034	fps
Volumetric Flow:	382,910	acfm
Volumetric Flow:	218,662	dscfm
Volumetric Flow:	247,938	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	163.8	ml
Difference:	163.8	
Total Water Gain:	174.4	

Silica Initial Wt.	0	grams
Silica Final Wt.	10.6	grams
Difference:	10.6	
Moisture, Bws:	0.118	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	10:40:00	1.70	0.75	95.77	1.304	335	82	82	4.0	6.141	90.946
1-1	10:50:00	1.70	0.75	101.91	1.304	334	83	81	3.0	4.510	90.946
1-1	11:00:00	1.60	0.71	106.42	1.265	334	85	82	3.0	5.220	88.231
1-1	11:10:00	1.70	0.75	111.64	1.304	334	86	82	3.0	4.770	90.946
1-1	11:20:00	1.70	0.75	116.41	1.304	335	87	83	4.0	5.510	90.946
1-1	11:30:00	1.80	0.79	121.92	1.342	334	87	83	4.0	5.990	93.583
1-1	11:40:00	1.70	0.75	127.91	1.304	333	87	84	4	5.500	90.946
1-1	11:50:00	1.6	0.705	133.41	1.265	332	87	84	4	5.680	88.231
1-1	12:00:00	1.6	0.705	139.09	1.265	332	84	83	4	6.220	88.231
1-1	12:10:00	1.6	0.705	145.31	1.265	331	83	81	4	4.330	88.231
1-1	12:20:00	1.7	0.749	149.64	1.304	331	81	80	3	4.970	90.946
1-1	12:30:00	1.6	0.71	154.61	1.265	331	82	79	3	5.720	88.231
	12:40:00			160.33							

Test Run 10

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 12:20
End Time: 14:20

DRY GAS METER CONDITIONS

ΔH:	0.72	In. H_2O
Meter Temperature, Tm:	85.6	°F
Sqrt ΔP:	1.278	In. H_2O
Stack Temperature, Ts:	333.4	°F
Meter Volume, Vm:	64.097	cf
Meter Volume, Vmstd:	60.643	dscf
Meter Volume, Vwstd:	7.969	wscf
Isokinetic Variance:	94.6	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.50	in. H_2O
Flue Pressure (Ps):	29.09	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.9	%
Nitrogen:	80.3	%
Gas Weight dry, Md:	30.324	lb/lb mole
Gas Weight wet, Ms:	28.893	lb/lb mole
Excess Air:	48.254	%
Gas Velocity, Vs:	89.139	fps
Volumetric Flow:	379,104	acfm
Volumetric Flow:	216,793	dscfm
Volumetric Flow:	245,283	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	157	ml
Difference:	157	
Total Water Gain:	169.2	

Silica Initial Wt.	0	grams
Silica Final Wt.	12.2	grams
Difference:	12.2	
Moisture, Bws:	0.116	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	12:20:00	1.50	0.66	162.09	1.225	332	81	81	3.0	5.099	85.453
1-1	12:30:00	1.50	0.66	167.19	1.225	332	85	81	3.0	4.810	85.453
1-1	12:40:00	1.60	0.71	172.00	1.265	332	87	82	3.0	5.880	88.256
1-1	12:50:00	1.70	0.75	177.88	1.304	333	88	83	3.0	5.130	90.972
1-1	13:00:00	1.60	0.71	183.01	1.265	333	88	84	3.0	4.700	88.256
1-1	13:10:00	1.70	0.75	187.71	1.304	333	89	85	3.0	5.600	90.972
1-1	13:20:00	1.70	0.75	193.31	1.304	334	89	85	3	5.300	90.972
1-1	13:30:00	1.7	0.749	198.61	1.304	334	90	85	3	6.550	90.972
1-1	13:40:00	1.5	0.662	205.16	1.225	334	90	85	4	4.360	85.453
1-1	13:50:00	1.7	0.749	209.52	1.304	334	85	80	4	5.500	90.972
1-1	14:00:00	1.7	0.749	215.02	1.304	335	89	86	43	5.500	90.972
1-1	14:10:00	1.7	0.749	220.52	1.304	335	91	86	4	5.668	90.972
	14:20:00			226.188							

Test Run 11

Customer: We Energies
Plant: PIPP
Location: Flue 9 Stack

Date: 6/21/07
Start Time: 14:50
End Time: 16:50

DRY GAS METER CONDITIONS

ΔH:	0.74	In. H_2O
Meter Temperature, Tm:	85.5	°F
Sqrt ΔP:	1.294	In. H_2O
Stack Temperature, Ts:	332.7	°F
Meter Volume, Vm:	64.690	cf
Meter Volume, Vmstd:	61.217	dscf
Meter Volume, Vwstd:	7.988	wscf
Isokinetic Variance:	94.2	%I

Sample Train Leak Checks

Pre	0.001	ft3	@	10	in Hg.
Post	0.001	ft3	@	10	in Hg.

Pitot Leak Checks

Pre	yes	Performed Leak Check @ 3 in. H2O?
Post	yes	

STACK CONDITIONS

Barometric Pressure (Pb):	29.20	in. Hg.
Static Pressure:	-1.40	in. H_2O
Flue Pressure (Ps):	29.10	in. Hg. abs.
Carbon Dioxide:	12.8	%
Oxygen:	6.9	%
Nitrogen:	80.3	%
Gas Weight dry, Md:	30.324	lb/lb mole
Gas Weight wet, Ms:	28.901	lb/lb mole
Excess Air:	48.254	%
Gas Velocity, Vs:	90.218	fps
Volumetric Flow:	383,692	acfm
Volumetric Flow:	219,860	dscfm
Volumetric Flow:	248,549	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	0	ml
Final Impinger Content:	162.6	ml
Difference:	162.6	
Total Water Gain:	169.6	

Silica Initial Wt.	0	grams
Silica Final Wt.	7	grams
Difference:	7	
Moisture, Bws:	0.115	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Pump Vacuum in. Hg	Collected Vol. ft^3	Point Vel ft/sec
1-1	14:50:00	1.60	0.71	226.32	1.265	334	85	85	4.0	5.270	88.189
1-1	15:00:00	1.70	0.75	231.59	1.304	334	88	85	3.0	5.440	90.903
1-1	15:10:00	1.70	0.75	237.03	1.304	333	89	85	4.0	5.440	90.903
1-1	15:20:00	1.70	0.75	242.47	1.304	333	89	85	4.0	5.210	90.903
1-1	15:30:00	1.70	0.75	247.68	1.304	333	89	85	4.0	5.480	90.903
1-1	15:40:00	1.60	0.71	253.16	1.265	333	89	85	3.0	5.660	88.189
1-1	15:50:00	1.60	0.71	258.82	1.265	332	88	84	4	5.620	88.189
1-1	16:00:00	1.7	0.749	264.44	1.304	332	87	83	3	5.000	90.903
1-1	16:10:00	1.8	0.794	269.44	1.342	332	87	83	3	6.150	93.539
1-1	16:20:00	1.7	0.749	275.59	1.304	332	86	83	3	4.420	90.903
1-1	16:30:00	1.7	0.749	280.01	1.304	332	84	82	3	5.200	90.903
1-1	16:40:00	1.6	0.705	285.21	1.265	332	85	82	4	5.800	88.189
	16:50:00			291.01							

Test Run 12

Mercury Test Results Summary
We Energies
Presque Isle Power Plant
Flue 7 Stack

Test No.	Date	Time	V_m (L)	ug detected	ppb	ug/dncm	ug/dscm	ug/wscm
1A	6/19/2007	07:25-09:25	84.31	0.2038	0.29	2.42	2.25	2.03
1B	6/19/2007	07:25-09:25	94.64	0.2144	0.27	2.27	2.11	1.90
Average				0.2091	0.28	2.34	2.18	**1.97**
2A	6/19/2007	10:15-12:15	85.43	0.2018	0.28	2.36	2.20	1.98
2B	6/19/2007	10:15-12:15	90.98	0.1882	0.25	2.07	1.93	1.74
Average				0.1950	0.27	2.22	2.07	**1.86**
3A	6/19/2007	12:50-14:50	86.92	0.2542	0.35	2.93	2.73	2.46
3B	6/19/2007	12:50-14:50	89.38	0.2502	0.34	2.80	2.61	2.35
Average				0.2522	0.34	2.86	2.67	**2.40**
4A	6/19/2007	15:25-17:25	88.97	0.2336	0.31	2.63	2.45	2.20
4B	6/19/2007	15:25-17:25	89.94	0.2341	0.31	2.61	2.43	2.19
Average				0.2339	0.31	2.62	2.44	**2.20**
5A	6/20/2007	07:40-10:10	95.30	0.3665	0.46	3.85	3.59	3.23
5B	6/20/2007	07:40-10:10	94.18	0.3860	0.49	4.10	3.82	3.44
Average				0.3763	0.48	3.98	3.71	**3.34**
6A	6/20/2007	10:40-12:40	13.74	0.045	0.39	3.28	3.06	2.75
6B	6/20/2007	10:40-12:40	83.31	0.281	0.40	3.37	3.14	2.83
Average				0.1628	0.40	3.32	3.10	**2.79**
7A	6/20/2007	13:10-15:10	25.17	0.1136	0.54	4.52	4.21	3.79
7B	6/20/2007	13:10-15:10	72.73	0.3262	0.54	4.49	4.18	3.77
Average				0.2199	0.54	4.50	4.20	**3.78**
8A	6/20/2007	15:40-17:40	26.90	0.1190	0.53	4.43	4.13	3.71
8B	6/20/2007	15:40-17:40	72.62	0.3465	0.57	4.78	4.45	4.01
Average				0.2328	0.55	4.60	4.29	**3.86**
9A	6/21/2007	07:20-09:20	55.13	0.1490	0.32	2.71	2.52	2.27
9B	6/21/2007	07:20-09:20	54.41	0.1660	0.37	3.05	2.85	2.56
Average				0.1575	0.34	2.88	2.68	**2.42**
10A	6/21/2007	09:50-11:50	61.22	0.1801	0.35	2.94	2.74	2.47
10B	6/21/2007	09:50-11:50	61.06	0.1797	0.35	2.95	2.75	2.47
Average				0.1799	0.35	2.95	2.74	**2.47**
11A	6/21/2007	12:20-14:20	60.12	0.1881	0.38	3.13	2.92	2.63
11B	6/21/2007	12:20-14:20	59.75	0.1939	0.39	3.25	3.03	2.72
Average				0.1910	0.38	3.19	2.97	**2.68**
12A	6/21/2007	14:50-16:50	64.87	0.1892	0.35	2.92	2.72	2.45
12B	6/21/2007	14:50-16:50	64.79	0.1905	0.35	2.94	2.74	2.47
Average				0.1899	0.35	2.93	2.73	**2.46**

APPENDIX K TEST RESULTS

Date:	6/19/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	1A	Time:	07:25-09:25
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.2038
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.29
Initial Volume (liters)	0	Hg (ug/dncm)	2.42
Final Volume (liters)	97.797	Hg (ug/dscm)	2.25
Meter Temperature (°F)	89.00	Hg (ug/wscm)	2.03
Meter Volume (Normal liters)	84.31		
Meter Volume (Standard liters)	90.47		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	2A	Time:	10:15-12:15
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.2018
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.28
Initial Volume (liters)	0	Hg (ug/dncm)	2.36
Final Volume (liters)	99.204	Hg (ug/dscm)	2.20
Meter Temperature (°F)	89.60	Hg (ug/wscm)	1.98
Meter Volume (Normal liters)	85.43		
Meter Volume (Standard liters)	91.68		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	3A	Time:	12:50-14:50
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.2542
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.35
Initial Volume (liters)	0	Hg (ug/dncm)	2.93
Final Volume (liters)	100.77	Hg (ug/dscm)	2.73
Meter Temperature (°F)	88.70	Hg (ug/wscm)	2.46
Meter Volume (Normal liters)	86.92		
Meter Volume (Standard liters)	93.28		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/19/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	1B	Time:	07:25-09:25
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.2144
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.27
Initial Volume (liters)	0	Hg (ug/dncm)	2.27
Final Volume (liters)	110.267	Hg (ug/dscm)	2.11
Meter Temperature (°F)	91.40	Hg (ug/wscm)	1.90
Meter Volume (Normal liters)	94.64		
Meter Volume (Standard liters)	101.57		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	2B	Time:	10:15-12:15
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.1882
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.25
Initial Volume (liters)	0	Hg (ug/dncm)	2.07
Final Volume (liters)	106.175	Hg (ug/dscm)	1.93
Meter Temperature (°F)	92.30	Hg (ug/wscm)	1.74
Meter Volume (Normal liters)	90.98		
Meter Volume (Standard liters)	97.64		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	3B	Time:	12:50-14:50
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.2502
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.34
Initial Volume (liters)	0	Hg (ug/dncm)	2.80
Final Volume (liters)	104.057	Hg (ug/dscm)	2.61
Meter Temperature (°F)	91.00	Hg (ug/wscm)	2.35
Meter Volume (Normal liters)	89.38		
Meter Volume (Standard liters)	95.92		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/19-20/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	4A	Time:	15:25-17:25
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.2336
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.31
Initial Volume (liters)	0	Hg (ug/dncm)	2.63
Final Volume (liters)	103.321	Hg (ug/dscm)	2.45
Meter Temperature (°F)	89.60	Hg (ug/wscm)	2.20
Meter Volume (Normal liters)	88.97		
Meter Volume (Standard liters)	95.48		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	5A	Time:	07:40-10:10
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.3665
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.46
Initial Volume (liters)	0	Hg (ug/dncm)	3.85
Final Volume (liters)	107.408	Hg (ug/dscm)	3.59
Meter Temperature (°F)	80.60	Hg (ug/wscm)	3.23
Meter Volume (Normal liters)	95.30		
Meter Volume (Standard liters)	102.28		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	6A	Time:	10:40-12:40
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.0450
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.39
Initial Volume (liters)	0	Hg (ug/dncm)	3.28
Final Volume (liters)	15.584	Hg (ug/dscm)	3.06
Meter Temperature (°F)	84.20	Hg (ug/wscm)	2.75
Meter Volume (Normal liters)	13.74		
Meter Volume (Standard liters)	14.74		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/19/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	4B	Time:	15:25-17:25
Pressure, Barometric(Hg"):	28.780	Hg (ug)	0.2341
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.706	Hg (ppb)	0.31
Initial Volume (liters)	0	Hg (ug/dncm)	2.61
Final Volume (liters)	104.791	Hg (ug/dscm)	2.43
Meter Temperature (°F)	91.40	Hg (ug/wscm)	2.19
Meter Volume (Normal liters)	89.94		
Meter Volume (Standard liters)	96.52		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	5B	Time:	07:40-10:10
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.3860
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.49
Initial Volume (liters)	0	Hg (ug/dncm)	4.10
Final Volume (liters)	106.842	Hg (ug/dscm)	3.82
Meter Temperature (°F)	84.20	Hg (ug/wscm)	3.44
Meter Volume (Normal liters)	94.18		
Meter Volume (Standard liters)	101.07		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	6B	Time:	10:40-12:40
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.2805
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.40
Initial Volume (liters)	0	Hg (ug/dncm)	3.37
Final Volume (liters)	94.666	Hg (ug/dscm)	3.14
Meter Temperature (°F)	85.10	Hg (ug/wscm)	2.83
Meter Volume (Normal liters)	83.31		
Meter Volume (Standard liters)	89.40		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/20-21/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	7A	Time:	13:10-15:10
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.1136
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.54
Initial Volume (liters)	0	Hg (ug/dncm)	4.52
Final Volume (liters)	28.742	Hg (ug/dscm)	4.21
Meter Temperature (°F)	87.80	Hg (ug/wscm)	3.79
Meter Volume (Normal liters)	25.17		
Meter Volume (Standard liters)	27.01		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	8A	Time:	15:40-17:40
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.1190
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.53
Initial Volume (liters)	0	Hg (ug/dncm)	4.43
Final Volume (liters)	30.777	Hg (ug/dscm)	4.13
Meter Temperature (°F)	88.82	Hg (ug/wscm)	3.71
Meter Volume (Normal liters)	26.90		
Meter Volume (Standard liters)	28.87		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	9A	Time:	07:20-09:20
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1490
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.32
Initial Volume (liters)	0	Hg (ug/dncm)	2.71
Final Volume (liters)	61.768	Hg (ug/dscm)	2.52
Meter Temperature (°F)	78.00	Hg (ug/wscm)	2.27
Meter Volume (Normal liters)	55.13		
Meter Volume (Standard liters)	59.16		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/20-21/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	7B	Time:	13:10-15:10
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.3262
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.54
Initial Volume (liters)	0	Hg (ug/dncm)	4.49
Final Volume (liters)	83.057	Hg (ug/dscm)	4.18
Meter Temperature (°F)	87.80	Hg (ug/wscm)	3.77
Meter Volume (Normal liters)	72.73		
Meter Volume (Standard liters)	78.05		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	8B	Time:	15:40-17:40
Pressure, Barometric(Hg"):	29.170	Hg (ug)	0.3465
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.096	Hg (ppb)	0.57
Initial Volume (liters)	0	Hg (ug/dncm)	4.78
Final Volume (liters)	83.124	Hg (ug/dscm)	4.45
Meter Temperature (°F)	89.10	Hg (ug/wscm)	4.01
Meter Volume (Normal liters)	72.62		
Meter Volume (Standard liters)	77.93		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	9B	Time:	07:20-09:20
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1660
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.37
Initial Volume (liters)	0	Hg (ug/dncm)	3.05
Final Volume (liters)	61.291	Hg (ug/dscm)	2.85
Meter Temperature (°F)	80.90	Hg (ug/wscm)	2.56
Meter Volume (Normal liters)	54.41		
Meter Volume (Standard liters)	58.39		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/21/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	10A	Time:	09:50-11:50
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1801
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.35
Initial Volume (liters)	0	Hg (ug/dncm)	2.94
Final Volume (liters)	69.617	Hg (ug/dscm)	2.74
Meter Temperature (°F)	86.00	Hg (ug/wscm)	2.47
Meter Volume (Normal liters)	61.22		
Meter Volume (Standard liters)	65.70		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	11A	Time:	12:20-14:20
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1881
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.38
Initial Volume (liters)	0	Hg (ug/dncm)	3.13
Final Volume (liters)	68.364	Hg (ug/dscm)	2.92
Meter Temperature (°F)	86.00	Hg (ug/wscm)	2.63
Meter Volume (Normal liters)	60.12		
Meter Volume (Standard liters)	64.52		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	12A	Time:	14:50-16:50
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1892
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.35
Initial Volume (liters)	0	Hg (ug/dncm)	2.92
Final Volume (liters)	73.97	Hg (ug/dscm)	2.72
Meter Temperature (°F)	87.50	Hg (ug/wscm)	2.45
Meter Volume (Normal liters)	64.87		
Meter Volume (Standard liters)	69.62		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/21/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	10B	Time:	09:50-11:50
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1797
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.35
Initial Volume (liters)	0	Hg (ug/dncm)	2.95
Final Volume (liters)	69.656	Hg (ug/dscm)	2.75
Meter Temperature (°F)	87.80	Hg (ug/wscm)	2.47
Meter Volume (Normal liters)	61.06		
Meter Volume (Standard liters)	65.52		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	11B	Time:	12:20-14:20
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1939
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.39
Initial Volume (liters)	0	Hg (ug/dncm)	3.25
Final Volume (liters)	68.161	Hg (ug/dscm)	3.03
Meter Temperature (°F)	87.80	Hg (ug/wscm)	2.72
Meter Volume (Normal liters)	59.75		
Meter Volume (Standard liters)	64.12		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	12B	Time:	14:50-16:50
Pressure, Barometric(Hg"):	29.200	Hg (ug)	0.1905
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	29.126	Hg (ppb)	0.35
Initial Volume (liters)	0	Hg (ug/dncm)	2.94
Final Volume (liters)	74.112	Hg (ug/dscm)	2.74
Meter Temperature (°F)	89.30	Hg (ug/wscm)	2.47
Meter Volume (Normal liters)	64.79		
Meter Volume (Standard liters)	69.53		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Mercury Test Results Summary
We Energies
Presque Isle Power Plant
Flue 7 Stack

Test No.	Date	Time	V_m (L)	ug detected	ppb	ug/dncm	ug/dscm	ug/wscm
1A	6/26/2007	08:30-11:30	136.81	0.0778	0.07	0.57	0.53	0.48
1B	6/26/2007	08:30-11:30	138.27	0.1007	0.09	0.73	0.68	0.61
Average				0.0893	0.08	0.65	0.60	**0.55**
2A	6/26/2007	11:50-14:50	136.17	0.1236	0.11	0.91	0.85	0.76
2B	6/26/2007	11:50-14:50	136.22	0.1168	0.10	0.86	0.80	0.72
Average				0.1202	0.11	0.88	0.82	**0.74**
3A	6/26/2007	15:00-18:00	134.54	0.1260	0.11	0.94	0.87	0.79
3B	6/26/2007	15:00-18:00	130.64	0.1240	0.11	0.95	0.89	0.80
Average				0.1250	0.11	0.94	0.88	**0.80**
4A	6/27/2007	7:10-10:10	123.01	0.0610	0.06	0.50	0.46	0.42
4B	6/27/2007	7:10-10:10	142.08	0.0761	0.06	0.54	0.50	0.45
Average				0.0686	0.06	0.52	0.48	**0.44**
5A	6/27/2007	10:30-13:30	119.35	0.0760	0.08	0.64	0.59	0.53
5B	6/27/2007	10:30-13:30	136.84	0.0937	0.08	0.69	0.64	0.57
Average				0.0849	0.08	0.66	0.62	**0.55**
6A	6/27/2007	13:50-16:50	128.86	0.0654	0.06	0.51	0.47	0.43
6B	6/27/2007	13:50-16:50	129.45	0.0690	0.06	0.53	0.50	0.45
Average				0.0672	0.06	0.52	0.49	**0.44**
7A	6/27/2007	17:10-20:10	109.70	0.0468	0.05	0.43	0.40	0.36
7B	6/27/2007	17:10-20:10	129.76	0.0510	0.05	0.39	0.37	0.33
Average				0.0489	0.05	0.41	0.38	**0.35**
8A	6/28/2007	7:00-10:00	126.58	0.0654	0.06	0.52	0.48	0.43
8B	6/28/2007	7:00-10:00	126.81	0.0727	0.07	0.57	0.53	0.48
Average				0.0691	0.07	0.55	0.51	**0.46**
9A	6/28/2007	10:30-13:30	122.46	0.0661	0.06	0.54	0.50	0.45
9B	6/28/2007	10:30-13:30	127.08	0.0685	0.06	0.54	0.50	0.45
Average				0.0673	0.06	0.54	0.50	**0.45**
10A	6/28/2007	13:50-16:55	126.18	0.0637	0.06	0.51	0.47	0.42
10B	6/28/2007	13:50-16:55	92.07	0.0425	0.06	0.46	0.43	0.39
Average				0.0531	0.06	0.48	0.45	**0.41**

APPENDIX K TEST RESULTS

Date:	6/26/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	1A	Time:	08:30-11:30
Pressure, Barometric(Hg"):	29.000	Hg (ug)	0.0778
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.926	Hg (ppb)	0.07
Initial Volume (liters)	0	Hg (ug/dncm)	0.57
Final Volume (liters)	160.25	Hg (ug/dscm)	0.53
Meter Temperature (°F)	98.60	Hg (ug/wscm)	0.48
Meter Volume (Normal liters)	136.81		
Meter Volume (Standard liters)	146.82		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	2A	Time:	11:50-14:50
Pressure, Barometric(Hg"):	29.000	Hg (ug)	0.1236
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.926	Hg (ppb)	0.11
Initial Volume (liters)	0	Hg (ug/dncm)	0.91
Final Volume (liters)	160.533	Hg (ug/dscm)	0.85
Meter Temperature (°F)	102.20	Hg (ug/wscm)	0.76
Meter Volume (Normal liters)	136.17		
Meter Volume (Standard liters)	146.13		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	3A	Time:	15:00-18:00
Pressure, Barometric(Hg"):	29.000	Hg (ug)	0.1260
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.926	Hg (ppb)	0.11
Initial Volume (liters)	0	Hg (ug/dncm)	0.94
Final Volume (liters)	159.77	Hg (ug/dscm)	0.87
Meter Temperature (°F)	106.30	Hg (ug/wscm)	0.79
Meter Volume (Normal liters)	134.54		
Meter Volume (Standard liters)	144.39		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/26/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	1B	Time:	08:30-11:30
Pressure, Barometric(Hg"):	29.000	Hg (ug)	0.1007
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.926	Hg (ppb)	0.09
Initial Volume (liters)	0	Hg (ug/dncm)	0.73
Final Volume (liters)	162.338	Hg (ug/dscm)	0.68
Meter Temperature (°F)	99.90	Hg (ug/wscm)	0.61
Meter Volume (Normal liters)	138.27		
Meter Volume (Standard liters)	148.38		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	2B	Time:	11:50-14:50
Pressure, Barometric(Hg"):	29.000	Hg (ug)	0.1168
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.926	Hg (ppb)	0.10
Initial Volume (liters)	0	Hg (ug/dncm)	0.86
Final Volume (liters)	161.102	Hg (ug/dscm)	0.80
Meter Temperature (°F)	104.00	Hg (ug/wscm)	0.72
Meter Volume (Normal liters)	136.22		
Meter Volume (Standard liters)	146.18		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	3B	Time:	15:00-18:00
Pressure, Barometric(Hg"):	29.000	Hg (ug)	0.1240
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.000
Pressure, Stack(Hg"):	28.926	Hg (ppb)	0.11
Initial Volume (liters)	0	Hg (ug/dncm)	0.95
Final Volume (liters)	155.621	Hg (ug/dscm)	0.89
Meter Temperature (°F)	108.10	Hg (ug/wscm)	0.80
Meter Volume (Normal liters)	130.64		
Meter Volume (Standard liters)	140.19		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/27/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	4A	Time:	7:10-10:10
Pressure, Barometric(Hg"):	29.040	Hg (ug)	0.0610
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	28.966	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.50
Final Volume (liters)	143.884	Hg (ug/dscm)	0.46
Meter Temperature (°F)	98.60	Hg (ug/wscm)	0.42
Meter Volume (Normal liters)	123.01		
Meter Volume (Standard liters)	132.00		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	5A	Time:	10:30-13:30
Pressure, Barometric(Hg"):	29.040	Hg (ug)	0.0760
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	28.966	Hg (ppb)	0.08
Initial Volume (liters)	0	Hg (ug/dncm)	0.64
Final Volume (liters)	140.508	Hg (ug/dscm)	0.59
Meter Temperature (°F)	102.20	Hg (ug/wscm)	0.53
Meter Volume (Normal liters)	119.35		
Meter Volume (Standard liters)	128.08		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	6A	Time:	13:50-16:50
Pressure, Barometric(Hg"):	29.040	Hg (ug)	0.0654
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	28.966	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.51
Final Volume (liters)	148.41	Hg (ug/dscm)	0.47
Meter Temperature (°F)	90.00	Hg (ug/wscm)	0.43
Meter Volume (Normal liters)	128.86		
Meter Volume (Standard liters)	138.29		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/27/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	4B	Time:	7:10-10:10
Pressure, Barometric(Hg"):	29.040	Hg (ug)	0.0761
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	28.966	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.54
Final Volume (liters)	166.584	Hg (ug/dscm)	0.50
Meter Temperature (°F)	99.90	Hg (ug/wscm)	0.45
Meter Volume (Normal liters)	142.08		
Meter Volume (Standard liters)	152.48		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	5B	Time:	10:30-13:30
Pressure, Barometric(Hg"):	29.040	Hg (ug)	0.0937
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	28.966	Hg (ppb)	0.08
Initial Volume (liters)	0	Hg (ug/dncm)	0.69
Final Volume (liters)	161.613	Hg (ug/dscm)	0.64
Meter Temperature (°F)	104.00	Hg (ug/wscm)	0.57
Meter Volume (Normal liters)	136.84		
Meter Volume (Standard liters)	146.85		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	6B	Time:	13:50-16:50
Pressure, Barometric(Hg"):	29.040	Hg (ug)	0.0690
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	28.966	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.53
Final Volume (liters)	149.086	Hg (ug/dscm)	0.50
Meter Temperature (°F)	90.00	Hg (ug/wscm)	0.45
Meter Volume (Normal liters)	129.45		
Meter Volume (Standard liters)	138.92		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/27-28/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	7A	Time:	17:10-20:10
Pressure, Barometric(Hg"):	29.380	Hg (ug)	0.0468
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	29.306	Hg (ppb)	0.05
Initial Volume (liters)	0	Hg (ug/dncm)	0.43
Final Volume (liters)	124.154	Hg (ug/dscm)	0.40
Meter Temperature (°F)	86.77	Hg (ug/wscm)	0.36
Meter Volume (Normal liters)	109.70		
Meter Volume (Standard liters)	117.73		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	8A	Time:	7:00-10:00
Pressure, Barometric(Hg"):	29.380	Hg (ug)	0.0654
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	29.306	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.52
Final Volume (liters)	144.099	Hg (ug/dscm)	0.48
Meter Temperature (°F)	90.00	Hg (ug/wscm)	0.43
Meter Volume (Normal liters)	126.58		
Meter Volume (Standard liters)	135.84		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	9A	Time:	10:30-13:30
Pressure, Barometric(Hg"):	29.380	Hg (ug)	0.0661
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	29.306	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.54
Final Volume (liters)	139.412	Hg (ug/dscm)	0.50
Meter Temperature (°F)	90.00	Hg (ug/wscm)	0.45
Meter Volume (Normal liters)	122.46		
Meter Volume (Standard liters)	131.42		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/27-28/2007	Condition:	Normal
Project:	We Energies - PIPP	Data Taken By:	ALS
Location:	Flue 7	Fuel Factor:	9780

Test Number:	7B	Time:	17:10-20:10
Pressure, Barometric(Hg"):	29.380	Hg (ug)	0.0510
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	29.306	Hg (ppb)	0.05
Initial Volume (liters)	0	Hg (ug/dncm)	0.39
Final Volume (liters)	147.339	Hg (ug/dscm)	0.37
Meter Temperature (°F)	88.60	Hg (ug/wscm)	0.33
Meter Volume (Normal liters)	129.76		
Meter Volume (Standard liters)	139.25		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	8B	Time:	7:00-10:00
Pressure, Barometric(Hg"):	29.380	Hg (ug)	0.0727
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	29.306	Hg (ppb)	0.07
Initial Volume (liters)	0	Hg (ug/dncm)	0.57
Final Volume (liters)	144.36	Hg (ug/dscm)	0.53
Meter Temperature (°F)	90.00	Hg (ug/wscm)	0.48
Meter Volume (Normal liters)	126.81		
Meter Volume (Standard liters)	136.09		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

Test Number:	9B	Time:	10:30-13:30
Pressure, Barometric(Hg"):	29.380	Hg (ug)	0.0685
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.100
Pressure, Stack(Hg"):	29.306	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.54
Final Volume (liters)	144.669	Hg (ug/dscm)	0.50
Meter Temperature (°F)	90.00	Hg (ug/wscm)	0.45
Meter Volume (Normal liters)	127.08		
Meter Volume (Standard liters)	136.38		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	**6/27-28/2007**	**Condition:**	**Normal**
Project:	**We Energies - PIPP**	**Data Taken By:**	**ALS**
Location:	**Flue 7**	**Fuel Factor:**	**9780**

Test Number:	10A	**Time:**	13:50-16:55
Pressure, Barometric(Hg"):	29.380	**Hg (ug)**	0.0637
Pressure, Static(H_2O"):	-1.00	**Water Vapor in Flue Gas (Bws):**	0.100
Pressure, Stack(Hg"):	29.306	**Hg (ppb)**	0.06
Initial Volume (liters)	0	**Hg (ug/dncm)**	0.51
Final Volume (liters)	141.033	**Hg (ug/dscm)**	0.47
Meter Temperature (°F)	80.00	**Hg (ug/wscm)**	0.42
Meter Volume (Normal liters)	126.18		
Meter Volume (Standard liters)	135.41		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

APPENDIX K TEST RESULTS

Date:	6/27-28/2007	**Condition:**	Normal
Project:	We Energies - PIPP	**Data Taken By:**	ALS
Location:	Flue 7	**Fuel Factor:**	9780

Test Number:	10B	**Time:**	13:40-16:55
Pressure, Barometric(Hg"):	29.380	**Hg (ug)**	0.0425
Pressure, Static(H_2O"):	-1.00	**Water Vapor in Flue Gas (Bws):**	0.100
Pressure, Stack(Hg"):	29.306	**Hg (ppb)**	0.06
Initial Volume (liters)	0	**Hg (ug/dncm)**	0.46
Final Volume (liters)	102.91	**Hg (ug/dscm)**	0.43
Meter Temperature (°F)	80.00	**Hg (ug/wscm)**	0.39
Meter Volume (Normal liters)	92.07		
Meter Volume (Standard liters)	98.81		
Meter Calibration (Y)	1.000		
Average Delta H (ΔH)	0.010		

PLATT ENVIRONMENTAL SERVICES, INC.

Procedures for Calibration

Nozzles

The nozzles are measured according to Method 5, Section 5.1.

Dry Gas Meters

The test meters are calibrated according to Method 5, Section 5.3 and "Procedures for Calibrating and Using Dry Gas Volume Meters as Calibration Standards" by P.R. Westlin and R.T. Shigehara, March 10, 1978.

Analytical Balance

The accuracy of the analytical balance is checked with Class S, Stainless Steel Type 303 weights manufactured by F. Hopken and Son, Jersey City, New Jersey.

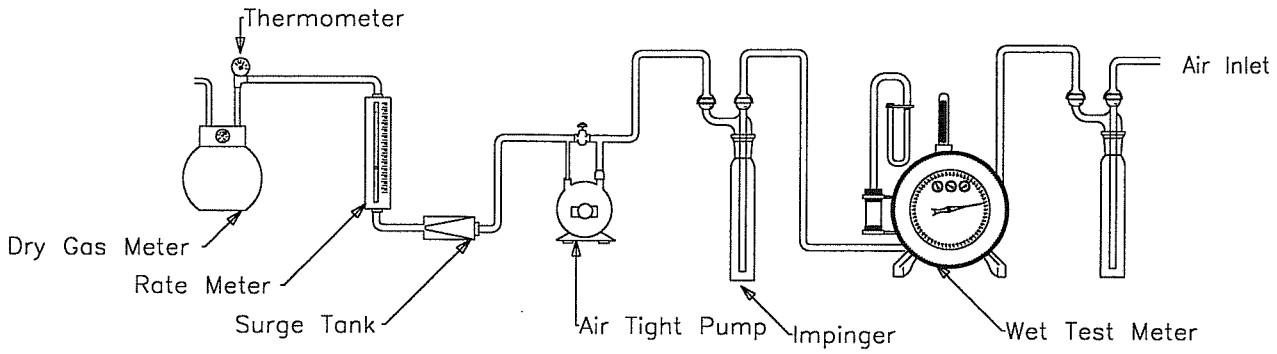
Temperature Sensing Devices

The potentiometer and thermocouples are calibrated utilizing a NBS traceable millivolt source.

Pitot Tubes

The pitot tubes utilized during this test program are manufactured according to specifications described and illustrated in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A, Methods 1 and 2. The pitot tubes comply with the alignment specifications in Method 2, Section 4; and the pitot tube assemblies are in compliance with specifications in the same section.

Dry Gas Meter Calibration Sample Train Diagram



Meter Box Calibration

Dry Gas Meter No.	CM2	Date:	May 11, 2007
Standard Meter No.	9605804	Calibrated By:	S. Sands
Standard Meter (Y)	1.0054	Barometric Pressure:	29.45

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			970.916	1000.438	67	73	72					
Initial			965.882	995.342	68	72	72					
Difference	1	0.20	5.034	5.096	68	73	72	72	19	40	0.996	1.717
Final			937.947	967.156	68	73	71					
Initial			922.724	951.850	68	71	70					
Difference	2	0.50	15.223	15.306	68	72	71	71	35	55	0.999	1.571
Final			945.033	974.318	68	74	72					
Initial			937.947	967.156	70	73	72					
Difference	3	0.70	7.086	7.162	69	74	72	73	14	35	0.995	1.675
Final			952.327	981.648	68	72	73					
Initial			945.033	974.318	68	72	72					
Difference	4	0.90	7.294	7.330	68	72	73	72	12	53	1.001	1.582
Final			960.327	989.720	67	75	72					
Initial			952.327	981.648	68	72	72					
Difference	5	1.20	8.000	8.072	68	74	72	73	11	41	0.998	1.438
Final			965.882	995.342	67	75	72					
Initial			960.327	989.720	68	74	72					
Difference	6	2.00	5.555	5.622	68	75	72	73	6	54	0.994	1.732
									Average		**0.997**	**1.619**

M072505A

U-85

81

Platt Environmental

Stack Temperature Sensor Calibration

Meter Box # : CM2 *Name :* S. Sands

Ambient Temperature : 71.7 °F *Date :* May 11, 2007

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	0	0.0
250	250	0.0
600	599	0.1
1200	1202	0.1

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Meter Box Calibration

Dry Gas Meter No.	CM8	Date:	May 15, 2007
Standard Meter No.	9605804	Calibrated By:	S. Dyra
Standard Meter (Y)	1.0054	Barometric Pressure:	29.11

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			31.501	38.332	73	78	77					
Initial			24.521	31.309	73	79	77					
Difference	1	0.20	6.980	7.023	73	79	77	78	24	42	1.002	1.440
Final			38.971	45.846	73	80	78					
Initial			31.501	38.332	73	78	77					
Difference	2	0.50	7.470	7.514	73	79	78	78	16	46	1.003	1.447
Final			44.998	51.926	73	80	78					
Initial			38.971	45.846	74	78	78					
Difference	3	0.70	6.027	6.080	74	79	78	79	11	39	0.999	1.504
Final			50.435	57.408	74	81	78					
Initial			44.998	51.926	74	78	78					
Difference	4	0.90	5.437	5.482	74	80	78	79	9	10	0.998	1.474
Final			55.821	62.831	74	83	78					
Initial			50.435	57.408	74	80	78					
Difference	5	1.20	5.386	5.423	74	82	78	80	8	8	1.001	1.573
Final			24.521	31.309	72	83	77					
Initial			14.346	21.054	72	77	76					
Difference	6	2.00	10.175	10.255	72	80	77	78	11	56	0.999	1.574
									Average		**1.000**	**1.502**

Stack Temperature Sensor Calibration

Meter Box # : CM8 *Name :* S. Dyra

Ambient Temperature : 77.1 °F *Date :* May 15, 2007

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	-2	0.4
250	249	0.1
600	601	0.1
1200	1208	0.5

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? Y yes ____ no

Pitot tube openings damaged? ____ yes (explain below) N no

α_1 = 1 ° (<10°), α_2 = 1 ° (<10°) z = A sin γ = 0.016 (in.); (<0.125 in.)

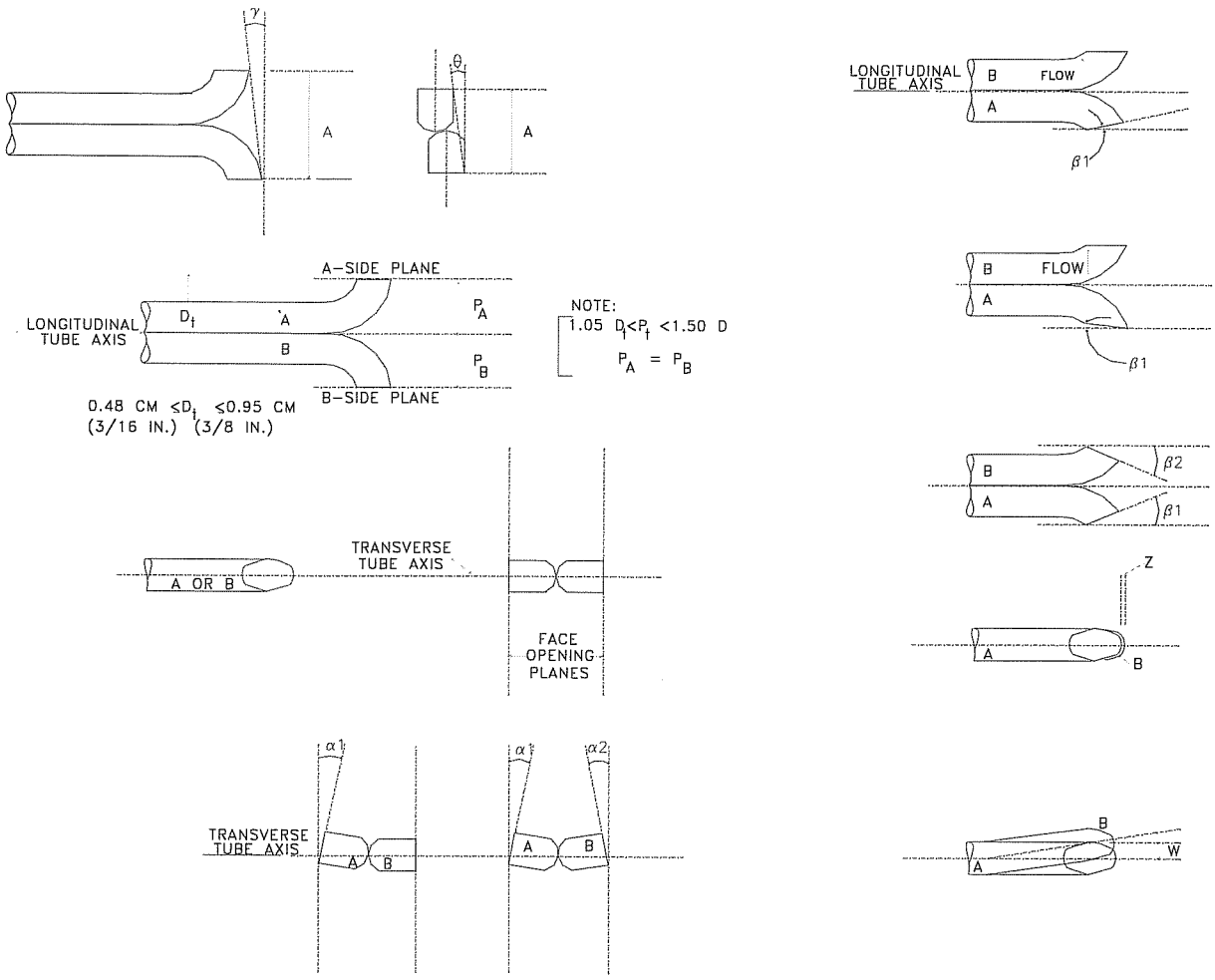
β_1 = 0 ° (<5°), β_2 = 0 ° (<5°) w = A sin θ = 0.016 (in.); (<0.03125 in.)

γ = 1 °, θ = 1 °, A = 0.932 (in.) P_A = 0.47 (in.), P_B = 0.47 (in.), D_t = 0.380 (in.)

Comments: _____

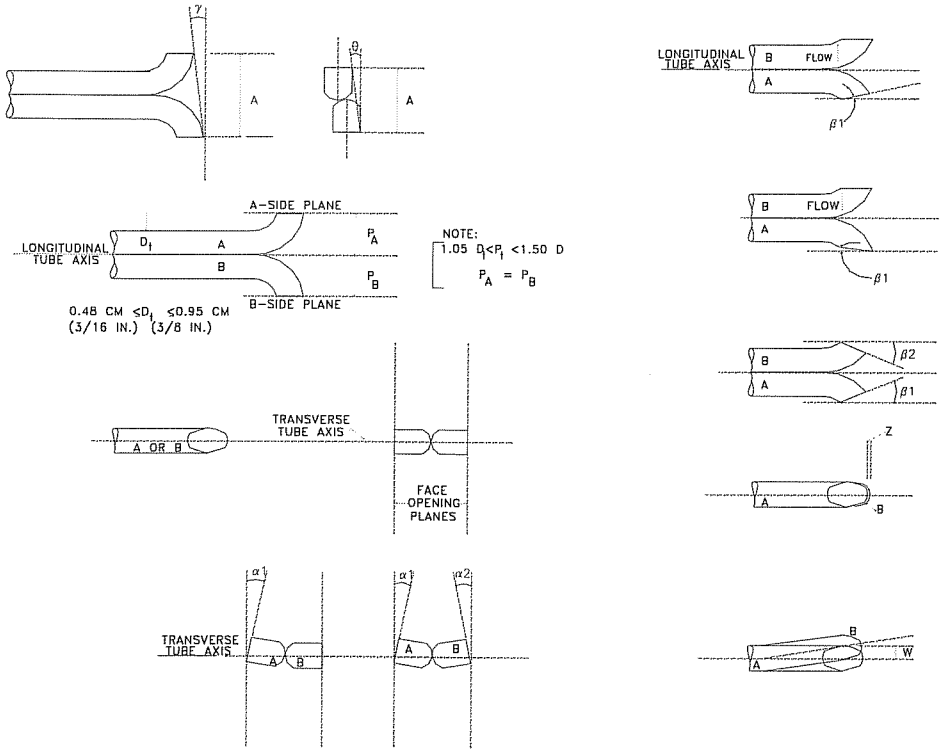
Calibration required? ____ yes N no

Pitot Tube No.: 19 Date: 12/28/2006 Name: AAS



S TYPE PITOT TUBE INSPECTION FORM

Pitot Tube No 45 Date: 5/11/2007 Inspectors Name: JLH



Pitot tube assembly level? x yes ____ no

Pitot tube openings damaged? ____ yes (explain below) x no

a_1 = 0 ° (<10°), a_2 = 0 ° (<10°) z = A sin g = 0.000 (in.); (<0.125 in.)

b_1 = 0 ° (<5°), b_2 = 0 ° (<5°) w = A sin q = 0.000 (in.); (<0.03125 in.)

γ = 0 °, θ = 0 °, A = 0.000 (in.) P_A = 0.470 (in.), P_B = 0.470 (in.), D_t = 0.375 (in.)

Calibration required? ____ yes x no

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Nozzle Calibration Sheet
Set No. 1

Nominal Diameter	0.120	0.175	0.230	0.250	0.275	0.300	0.310	0.375	0.425	0.500	Other
Nozzle Diameter	.120	.176	.231	.242	.267	.295	.325	.364	.433	.486	
Nozzle Identification Number	#4	#6	#8	#8M	#9	#10M	#11	#12	#14	#16	

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Nozzle Calibration Sheet
Set No. 2

Nominal Diameter	0.120	0.175	0.230	0.250	0.275	0.300	0.310	0.375	0.425	0.500	Other
Nozzle Diameter	.120	.172	.231	.262	.268		.309	.367	.431	.498	
Nozzle Identification Number	#4	#6	#8	#9	#9M		#10	#12	#14	#16	

M072505A

APEX SOURCE TESTING EQUIPMENT INSTRUMENTS

APEX INSTRUMENTS METER CONSOLE CALIBRATION

Meter Console Information

Console Model	XC-260	Console Serial Number	0705013 Side A	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002493	Totalizer Scale Factor (Final)	**0.9722**	Temp Display Model	JENCO

Calibration Conditions

WTM ID	W-NK-1A	Calibration Technician	SH			Calibration Date	9-May-07
WTM Cal Factor	1.0000	Barometric Pressure	(Pb)	753.8	mm Hg		

Calibration Data / Results

	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	36.2	20	0	515.5095	23.8									
Final	6.00	0	42.2	21	5.887	521.2876	24									
Total/Avg	6.00	0	6	20.5	5.887	5.7781	23.9	5.833	5.671	5.945	5.660	0.998	-0.002	0.952	-0.012	0.94
Run 2 - Initial	0.00	0	42.2	21	0	521.2876	24									
Final	9.00	0	48.05	21	5.872	527.0396	24									
Total/Avg	9.00	0	5.85	21	5.872	5.752	24	5.808	5.647	5.787	5.632	0.997	-0.003	0.973	0.009	0.63
Run 3 - Initial	0.00	0	48.05	21	0	527.0396	24									
Final	18.00	0	53.9	22	5.792	532.7448	24									
Total/Avg	18.00	0	5.85	21.5	5.792	5.7052	24	5.720	5.561	5.777	5.586	1.005	0.005	0.967	0.003	0.31

Average Meter Calibration Factor Y **1.000** **0.964**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

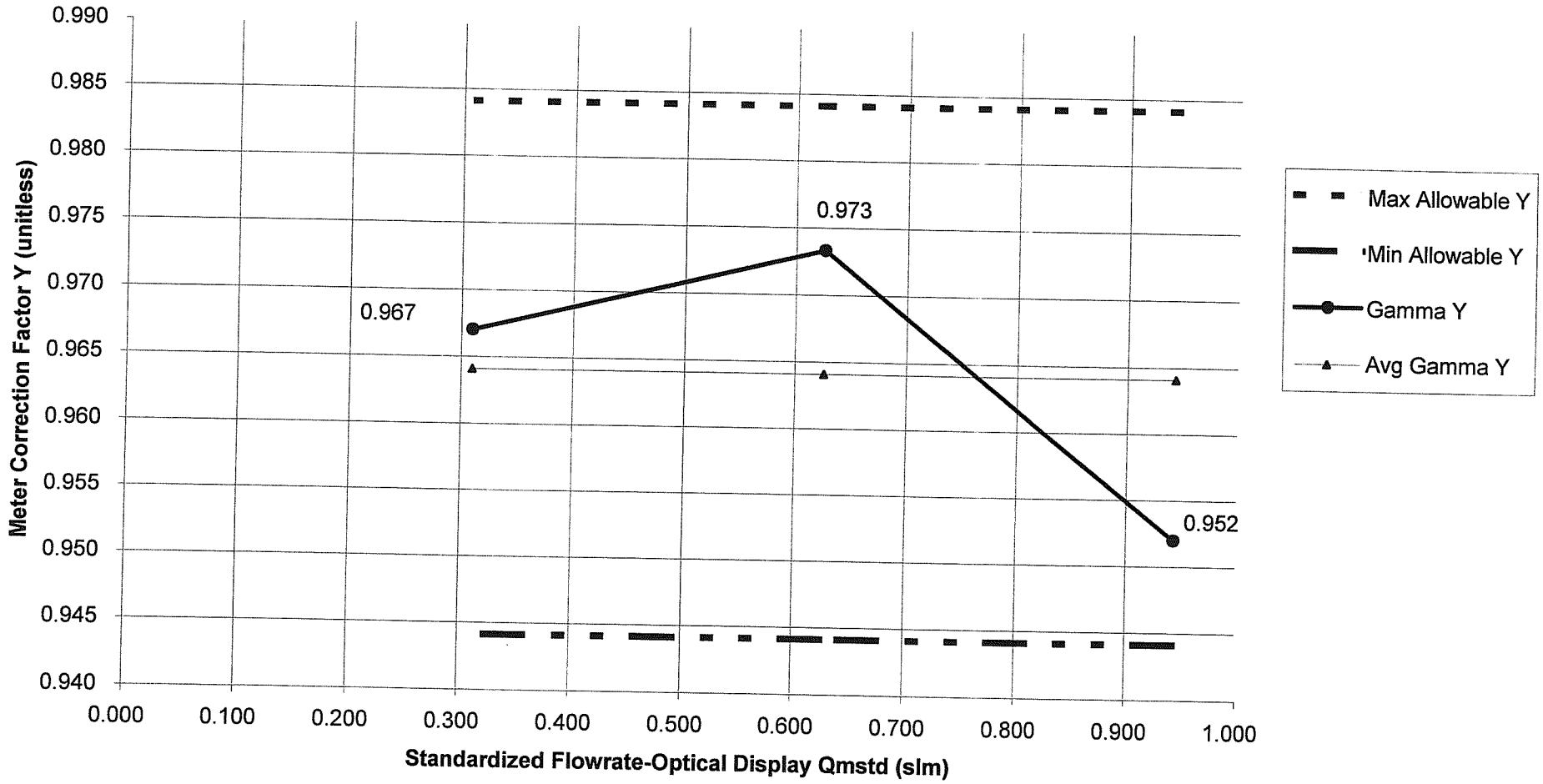
Signature Sherman Howell Date 5-9-07

Platt Environmental

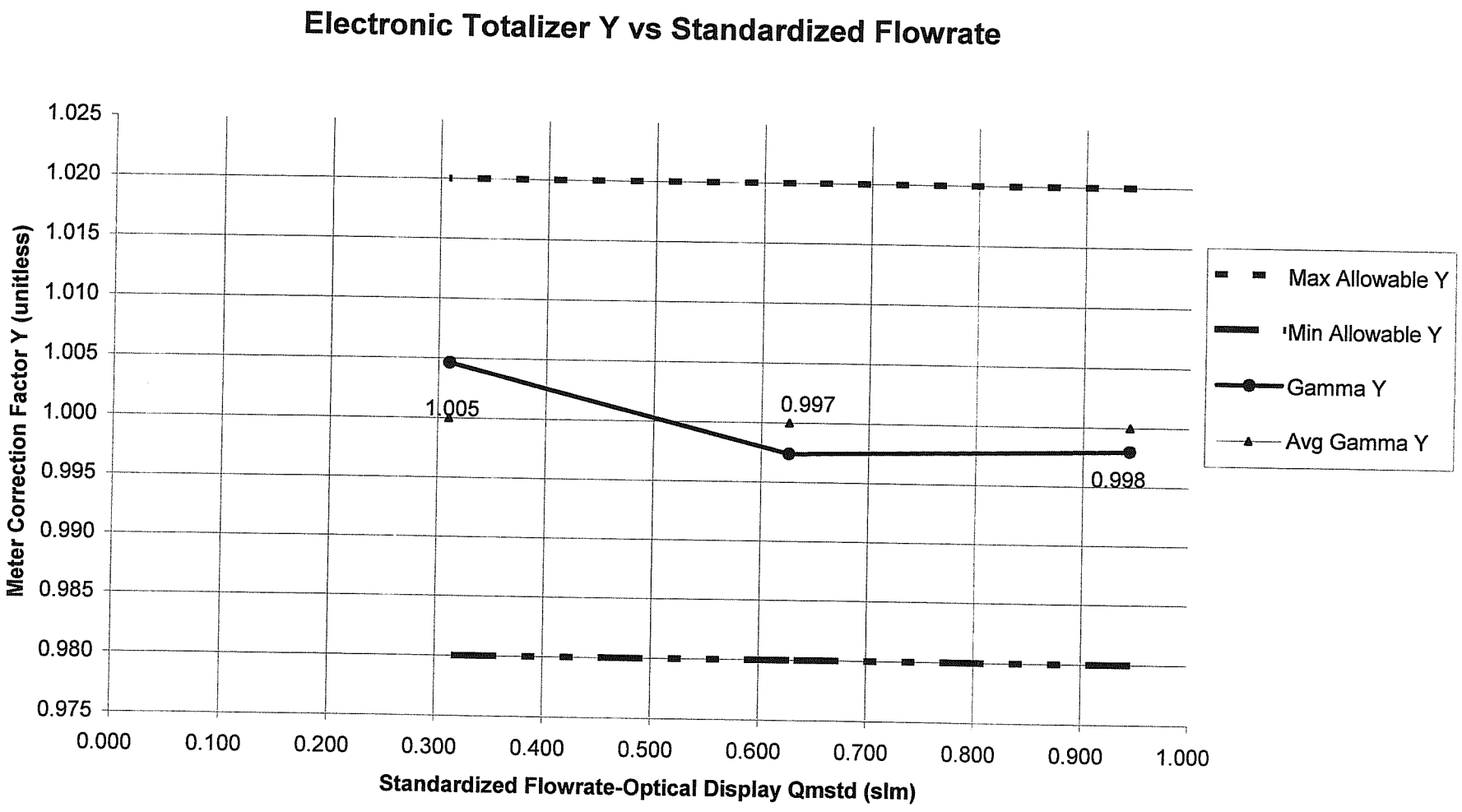
M072505A

Platt Environmental

Mechanical DGM Index Y vs Standardized Flowrate



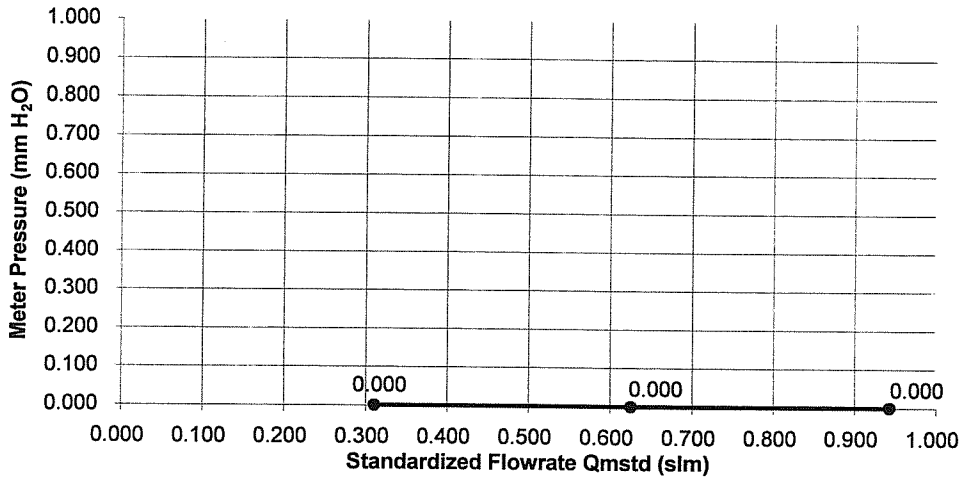
Console Serial: *0705013*
Side A



Console Serial: *0705013*
Side A

Console Model: *XC-260* *Calibration Date:* *5-9-2007*

Meter Pressure vs Standardized Flowrate



M072505A

93

Platt Environmental

APEX SOURCE TESTING EQUIPMENT INSTRUMENTS

APEX INSTRUMENTS METER CONSOLE CALIBRATION

Meter Console Information					
Console Model	XC-260	Console Serial Number	0705013 Side B	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002490	Totalizer Scale Factor (Final)	**0.9518**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	W-NK-0.5A	Calibration Technician	SH			Calibration Date	9-May-07
WTM Cal Factor	1.0000	Barometric Pressure	(Pb)	753.8	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	117.21	21	0	132.1654	24									
Final	6.00	0	123.1	21	5.72	137.6718	24									
Total/Avg	6.00	0	5.89	21	5.72	5.5064	24	5.658	5.386	5.826	5.392	1.001	0.001	0.925	-0.017	0.90
Run 2 - Initial	0.00	0	123.1	21	0	137.6718	24									
Final	9.00	0	128.7	21	5.626	143.0908	24									
Total/Avg	9.00	0	5.6	21	5.626	5.419	24	5.565	5.297	5.539	5.306	1.002	0.002	0.958	0.015	0.59
Run 3 - Initial	0.00	0	128.7	21	0	143.0908	24									
Final	18.00	0	133.92	23	5.195	148.055	24									
Total/Avg	18.00	0	5.22	22	5.195	4.9642	24	5.121	4.875	5.146	4.861	0.997	-0.003	0.945	0.002	0.27

U-97

Average Meter Calibration Factor Y	1.000	0.943

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature Sherman Howell Date 5-9-07

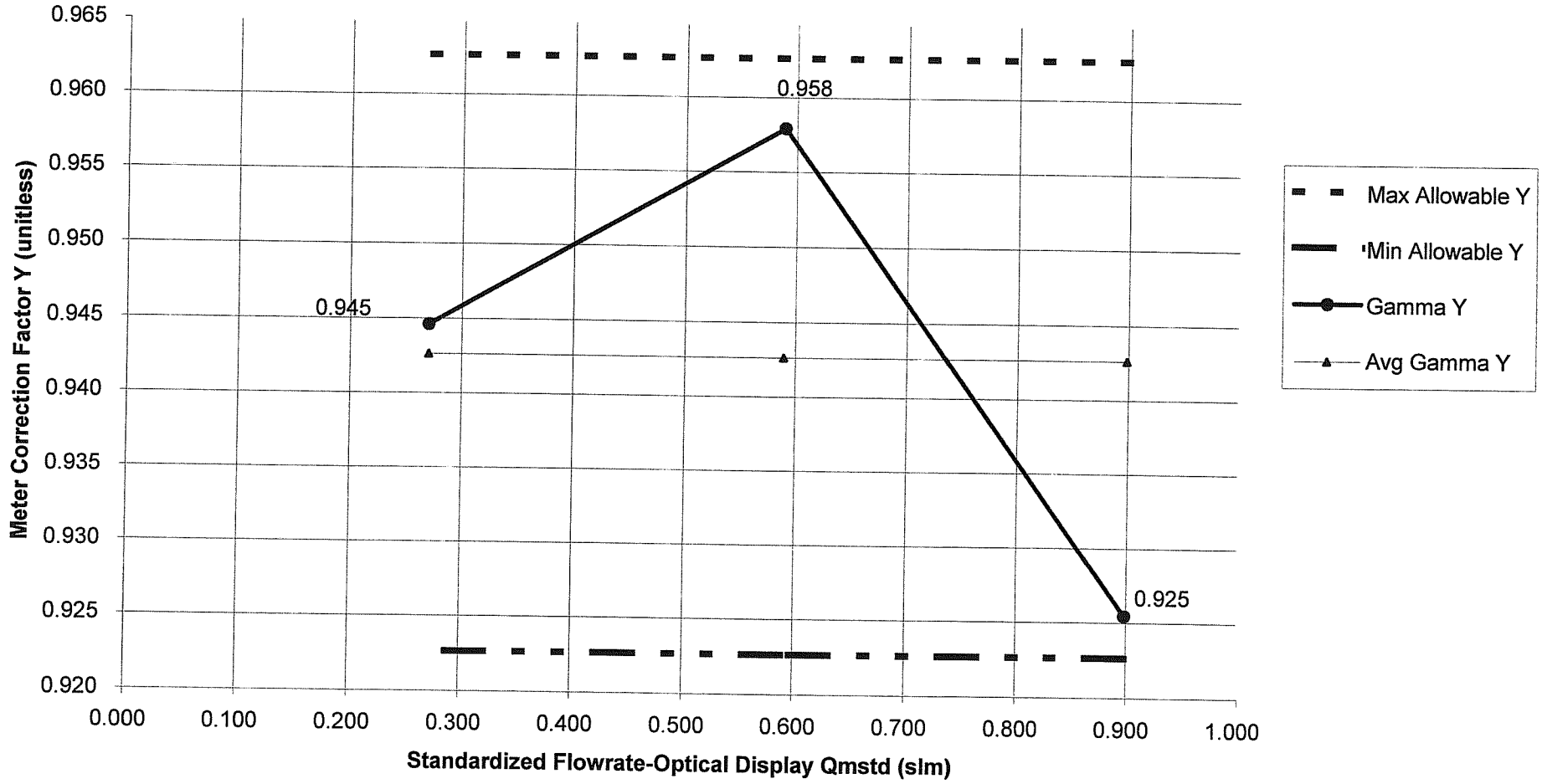
M072505A

U-98

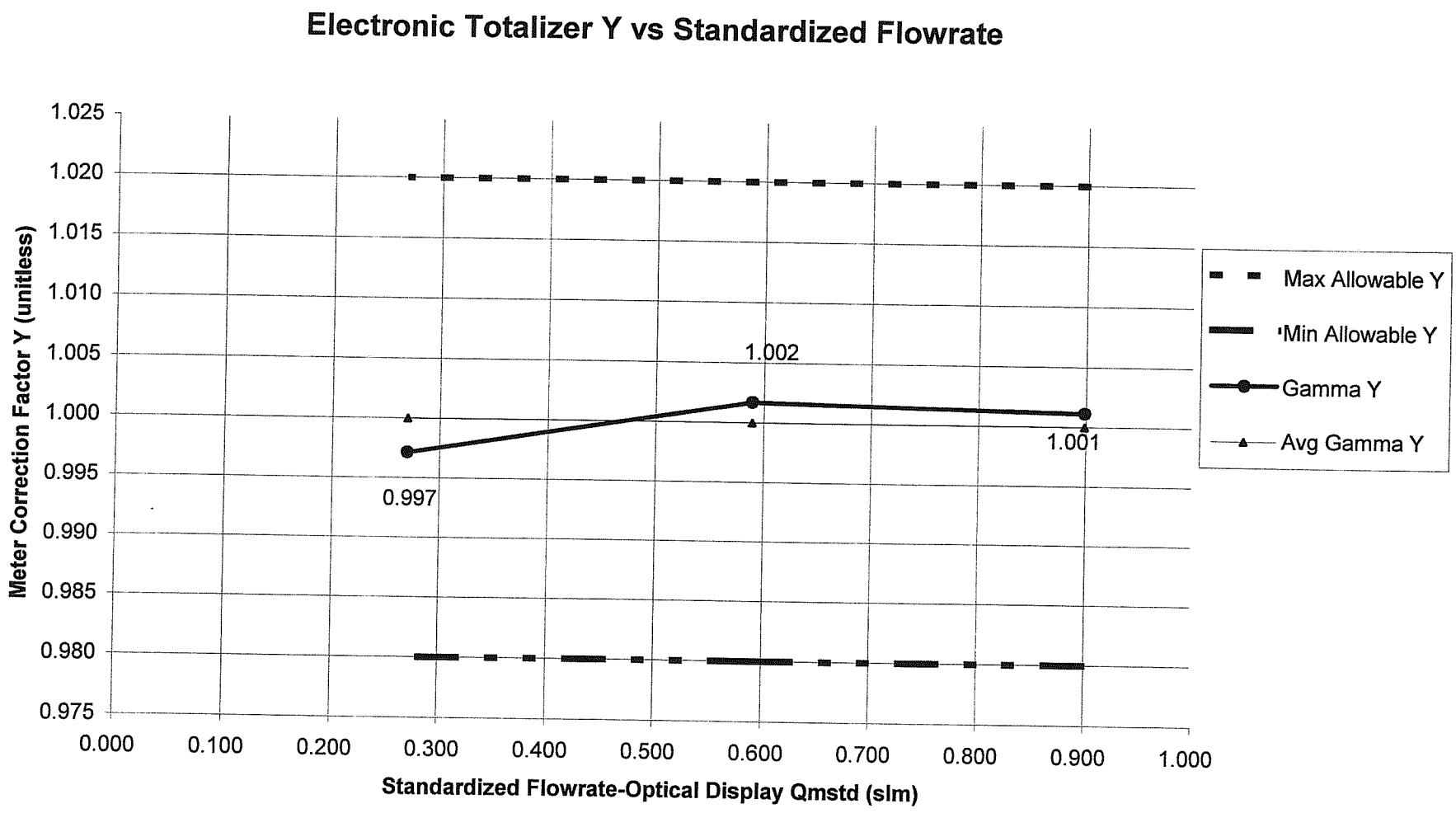
94

Platt Environmental

Mechanical DGM Index Y vs Standardized Flowrate



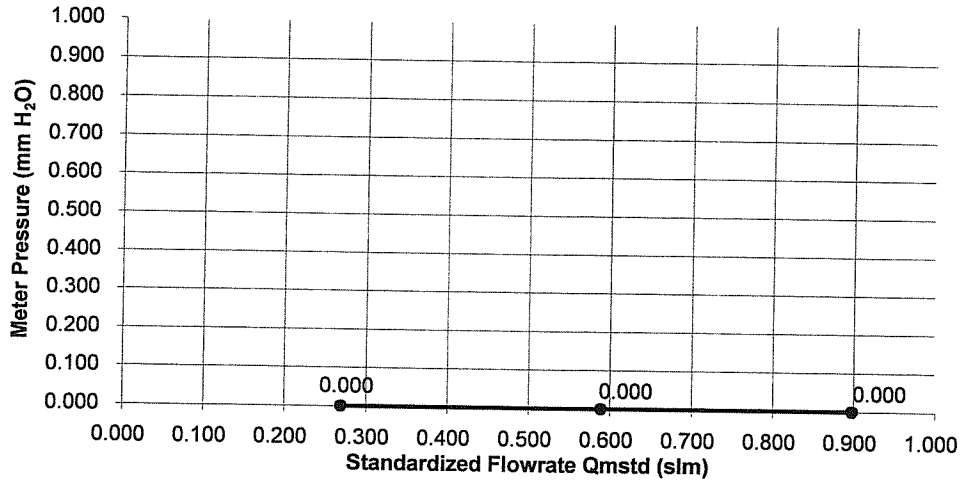
Console Serial: *0705013*
Side B



Console Serial: *0705013*
Side B

Console Model: *XC-260* *Calibration Date:* *5-9-2007*

Meter Pressure vs Standardized Flowrate



APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

APEX INSTRUMENTS METERING CONSOLE CHECK LIST

MODEL: KC-260 **S/N:** 0705013

DATE: 5-3-07 **INITIALS:** LP

VOLTAGE:
- ☑ 120VAC
- ☐ 220VAC

PUMP:
- ☑ MOTOR OPERATION
- ☑ PNEUMATIC

PROBE:
- ☑ TC SIMULATOR
- ☐ LIGHT ASSEMBLY N/A

OVEN:
- ☐ TC SIMULATOR
- ☐ LIGHT ASSEMBLY N/A

AUX:
- ☐ TC SIMULATOR
- ☐ LIGHT ASSEMBLY N/A

TEMP DISPLAY:
- ☑ C°
- ☐ F°

TIMER:
- ☑ COUNTS W/SWITCH ON
- ☑ STOPS W/SWITCH OFF
- ☑ ZERO RESET
- ☑ H/M/S
- ☑ MIN/MIN

MANOMETER:
- ☐ SOLENOID ACTIVATE N/A

SCALE:
- ☐ ENGLISH
- ☑ METRIC

TC CONNECTIONS:
- ☑ METER (DIRECT READ)
- ☑ STACK (SIMULATOR)
- ☑ AUXILLARY (SIMULATOR)
- ☑ EXIT (SIMULATOR)

ORSAT (OPTIONAL):
- ☐ MOTOR
- ☐ PNEUMATIC N/A

220V OPERATION / NOT APPLICABLE
- ☐ PWR. CORD
- ☐ 220V LABEL N/A
- ☐ FAN
- ☐ FUSES
- ☐ PUMP
- ☐ SOLENOIDS

Thermocouple Simulator: Model Altek Series 22Type K, Range 0-2100° F

Serial Number: 10763902

Thermocouple Simulator Setting		Meter Box Channel Temperature Reading				
C°	F°	Probe	Stack	~~Filter~~ AUX-1	~~Exit~~ AUX-2	Aux-3
-18	0	-018	-018	-018	-018	-018
38	100	36	36	36	36	36
93	200	93	93	93	[redacted]	93
149	300	148	148	148	[redacted]	148
260	500	[redacted]	258	[redacted]	[redacted]	[redacted]
371	700	[redacted]	371	[redacted]	[redacted]	[redacted]
482	900	[redacted]	482	[redacted]	[redacted]	[redacted]
593	1100	[redacted]	593	[redacted]	[redacted]	[redacted]
816	1500	[redacted]	814	[redacted]	[redacted]	[redacted]
1038	1900	[redacted]	1037	[redacted]	[redacted]	[redacted]

Tolerance Range

Stack	1.5 % +/- Absolute (°R or K)	
Filter	5.4° F +/-	3.0° C +/-
Meter	5.4° F +/-	3.0° C +/-
Exit	2.0° F +/-	1.1° C +/-
Aux	5.4° F +/-	3.0° C +/-

Average Absolute "Stack" Error = 0.168 %

Ice Water 32° F	Meter TC Reading
32	0

U-101

OHIO LUMEX

Train A

APPENDIX K (PART 75 CAMR)

Plant/Source: WE Energies / Unit 7 Stack Test Location:

Test ID: 1 Train A Carbon Trap ID: OL 10907

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/19/0725 Leak Check Pass/Fail Test End (Date/Time) 6/19/0925 Leak Check Pass/Fail

6/19 0725 340 30 1,000 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	0745	341°F	31°C	750		16.642	
6/19	0805	341°F	31°C	750		32.763	
6/19	0825	342°F	32°C	750		48.867	
6/19	0845	342°F	32°C	750		65.115	
6/19	0905	339°F	32°C	750		82.347	
6/19	0925	340°F	32°C	750		97.797	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies/ Unit 7 Stack Test Location:

Test ID: 1 Train B Carbon Trap ID: OL 10872

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/19/0725 Leak Check Pass/Fail Test End (Date/Time) 6/19/0925 Leak Check Pass/Fail

6/19 0725 340 31 1,000 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	0745	341 °F	32 °C	850		19.784	
6/19	0805	341 °F	33 °C	850		36.982	
6/19	0825	342 °F	33 °C	900		54.685	
6/19	0845	342 °F	33 °C	900		73.186	
6/19	0905	339 °F	33 °C	900		92.349	
6/19	0925	340 °F	33 °C	900		110.267	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies/Unit 7 Test Location:

Test ID: 2 / Train A Carbon Trap ID: OL 10951

Spiked At: QA/QC Signature

Sampled By: A. Sorc Sampling Console Ser# 1

Test Start (Date/Time): 6/19/1015 Leak Check (Pass/Fail) Test End (Date/Time) 6/19/1215 Leak Check Pass/Fail

1015 336 32 759 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	1035	335	32	750		16.654	
6/19	1055	333	32	800		33.066	
6/19	1115	333	32	800		49.602	
6/19	1135	332	32	800		66.100	
6/19	1155	332	32	800		82.665	
6/19	1215	333	32	800		99.204	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 2 / Train B Carbon Trap ID: OL 10910

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/19/1015 Leak Check Pass/Fail Test End (Date/Time) 6/19/1215 Leak Check Pass/Fail

	1015	336	34	909		0.000	
Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	1035	335	34	900		17.753	
6/19	1055	333	33	860		35.432	
6/19	1115	333	33	850		52.987	
6/19	1135	332	33	850		70.748	
6/19	1155	332	34	850		88.432	
6/19	1215		33	850		106.175	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies / Unit 2 Test Location:

Test ID: 3/Train A Carbon Trap ID: OL 10945

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/19/1250 Leak Check Pass/Fail Test End (Date/Time) 6/19/0250 Leak Check Pass/Fail

6/19 1250 335 31 750 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	0110	336	31	780		16.932	
6/19	0130	336	31	800		33.774	
6/19	0150	337	31	800		50.561	
6/19	0210	338	32	800		67.892	
6/19	0230	339	32	800		84.067	
6/19	0250	339	32	800		100.770	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 3 / Train B Carbon Trap ID: OL 10942

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/19/1250 Leak Check (Pass/Fail) Test End (Date/Time) 6/19/0250 Leak Check Pass/Fail

6/19 1250 335 33 850 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	0110	336	32	840		17.243	
6/19	0130	336	32	840		34.576	
6/19	0150	337	33	840		51.947	
6/19	0210	337	33	840		70.134	
6/19	0230	339	33	840		86.719	
6/19	0250	339	33	840		104.057	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 4 Train A Carbon Trap ID: OL 10918

Spiked At: QA/QC Signature

Sampled By: A. Soria Sampling Console Ser# 1

Test Start (Date/Time): 6/19 1525 Leak Check Pass/Fail Test End (Date/Time) Leak Check Pass/Fail

6/19 1525 339 32 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	1545	338	32	800		16.612	
6/19	1605	336	32	800		33.882	
6/19	1625	335	32	800		51.250	
6/19	1645	334	32	800		68.593	
6/19	1705	334	32	800		85.965	
6/19	1725	332	32	800		103.321	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: _____ Test Location: _____

Test ID: 4/Train B Carbon Trap ID: OL 10923

Spiked At: _____ QA/QC Signature _____

Sampled By: A. Sorice Sampling Console Ser# 1

Test Start (Date/Time): 6/19/1525 Leak Check Pass/Fail (Pass) Test End (Date/Time) _____ Leak Check Pass/Fail _____

6/19 1525 339 33 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/19	1545	338	33	850		17.336	
6/19	1605	336	33	860		34.764	
6/19	1625	335	33	860		52.332	
6/19	1645	334	33	860		69.875	
6/19	1705	334	33	860		87.237	
6/19	1725	332	33	860		104.791	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: W/E Energies Unit 7 Test Location:

Test ID: 5 / Train A Carbon Trap ID: OL 10937

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/20 / 0740 Leak Check Pass/Fail Test End (Date/Time) 6/20 / 1010 Leak Check Pass/Fail

6/20 0740 331 26 790 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	0800	332	26	820		17.395	
6/20	0830	332	27	820		17.395	
6/20	0850	332	27	820		35.098	
6/20	0910		27	820		44.036	
6/20	0930		28	820		62.019	
6/20	0950		28	840		79.928	
Total/Average			29	840		98.019	
	1010		29	990		107.408	

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 5/Train B Carbon Trap ID: OL 10947

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/20 / 0740 Leak Check Pass/Fail Test End (Date/Time) 6/20 / 1010 Leak Check Pass/Fail

6/20 740 331 27 820

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	0800	332	28	880		17.824	
6/20	0830	332	28	880		17.824	
6/20	0850	332	28	880		36.093	
6/20	0910		28	880		45.282	
6/20	0930		29	900		63.538	
6/20	0950		30	920		81.652	
Total/Average			30	949		99.849	
	1010		30	800		106.842	

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 6/Train A Carbon Trap ID: OL 10946

Spiked At: QA/QC Signature

Sampled By: A. Sara Sampling Console Ser# 4

Test Start (Date/Time): 6/20/1040 Leak Check Pass/Fail Test End (Date/Time) 6/20/1240 Leak Check Pass/Fail

6/20 1040 29 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	1100						
6/20	1120						
6/20	1140	332	29	200		2.164	
6/20	1200	331	29	200		6.522	
6/20	1220	330	29	220		11.001	
6/20	1240	330	29	220		15.584	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 6/ Train B Carbon Trap ID: OL 10906

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/20/1040 Leak Check (Pass/Fail) Test End (Date/Time) 6/20/1240 Leak Check Pass/Fail

6/20 1040 333 30 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	1100	332	30	900		16.893	
6/20	1120	332	30	800		34.869	
6/20	1140	332	29	750		48.738	
6/20	1200	331	29	750		64.064	
6/20	1220	330	29	750		79.345	
6/20	1240	330	30	750		94.666	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 7 / Train A Carbon Trap ID: OL 10882

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/20 / 1310 Leak Check (Pass/Fail) Test End (Date/Time) 6/20 / 1510 Leak Check Pass/Fail

6/20 1310 332 29 220 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	1330	337	30	230		4.649	
6/20	1350	340	31	240		9.412	
6/20	1410	340	31	200		14.213	
6/20	1430	339	31	200		19.038	
6/20	1450	339	31	200		23.885	
6/20	1510	339	31	200		28.742	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies / Unit 7 Test Location: _____

Test ID: 7 / Train B Carbon Trap ID: OL 10953

Spiked At: _____ QA/QC Signature _____

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/20 / 1310 Leak Check (Pass/Fail) Test End (Date/Time) 6/20 / 1510 Leak Check Pass/Fail

6/20 1310 332 30 700 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	1330	337	31	700		12.694	
6/20	1350	340	32	700		26.778	
6/20	1410	340	32	700		40.885	
6/20	1430	339	31	700		54.954	
6/20	1450	339	31	700		69.003	
6/20	1510	339	31	700		83.057	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 8 Train A Carbon Trap ID: OL 10997

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/20 / 1440 Leak Check (Pass/Fail) Test End (Date/Time) 6/20 / 1640 Leak Check (Pass/Fail)

6/20 1440 340 32 250 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	1500	339	32	250		5.142	
6/20	1520	341	31	210		10.298	
6/20	1540	341	31	210		15.437	
6/20	1600	341	31	250		20.576	
6/20	1620	341	32	250		25.735	
6/20	1640	341	32	250		30.777	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 8 / Train B Carbon Trap ID: OL 10916

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/20 / 1440 Leak Check (Pass/Fail) Test End (Date/Time) 6/20 / 1640 Leak Check (Pass/Fail)

6/20 1440 340 32 700 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/20	1500	339	32	700		13.863	
6/20	1520	341	31	700		27.600	
6/20	1540	341	31	700		41.334	
6/20	1600	341	32	700		55.275	
6/20	1620	341	32	700		69.200	
6/20	1640	341	32	700		83.124	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 9 / Train A Carbon Trap ID: OL 10925

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/21/0720 Leak Check Pass/Fail Test End (Date/Time) 6/21/0920 Leak Check Pass/Fail

6/21 0720 333 19 500 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	0740	334	23	490		10.124	
6/21	0800	335	26	500		20.295	
6/21	0820	337	27	500		30.567	
6/21	0840	337	28	500		40.883	
6/21	0900	336	29	500		51.386	
6/21	0920	336	29	500		61.768	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 9/ Train B Carbon Trap ID: OL 10933

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/21/0720 Leak Check Pass/Fail Test End (Date/Time) 6/21/0920 Leak Check Pass/Fail

6/21 0720 333 21 500 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	0740	334	24	500		10.456	
6/21	0800	335	27	500		20.524	
6/21	0820	337	29	500		30.679	
6/21	0840	337	29	500		40.862	
6/21	0900	336	30	500		51.081	
6/21	0920	336	30	500		61.291	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 10 Train A Carbon Trap ID: OL 10903

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/21 0950 Leak Check Pass/Fail Test End (Date/Time) 6/21 1150 Leak Check Pass/Fail

6/21 0950 335 3.0 550 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	1010	334	30	550		11.559	
6/21	1030	335	30	550		23.016	
6/21	1050	353	30	550		34.674	
6/21	1110	332	30	550		46.313	
6/21	1130	331	30	550		57.998	
6/21	1150	331	30	550		69.617	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 10 Train B Carbon Trap ID: OL 10930

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/21/0950 Leak Check (Pass/Fail) Test End (Date/Time) 6/21/1150 Leak Check (Pass/Fail)

6/21 0950 335 31 550 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	1010	334	31	550		11.271	
6/21	1030	335	31	550		23.035	
6/21	1050	333	31	550		34.718	
6/21	1110	332	31	550		46.460	
6/21	1130	331	31	550		58.084	
6/21	1150	331	31	550		69.656	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 11 / Train A Carbon Trap ID: OL 10924

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/21 / 1220 Leak Check Pass/Fail Test End (Date/Time) 6/21 / 1420 Leak Check Pass/Fail

6/21 1220 332 30 550 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	1240	332	30	550		11.616	
6/21	1300	332	30	550		23.054	
6/21	1320	334	30	550		34.432	
6/21	1340	334	30	550		45.787	
6/21	1400	335	30	550		57.073	
6/21	1420	335	30	550		68.364	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 11/Train B Carbon Trap ID: OL001731

Spiked At: 330ng QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/21/1220 Leak Check Pass/Fail Test End (Date/Time) 6/21/1420 Leak Check Pass/Fail

6/21 1220 332 31 550 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	1240	332	31	550		11.790	
6/21	1300	332	31	550		23.069	
6/21	1320	334	31	550		34.401	
6/21	1340	334	31	550		46.222	
6/21	1400	335	31	550		57.254	
6/21	1420	335	31	550		68.161	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 12 Train A Carbon Trap ID: OL 10920

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 4

Test Start (Date/Time): 6/21 / 1450 Leak Check Pass/Fail Test End (Date/Time) 6/21 / 1650 Leak Check Pass/Fail

6/21 1450 333 30 600 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	1510	333	31	600		12.078	
6/21	1530	333	31	600		24.800	
6/21	1550	332	31	600		37.094	
6/21	1610	332	31	600		49.478	
6/21	1630	332	31	600		61.648	
6/21	1650	332	31	600		73.970	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 1 Test Location:

Test ID: 12 Train B Carbon Trap ID: OL001525

Spiked At: 330ng QA/QC Signature

Sampled By: A. Sorg Sampling Console Ser# 1

Test Start (Date/Time): 6/21 / 1450 Leak Check (Pass/Fail) Test End (Date/Time) 6/21 / 1650 Leak Check (Pass/Fail)

6/21 1450 333 31 600 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6/21	1510	333	32	600		12.654	
6/21	1530	333	32	600		24.970	
6/21	1550	332	32	600		36.878	
6/21	1610	332	32	600		49.362	
6/21	1630	332	32	600		61.549	
6/21	1650	332	32	600		74.112	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

TRAIN A

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 1
Date: 6/19/07
Project Number:
Test Location: Unit 9 Stack
Client Name: AEP
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 6
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: 0.997
Pitot ID: 019A-
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson Oven
Filter Number/Weight: HP #334
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: ✓ @ 10 "Hg
Post-Test Nozzle Leak Check: ✓ @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120 min.
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
Static Pressure:
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

K' = .531
K = .449

Isokinetic Sampling Field Data Sheet

Project Number:
Client: AEP
Plant: PIPP

Date: 6/19/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 1
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.531 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	Meter Rate, Cubic Feet/ Min.	x 10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	7:25	2.0	1.1	49.346	1.414	.6350	6.35		340	86	86	4	289	316	69
	7:35	1.8	.96	55.50	1.342	.6024	6.02	55.70	340	87	86	4	294	324	73
	7:45	2.1	1.1	61.38	1.449	.6507	6.51	61.52	341	90	87	5	294	331	82
	7:55	2.0	1.1	67.90	1.414	.6350	6.35	67.89	341	93	88	4	295	337	75
	8:05	2.0	1.1	74.30	1.414	.6350	6.35	74.25	342	92	89	4	293	341	69
	8:15	2.0	1.1	80.66	1.414	.6350	6.35	80.65	343	93	90	4	281	343	68
	8:25	2.0	1.1	87.08	1.414	.6350	6.35	87.01	343	94	91	4	282	345	63
	8:35	1.9	1.0	93.40	1.378	.6189	6.20	93.43	342	95	92	4	282	347	63
	8:45	1.9	1.0	99.54	1.378	.6189	6.20	99.60	342	92	91	4	280	347	63
	8:55	1.9	1.0	105.67	1.378	.6189	6.20	105.74	340	91	91	4	279	347	64
	9:05	1.9	1.0	111.80	1.378	.6189	6.20	111.87	340	90	90	4	278	346	65
	9:15	1.9	1.0	118.00	1.378	.6189	6.20	118.07	339	92	89	4	281	346	67
	9:25			124.12				124.20							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 2
Date: 6/19/07
Project Number:
Test Location: Unit 9 stack
Client Name: AEP
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: ____ Width: ____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7.5"
Port Size:

Meter and Probe Data

Operator: ED
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019B
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson oven
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: ✓ @ 10 "Hg
Post-Test Nozzle Leak Check: ✓ @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ at 3 "H_2O
Post-Test Pitot Leak Check: ✓ at 3 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120 min.
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
Static Pressure:
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: AEP
Plant: PIPP

Date: 6/19/07
Test Location: unit 9 stack
Test Method: Ontario Hydro

Test Number: 2
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.531 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.449 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	10:15	2.0	1.1	39.008	1.414	.6350	6.35		336	86	86	5	250	289	79
	10:25	2.0	1.1	45.20	1.414	.6350	6.35	45.35	335	85	85	5	250	295	55
	10:35	2.0	1.1	51.61	1.414	.6350	6.35	51.55	335	86	84	5	250	309	53
	10:45	1.9	1.0	57.99	1.378	.6189	6.20	57.96	334	89	85	5	252	323	53
	10:55	1.9	1.0	64.15	1.378	.6189	6.20	64.18	333	90	86	5	252	334	55
	11:05	2.0	1.1	70.39	1.414	.6350	6.35	70.35	333	90	88	5	258	341	56
	11:15	1.9	1.0	76.77	1.378	.6189	6.20	76.74	332	91	88	5	260	344	57
	11:25	1.9	1.0	83.20	1.378	.6189	6.20	82.97	332	93	89	5	262	347	59
	11:35	2.0	1.1	89.50	1.414	.6350	6.35	89.40	332	93	89	5	264	349	62
	11:45	2.0	1.1	95.85	1.414	.6350	6.35	95.85	332	93	90	5	264	350	65
	11:55	1.9	1.0	102.20	1.378	.6189	6.20	102.20	333	90	90	5	265	350	67
	12:05	1.9	1.0	108.38	1.378	.6189	6.20	108.40	332	88	88	5	265	349	67
	12:15			114.580				114.58							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 3
Date: 6/19/07
Project Number:
Test Location: Unit 9 Stack
Client Name: AEP
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7.5"
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019 B
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .276
Train Type: Anderson
Filter Number/Weight: HP
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: ✓ @ 8 "Hg
Post-Test Nozzle Leak Check: ✓ @ 8 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120 min.
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
Static Pressure: -1.1
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: _____ Date: 6/19/07 Test Number: 3

Client: AEP Test Location: Unit 9 Stack Operator: EO

Plant: PIPP Test Method: Ontario Hydro Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.531 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	Meter Rate, Cubic Feet/ Min.	.449 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	12:50	2.0	1.1	117.191	1.414	.6350	6.35		335	87	87	4	250	338	58
	13:00	2.0	1.1	123.54	1.414	.6350	6.35	23.54	335	87	88	4	250	340	57
	13:10	2.0	1.1	129.90	1.414	.6350	6.35	129.89	336	92	88	4	254	342	55
	13:20	2.0	1.1	136.36	1.414	.6350	6.35	136.25	336	93	89	4	255	345	55
	13:30	1.9	1.0	142.63	1.378	.6189	6.20	142.61	336	90	89	4	255	345	56
	13:40	2.0	1.1	149.01	1.414	.6350	6.35	148.83	336	93	89	4	255	346	57
	13:50	2.0	1.1	155.36	1.414	.6350	6.35	155.36	338	92	90	4	253	347	59
	14:00	2.0	1.1	161.58	1.414	.6350	6.35	161.71	338	92	90	4	255	347	61
	14:10	2.0	1.1	167.95	1.414	.6350	6.35	167.93	338	92	90	4	256	348	62
	14:20	2.1	1.1	174.30	1.449	.6507	6.51	174.30	339	93	90	4	256	348	65
	14:30	2.0	1.1	180.83	1.414	.6350	6.35	180.81	339	93	91	5	256	350	67
	14:40	2.0	1.1	187.18	1.414	.6350	6.35	187.18	339	92	91	5	257	349	71
	14:50			193.652				193.33							

M072505A

127

U-131

Platt Environmental

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 4
Date: 6/19/07
Project Number:
Test Location: Unit 9 Stack
Client Name: AEP
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: ____ Width: ____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7.5"
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019 B
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .276
Train Type: Anderson
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: 0.001 @ 10 "Hg
Post-Test Nozzle Leak Check: ✓ @ "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 10 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120 min.
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
Static Pressure:
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: _____ Date: 6/19/07 Test Number: 4

Client: AEP Test Location: Unit 9 Stack Operator: EO

Plant: PIPP Test Method: Ontario Hydro Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	15:25	2.0	1.1	93.800	1.414	.6350	6.35		340	92	93	4	256	338	61
	15:35	1.9	1.0	100.15	1.378	.6189	6.20	100.15	338	94	92	4	265	344	61
	15:45	2.0	1.1	106.39	1.414	.6350	6.35	106.35	338	96	93	4	268	347	57
	15:55	1.9	1.0	112.70	1.378	.6189	6.20	112.74	337	97	94	4	271	349	58
	16:05	1.9	1.0	118.90	1.378	.6189	6.20	118.90	336	97	94	4	264	350	58
	16:15	1.9	1.0	125.10	1.378	.6189	6.20	125.10	335	98	94	4	266	350	58
	16:25	2.0	1.1	131.30	1.414	.6350	6.35	131.30	335	98	95	4	266	350	54
	16:35	2.0	1.1	137.80	1.414	.6350	6.35	137.65	334	98	95	4	262	350	55
	16:45	2.0	1.1	144.10	1.414	.6350	6.35	144.15	334	98	95	4	266	350	55
	16:55	2.0	1.1	150.40	1.414	.6350	6.35	150.45	334	96	94	5	266	350	56
	17:05	2.0	1.1	156.75	1.414	.6350	6.35	156.75	334	98	95	5	254	349	57
	17:15	2.0	1.1	163.50	1.414	.6350	6.35	163.10	334	99	95	5	255	350	57
	17:25			169.85				169.85							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 5
Date: 6/20/07
Project Number:
Test Location: Unit 9 Stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson Oven
Filter Number/Weight: HP
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: ✓ @ 10 "Hg
Post-Test Nozzle Leak Check: ✓ @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure: -1.5
CO_2 %: 13.1
O_2 %: 6.3
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: PIPP

Date: 6/20/07
Test Location: Unit 4 Stack
Test Method: Ontario Hydro

Test Number: 5
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.521 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.441 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	7:40	1.9	.99	70.225	1.378	.6079	6.1		331	75	75	5	319	342	51
	7:50	1.9	.99	76.34	1.378	.6079	6.1	76.33	332	77	76	5	311	340	51
	8:00	1.9	.99	82.44	1.378	.6079	6.1	82.44	332	78	77	5	305	339	55
	8:30	1.9	.99	82.44	1.378	.6079	6.1		334	77	77	5	302	335	58
	8:40	1.9	.99	89.53	1.378	.6079	6.1	89.54	335	80	78	5	307	336	58
	8:50	1.9	.99	95.58	1.378	.6079	6.1	95.64	336	82	79	5	307	336	60
	9:00	2.0	1.0	101.66	1.414	.6237	6.2	101.68	337	83	80	5	306	336	62
	9:10	2.0	1.0	107.91	1.414	.6237	6.2	107.86	337	83	80	5	307	337	65
	9:20	1.9	.99	114.20	1.378	.6079	6.1	114.11	338	84	81	5	314	339	56
	9:30	1.9	.99	120.33	1.378	.6079	6.1	120.30	338	86	82	4	319	343	53
	9:40	2.0	1.0	126.40	1.414	.6237	6.2	126.43	339	86	83	4	318	346	53
	9:50	1.9	.99	132.58	1.378	.6079	6.1	132.60	339	87	84	5	317	346	54
	10:00	1.9	.99	138.75	1.378	.6079	6.1	138.68	340	88	84	5	317	347	54
	10:10			144.85				144.85							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 6
Date: 6/20/07
Project Number:
Test Location: Unit 4 stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7"
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson oven
Filter Number/Weight: HP
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure: -1.5
CO_2 %: 15.0
O_2 %: 4.7
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	6/20/07	Test Number:	6
Client:	ADA	Test Location:	Unit 9 Stack	Operator:	EO
Plant:	PIPP	Test Method:	Ontario Hydro	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	Orifice Setting (ΔH)	.521 Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.443 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	10:40	2.0	1.0	50.124	1.414	.6264	6.26		340	90	88	4	316	330	47
	10:50	1.9	.99	56.40	1.378	.6106	6.11	56.38	338	90	88	4	315	336	47
	11:00	2.0	1.0	62.55	1.414	.6264	6.26	62.51	336	90	89	4	318	341	50
	11:10	1.9	.99	68.81	1.378	.6106	6.11	68.81	335	89	88	4	316	345	50
	11:20	1.9	.99	74.90	1.378	.6106	6.11	74.92	334	90	88	4	316	346	51
	11:30	2.0	1.0	81.04	1.414	.6264	6.26	81.01	333	90	88	4	311	348	53
	11:40	1.9	.99	87.33	1.378	.6106	6.11	87.30	332	90	87	4	310	346	53
	11:50	1.9	.99	93.42	1.378	.6106	6.11	93.44	332	91	88	4	314	348	56
	12:00	1.9	.99	99.58	1.378	.6106	6.11	99.53	331	91	88	4	308	349	57
	12:10	1.9	.99	105.70	1.378	.6106	6.11	105.69	329	90	87	4	311	348	58
	12:20	1.9	.99	111.78	1.378	.6106	6.11	111.81	330	91	88	4	315	350	60
	12:30	1.9	.99	117.90	1.378	.6106	6.11	117.89	330	92	88	4	317	352	64
	12:40			124.226				124.01							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 7
Date: 6/20/07
Project Number:
Test Location: Unit 1 Stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7"
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson
Filter Number/Weight: HP
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure: -1.7
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: PIPP

Date: 6/20/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 7
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.521 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.443 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1310	1.9	.99	26.98	1.378	.6106	6.11		332	88	88	5	324	345	60
	1320	1.9	.99	33.18	1.378	.6106	6.11	33.09	334	88	88	5	323	344	60
	1330	1.9	.99	39.30	1.378	.6106	6.11	39.29	337	89	88	4	312	341	62
	1340	1.9	.99	45.41	1.378	.6106	6.11	45.41	338	88	90	4	314	340	65
	1350	2.0	1.0	51.60	1.414	.6264	6.26	51.52	340	88	91	4	317	339	62
	1400	1.9	.99	57.70	1.378	.6106	6.11	57.86	340	88	91	4	322	342	57
	1410	1.9	.99	63.98	1.378	.6106	6.11	64.01	340	90	89	5	325	346	56
	1420	2.0	1.0	70.10	1.414	.6264	6.26	70.09	339	91	88	4	326	347	57
	1430	2.0	1.0	76.36	1.414	.6264	6.26	76.36	339	90	88	4	327	349	59
	1440	1.9	.99	82.58	1.378	.6106	6.11	82.62	338	90	88	4	329	350	61
	1450	1.9	.99	88.59	1.378	.6106	6.11	88.69	339	92	89	4	329	352	63
	1500	2.0	1.0	94.73	1.414	.6264	6.26	94.70	339	92	89	4	330	352	64
	1510			100.99				100.99							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 8
Date: 6/20/07
Project Number:
Test Location: Unit 9 Stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High load
Test Method: Ontario Hydro
Flue Area:
Port Type: flange
Port Length: 7'
Port Size:

Meter and Probe Data

Operator: ED
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson
Filter Number/Weight: HP
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure: -1.4
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: PIPP

Date: 6/20/17
Test Location: Unit 9 stack
Test Method: Ontario Hydro

Test Number: 8
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	15:40	2.0	1.0	1.154	1.414	.6264	6.26		341	88	88	4	318	346	58
	15:50	2.0	1.0	7.45	1.414	.6264	6.26	7.41	340	90	88	3	319	349	58
	16:00	1.9	.99	13.69	1.378	.6106	6.11	13.71	340	92	89	3	322	352	60
	16:10	1.9	.99	19.80	1.378	.6106	6.11	19.80	340	93	89	3	311	351	64
	16:20	1.9	.99	25.89	1.378	.6106	6.11	25.91	341	93	90	3	315	352	66
	16:30	1.9	.99	31.90	1.378	.6106	6.11	32.00	341	93	90	3	320	352	66
	16:40	1.9	.99	38.05	1.378	.6106	6.11	38.01	341	93	90	3	318	352	66
	16:50	2.0	1.0	44.20	1.414	.6264	6.11	44.16	341	92	89	3	318	353	66
	17:00	1.9	.99	50.31	1.378	.6106	6.11	50.31	341	92	90	3	313	352	67
	17:10	2.0	1.0	56.47	1.414	.6264	6.26	56.42	341	91	89	3	314	351	55
	17:20	2.0	1.0	62.80	1.414	.6264	6.26	62.73	341	91	89	3	310	347	54
	17:30	1.9	.99	69.10	1.378	.6106	6.11	69.06	342	91	88	3	310	345	54
	17:40			75.21				75.21							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 9
Date: 6/21/07
Project Number:
Test Location: Unit 9 Stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7"
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019A
Pitot Coefficient: 1.840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson
Filter Number/Weight: N/A
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: 0.00 @ 10 "Hg
Post-Test Nozzle Leak Check: 0.00 @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120 min.
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure:
Static Pressure: -1.1
CO_2 %: 13
O_2 %: 6.6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	6/21/07	Test Number:	9
Client:	ADA	Test Location:	Unit 9 Stack	Operator:	EO
Plant:	PIPP	Test Method:	Ontario Hydro	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	.526 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.442 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	7:20	1.9	.99	77.30	1.378	.6093	6.09		333	81	81	3	307	299	50
	7:30	2.0	1.1	83.40	1.414	.6251	6.25	83.39	334	83	82	3	308	308	50
	7:40	1.9	.99	89.63	1.378	.6093	6.09	89.65	334	84	82	3	311	317	52
	7:50	1.9	.99	95.80	1.378	.6093	6.09	95.72	335	85	82	3	307	322	53
	8:00	1.9	.99	101.89	1.378	.6093	6.09	101.89	335	85	83	3	310	325	55
	8:10	2.0	1.1	107.97	1.414	.6251	6.25	107.98	336	86	83	3	316	329	57
	8:20	2.0	1.1	114.10	1.414	.6251	6.25	114.22	337	86	83	3	309	331	59
	8:30	2.0	1.1	120.37	1.414	.6251	6.25	120.35	337	86	84	3	316	332	62
	8:40	1.9	.99	126.68	1.378	.6093	6.09	126.62	337	87	85	3	308	334	64
	8:50	2.0	1.1	132.82	1.414	.6251	6.25	132.77	336	87	85	3	302	333	66
	9:00	1.9	.99	139.09	1.378	.6093	6.09	139.07	336	87	85	3	292	331	65
	9:10	1.9	.99	145.20	1.378	.6093	6.09	145.18	336	86	85	2	256	320	61
	9:20			151.29				151.29							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 10
Date: 6/21/07
Project Number:
Test Location: Unit 9 stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: ontano Hydro
Flue Area:
Port Type: flange
Port Length: 7"
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM 2
Meter Y Value: .997
Pitot ID: 019A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson Oven
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: 0.001 @ 10 "Hg
Post-Test Nozzle Leak Check: 0.001 @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure: -1.4
CO_2 %: 13
O_2 %: 6.6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: PIPP

Date: 6/21/07
Test Location: Unit 9 stack
Test Method: Ontario Hydro

Test Number: 10
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.521 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.438 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	9:50	1.9	.99	51.568	1.378	.6093	6.09		335	77	79	4	250	300	50
	10:00	2.0	1.0	57.66	1.414	.6194	6.19	57.66	334	79	78	4	254	299	46
	10:10	2.0	1.0	63.85	1.414	.6194	6.19	63.85	334	81	79	4	269	305	47
	10:20	2.0	1.0	70.03	1.414	.6194	6.19	70.04	334	83	80	4	283	314	49
	10:30	1.9	.99	76.00	1.378	.6037	6.04	76.22	335	83	81	6	263	313	50
	10:40	1.9	.99	82.20	1.378	.6037	6.04	82.04	334	83	81	5	271	311	50
	10:50	1.9	.99	88.30	1.378	.6037	6.04	88.24	333	83	81	4	265	313	52
	11:00	1.9	.99	94.40	1.378	.6037	6.04	94.34	333	82	81	4	258	308	52
	11:10	1.9	.99	100.50	1.378	.6037	6.04	100.44	332	80	79	4	261	304	52
	11:20	1.9	.99	106.54	1.378	.6037	6.04	106.54	331	79	78	4	295	308	54
U-145	11:30	1.9	.99	112.58	1.378	.6037	6.04	112.58	331	79	77	4	365	311	56
	11:40	1.9	.99	118.60	1.378	.6037	6.04	118.62	330	81	78	4	384	321	60
	11:50							124.64							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 11
Date: 6/21/07
Project Number:
Test Location: Unit 9 stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High Load
Test Method: ontario Hydro
Flue Area:
Port Type: flange
Port Length: 7"
Port Size:

Meter and Probe Data

Operator: ED
Meter ID: CM2
Meter Y Value: .997
Pitot ID: .840
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .196
Train Type: Anderson Array
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: 0.001 @ 10 "Hg
Post-Test Nozzle Leak Check: 0.001 @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120
Total Points: 1
Total Test Time: 120 min.
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure:
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: PIPP

Date: 6/21/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 11
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	12:20	1.9	.99	24.940	1.378	.6037	6.04		332	82	82	4	334	343	68
	12:30	1.9	.99	31.00	1.378	.6037	6.04	30.98	332	84	82	3	333	341	43
	12:40	1.9	.99	37.01	1.378	.6037	6.04	37.04	332	86	83	3	327	343	44
	12:50	1.9	.99	43.07	1.378	.6037	6.04	43.05	332	88	84	3	325	345	44
	13:00	1.9	.99	49.11	1.378	.6037	6.04	49.11	332	89	85	3	322	345	44
	13:10	1.9	.99	55.20	1.378	.6037	6.04	55.15	333	89	86	3	324	346	46
	13:20	1.9	.99	61.22	1.378	.6037	6.04	61.24	334	89	86	3	324	345	49
	13:30	1.9	.99	67.36	1.378	.6037	6.04	67.26	334	89	86	3	323	345	51
	13:40	1.9	.99	73.40	1.378	.6037	6.04	73.40	334	89	86	3	328	346	50
	13:50	1.9	.99	79.40	1.378	.6037	6.04	79.44	334	89	87	3	334	347	49
	14:00	1.9	.99	85.39	1.378	.6037	6.04	85.44	335	90	87	3	330	347	52
	14:10	1.9	.99	91.50	1.378	.6037	6.04	91.43	335	91	87	3	325	347	53
	14:20			97.54				97.54							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 12
Date: 11/21/07
Project Number:
Test Location: Unit 9 Stack
Client Name: ADA
Plant Name: PIPP
Duct Shape: Circular or Rectangular
Length: ____ Width: ____ or
Diameter:
Source Condition: High Load
Test Method: Ontario Hydro
Flue Area:
Port Type: Flange
Port Length: 7"
Port Size:

Meter and Probe Data

Operator: EO
Meter ID: CM2
Meter Y Value: .997
Pitot ID: 019A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: glass
Nozzle Diameter: .176
Train Type: Anderson Oven
Filter Number/Weight: N/A
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: ____ @ ____ "Hg
Post-Test Nozzle Leak Check: ____ @ ____ "Hg
Pre-Test Pitot Leak Check: ____ "H_2O
Post-Test Pitot Leak Check: ____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 120
Total Points: 1
Total Test Time: 120 min
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure: -1.4
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: PIPP

Date: 6/21/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 12
Operator: EO
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.521 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.438 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	14:50	1.9	.99	1.781	1.378	.6037	6.04		334	85	86	3	322	347	53
	15:00	1.8	.94	7.80	1.342	.5876	5.88	7.82	333	85	85	3	322	342	53
	15:10	1.9	.99	13.65	1.378	.6037	6.04	13.68	333	87	85	3	318	342	52
	15:20	1.9	.99	19.73	1.378	.6037	6.04	19.69	333	85	85	3	312	338	52
	15:30	1.9	.99	25.85	1.378	.6037	6.04	25.77	333	87	85	3	308	340	52
	15:40	1.9	.99	31.84	1.378	.6037	6.04	31.89	333	87	85	3	308	339	52
	15:50	1.9	.99	39.00	1.378	.6037	6.04	37.88	332	87	84	3	304	335	53
	16:00	1.9	.99	45.10	1.378	.6037	6.04	45.04	332	85	83	3	308	335	57
	16:10	1.8	.94	51.20	1.342	.5876	5.88	51.14	332	85	83	3	303	337	57
	16:20	1.9	.99	57.08	1.378	.5876	6.04	57.08	332	84	83	4	292	336	59
	16:30	1.9	.99	63.02	1.378	.5876	6.04	63.12	332	85	83	4	291	333	59
	16:40	1.9	.99	69.10	1.378	.5876	6.04	69.06	332	85	82	4	285	329	66
	16:50			75.14				75.14							

TRAIN B

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 1
Date: 6/19/07
Project Number: M0
Test Location: Stack 9
Client Name: AEP
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter: _____
Source Condition: High
Test Method: Ontario Hydro
Flue Area: _____
Port Type: Flange
Port Length: 7.5
Port Size: 6

Meter and Probe Data

Operator: Marty Platt
Meter ID: CM8
Meter Y Value: 1.000
Pitot ID: 045 A
Pitot Coefficient: .84
Probe Length: 4'
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Owen
Filter Number/Weight: _____
Thimble Number/Weight: _____
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
Static Pressure: -1.2
CO_2 %: _____
O_2 %: _____
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: _____
Final Imp. Volume or Weight: _____
Imp. Volume or Weight Gain: _____
Initial Silica Weight: _____
Final Silica Weight: _____
Silica Weight Gain: _____
Balance used for impingers and/or silica weights (Model and S/N): _____

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: AEP
Plant: WE Energies Presque Isle

Date: 6/19/07
Test Location: Stack 9
Test Method: Ontario Hydro

Test Number: 1
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.527 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.464 Meter Rate, Cubic Feet/ Min.	X10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	725	1.9	1.001	74.261	1.378	.639	6.393		339	84	84	4	264	313	53
2	735	1.85	.974	80.234	1.360	.631	6.311	80.654	339	87	85	4	266	316	55
3	745	1.9	1.001	86.179	1.378	.639	6.393	86.965	340	91	85	4	267	318	57
4	755	1.9	1.001	93.358	1.378	.639	6.393	93.358	341	95	87	4	266	319	61
5	805	1.9	1.001	99.874	1.378	.639	6.393	99.751	341	91	87	4	270	320	61
6	815	1.9	1.001	106.197	1.378	.639	6.393	106.144	342	92	87	4	266	322	54
7	825	1.85	.974	112.213	1.360	.631	6.311	112.537	342	93	88	4	265	324	52
8	835	1.85	.974	118.848	1.360	.631	6.311	118.848	342	93	88	5	269	323	52
9	845	1.9	1.001	125.159	1.378	.639	6.393	125.159	342	91	88	5	272	322	54
10	855	1.8	.948	131.586	1.341	.622	6.225	131.552	340	90	87	5	269	325	54
11	905	1.8	.948	137.981	1.341	.622	6.225	137.777	339	89	86	4	268	326	57
12	915	1.8	.948	144.621	1.341	.622	6.225	144.002	338	92	86	4	264	327	59
	925			150.227				150.227							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 2
Test Location: Stack 9
Duct Shape: Circular or Rectangular
Source Condition: High
Port Type:

Date: 6/19/07
Client Name: AEP
Length: Width: or
Test Method: Ontario Hydro
Port Length: 7

Project Number:
Plant Name: Presque Isle Ile Energies
Diameter:
Flue Area:
Port Size: 6

Meter and Probe Data

Operator: Marty Platt
Pitot ID: 45
Probe Liner: Glass
Filter Number/Weight:
Pre-Test Nozzle Leak Check: @ "Hg
Pre-Test Pitot Leak Check: "H_2O

Meter ID: CM 8
Pitot Coefficient: .84
Nozzle Diameter: .172

Meter Y Value: 1.000
Probe Length: 4'
Train Type: Anderson oven
Thimble Number/Weight:
Post-Test Nozzle Leak Check: @ "Hg
Post-Test Pitot Leak Check: "H_2O

Traverse Data

Ports Sampled: 1
Total Points: 1

Points/Port: 1
Total Test Time: 120

Min./Point: 10
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
CO_2 %:
Initial Imp. Volume or Weight:
Initial Silica Weight:

Static Pressure:
O_2 %:
Final Imp. Volume or Weight:
Final Silica Weight:

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain:
Silica Weight Gain:

Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: AEP
Plant: Presque Isle

Date: 6/19/07
Test Location: Stack 9
Test Method: Ontario Hydro

Test Number:
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.449 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.428 Meter Rate, Cubic Feet/ Min.	x10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1015	1.75	.785	151.654	1.32	.564	5.6496		336	83	83	5	310	319	57
2	1025	1.9	.853	159.961	1.37	.589	5.8995	157.303	336	85	82	4	303	325	55
3	1035	1.8	.808	163.812	1.34	.574	5.7422	163.205	335	83	82	3	304	326	55
4	1045	1.8	.808	168.947	1.34	.574	5.7422	168.947	334	87	83	4	303	329	54
5	1055	1.7	.763	174.316	1.30	.558	5.5804	174.689	333	89	84	4	301	330	54
6	1105	1.9	.808	180.267	1.34	.574	5.7422	180.269	333	89	85	4	303	330	55
7	1115	1.7	.763	186.015	1.30	.558	5.5804	186.011	332	90	89	3	302	331	55
8	1125	1.8	.808	191.592	1.34	.574	5.7422	191.592	332	91	86	3	303	332	49
9	1135	1.7	.763	197.334	1.30	.558	5.5804	197.334	332	91	86	4	306	334	49
10	1145	1.8	.808	202.813	1.34	.574	5.7422	202.914	332	91	87	4	302	333	49
11	1155	1.7	.763	208.656	1.30	.558	5.5804	208.656	332	88	87	4	304	337	52
12	1205	1.8	.808	214.247	1.34	.574	5.7422	214.236	332	87	85	4	304	331	53
	1215			219.978				219.978							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 3
Date: 6/19/07
Project Number:
Test Location: Stack 9
Client Name: PEP
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: ____ Width: ____ or
Diameter:
Source Condition: High
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: Monty Platt
Meter ID: CM8
Meter Y Value: 1.000
Pitot ID: 45
Pitot Coefficient: .84
Probe Length: 4
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Owen
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: ____ @ ____ "Hg
Post-Test Nozzle Leak Check: ____ @ ____ "Hg
Pre-Test Pitot Leak Check: ____ "H_2O
Post-Test Pitot Leak Check: ____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
Static Pressure: -1.5
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: AEP
Plant: Presque Isle

Date: 6/19/07
Test Location: Stack 9
Test Method: Ontario Hydro

Test Number: 3
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.449 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.428 Meter Rate, Cubic Feet/ Min.	X10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1250	1.8	.808	220.299	1.34	.574	5.7422		335	84	84	4	285	327	68
2	1300	1.9	.853	226.791	1.37	.589	5.8995	226.041	335	89	84	4	285	329	58
3	1310	1.8	.808	232.014	1.34	.574	5.7422	231.940	335	90	85	3	287	326	59
4	1320	1.8	.808	237.682	1.34	.574	5.7422	237.682	336	91	86	3	291	329	58
5	1330	1.9	.853	243.424	1.37	.589	5.8995	243.424	336	88	86	3	289	329	58
6	1340	1.8	.808	249.323	1.34	.574	5.7422	249.323	336	91	86	4	283	328	60
7	1350	1.8	.808	255.065	1.34	.574	5.7422	255.065	337	90	87	4	286	329	60
8	1400	1.8	.808	260.807	1.34	.574	5.7422	260.807	336	91	86	4	292	330	51
9	1410	1.8	.808	266.549	1.34	.574	5.7422	266.549	338	91	86	4	288	329	49
10	1420	1.8	.808	272.291	1.34	.574	5.7422	272.291	338	91	87	4	287	329	51
11	1430	1.7	.763	278.033	1.30	.558	5.5804	278.033	339	91	87	4	287	329	52
12	1440	1.7	.763	283.795	1.30	.558	5.5804	283.613	338	92	87	3	286	329	
	1450			289.193				289.193							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 4
Test Location: Stack 9
Duct Shape: Circular or Rectangular
Source Condition: High
Port Type:

Date: 6/19/07
Client Name: AEP
Length: _____ Width: _____ or
Test Method: Ontario Hydro
Port Length: 77

Project Number:
Plant Name: Presque Isle
Diameter:
Flue Area:
Port Size: 6

Meter and Probe Data

Operator: Marty Platt
Pitot ID: 45
Probe Liner: Glass
Filter Number/Weight:
Pre-Test Nozzle Leak Check: @ "Hg
Pre-Test Pitot Leak Check: "H_2O

Meter ID: CM8
Pitot Coefficient: .84
Nozzle Diameter: .179
Thimble Number/Weight:

Meter Y Value: 1.000
Probe Length: 4'
Train Type: Anderson oven
Post-Test Nozzle Leak Check: @ "Hg
Post-Test Pitot Leak Check: "H_2O

Traverse Data

Ports Sampled: 1
Total Points: 1

Points/Port: 1
Total Test Time: 120

Min./Point: 10
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.73
CO_2 %:
Initial Imp. Volume or Weight:
Initial Silica Weight:

Static Pressure:
O_2 %:
Final Imp. Volume or Weight:
Final Silica Weight:

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain:
Silica Weight Gain:

Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: AEP
Plant: Presque Isle

Date: 6/19/07
Test Location: Stack 9
Test Method: Ontario Hydro

Test Number: 4
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.449 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.428 Meter Rate, Cubic Feet/ Min.	x10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1525	1.9	.853	289.512	1.378	.589	5.8995		339	89	89	5	272	328	68
2	1535	1.8	.808	295.511	1.34	.574	5.7422	295.411	337	93	89	4	279	331	54
3	1545	1.8	.808	301.151	1.34	.574	5.7422	301.151	337	95	90	5	279	329	53
4	1555	1.8	.808	306.893	1.34	.574	5.7422	306.893	336	95	90	5	277	330	53
5	1605	1.8	.808	312.449	1.34	.574	5.7422	312.635	335	95	91	5	277	330	54
6	1615	1.7	.763	318.212	1.303	.558	5.5804	318.377	334	96	91	5	274	330	53
7	1625	1.9	.853	323.955	1.378	.589	5.8995	323.957	334	97	92	5	276	331	54
8	1635	1.8	.808	329.891	1.34	.574	5.7422	329.856	333	96	92	5	273	330	48
9	1645	1.8	.808	335.846	1.34	.574	5.7422	335.598	333	96	92	5	270	326	47
10	1655	1.8	.808	341.341	1.34	.574	5.7422	341.341	333	95	91	5	271	328	49
11	1705	1.9	.853	347.152	1.378	.589	5.8995	346.763	333	96	91	4	272	328	49
12	1715	1.8	.808	352.662	1.34	.574	5.7422	352.1662	332	96	92	4	275	337	52
	1725			358.405				358.405							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 5
Date: 6/20/07
Project Number:
Test Location: Unit 9
Client Name: ADA
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: ____ Width: ____ or
Diameter:
Source Condition: High
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: MP
Meter ID: CM 8
Meter Y Value: 1.000
Pitot ID: 045
Pitot Coefficient: .84
Probe Length: 4
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Owen
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: @ "Hg
Post-Test Nozzle Leak Check: @ "Hg
Pre-Test Pitot Leak Check: "H_2O
Post-Test Pitot Leak Check: "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure: -1.5
CO_2 %: 13.1
O_2 %: 6.3
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: Presque Isle

Date: 6/20/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 5
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.441 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.420 Meter Rate, Cubic Feet/ Min.	x/0 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	740	1.7	.749	60.545	1.30	.547	5.476		331	73	73	4	293	307	56
2	750	1.6	.705	66.021	1.26	.531	5.312	66.021	332	75	74	4	288	307	47
3	800	1.7	.749	71.333	1.30	.547	5.476	71.333	332	77	74	4	288	309	48
4	830	1.6	.705	71.333	1.26	.531	5.312		334	76	75	4	291	312	56
5	840	1.6	.705	76.711	1.26	.531	5.312	76.809	335	79	76	4	295	314	51
6	850	1.7	.749	82.056	1.30	.547	5.476	82.121	336	81	77	4	295	315	53
7	900	1.6	.705	87.591	1.26	.531	5.312	87.597	336	82	78	5	292	315	53
8	910	1.7	.749	92.911	1.30	.547	5.476	92.909	338	83	79	4	293	316	57
9	920	1.6	.705	98.541	1.26	.531	5.312	98.385	338	83	80	4	292	317	59
10	930	1.5	.662	103.697	1.22	.514	5.143	103.697	338	84	80	3	297	317	60
11	940	1.6	.705	108.453	1.26	.531	5.312	108.840	339	84	81	4	300	318	61
12	950	1.5	.662	114.013	1.22	.514	5.143	114.152	339	85	81	4	302	318	62
	1000	1.6	.705	119.285	1.26	.531	5.312	119.295	340	86	82	4	306	320	63
	1010			124.607				124.607							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 6
Date: 6/20/07
Project Number:
Test Location: Unit 9
Client Name: ADA
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: MP
Meter ID: CM8
Meter Y Value: 1.000
Pitot ID: D45
Pitot Coefficient: .84
Probe Length: 4'
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Owen
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: @ "Hg
Post-Test Nozzle Leak Check: @ "Hg
Pre-Test Pitot Leak Check: "H_2O
Post-Test Pitot Leak Check: "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure: -1.5
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	6/20/07	Test Number:	6
Client:	ADA	Test Location:	Stack 9	Operator:	MP
Plant:	Presque Isle	Test Method:	Ontario Hydro	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	.441 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.417 Meter Rate, Cubic Feet/ Min.	x10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1040	1.8	.794	128.019	1.34	.559	5.595		337	86	86	3	308	325	63
2	1050	1.8	.794	133.513	1.34	.559	5.595	133.613	337	90	86	3	304	324	53
3	1100	1.7	.749	139.443	1.30	.544	5.437	139.208	335	91	87	4	289	322	47
4	1110	1.8	.794	144.624	1.34	.559	5.595	144.645	335	90	87	3	301	320	46
5	1120	1.8	.794	150.834	1.34	.559	5.595	150.240	333	91	87	3	309	328	48
6	1130	1.8	.794	155.131	1.34	.559	5.595	155.835	332	91	86	4	320	330	48
7	1140	1.8	.794	160.891	1.34	.559	5.595	161.43	332	91	87	3	322	332	49
8	1150	1.8	.794	167.025	1.34	.559	5.595	167.025	331	92	87	4	326	334	49
9	1200	1.8	.794	172.498	1.34	.559	5.595	172.620	331	91	87	4	328	337	50
10	1210	1.9	.837	178.215	1.37	.575	5.747	178.215	330	91	87	4	320	337	51
11	1220	1.7	.749	183.414	1.30	.544	5.437	183.963	330	92	87	4	302	337	51
12	1230	1.7	.749	189.400	1.30	.544	5.437	189.400	330	92	87	4	290	334	52
	1240			194.837				194.837							

U-161

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 7
Date: 6/20/07
Project Number:
Test Location: Unit 4
Client Name: ADA
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: MP
Meter ID: CM 8
Meter Y Value: 1.000
Pitot ID: 045
Pitot Coefficient: .84
Probe Length: 4.
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson oven
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure:
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	6/20/07	Test Number:	7
Client:	ADA	Test Location:	Stack 9	Operator:	MP
Plant:	Presque Isle	Test Method:	Ontario Hydro	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	.441 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.417 Meter Rate, Cubic Feet/Min.	x10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1310	1.9	.837	195.059	1.37	.575	5.747		332	87	87	4	302	330	68
2	1320	1.8	.794	200.778	1.34	.559	5.594	200.806	334	90	87	4	303	330	58
3	1330	1.9	.837	206.216	1.37	.575	5.747	206.409	336	91	87	4	305	331	57
4	1340	1.7	.749	212.136	1.30	.543	5.437	212.148	338	92	88	4	308	333	60
5	1350	1.8	.794	217.576	1.34	.559	5.594	217.585	339	92	88	4	306	333	62
6	1400	1.7	.749	223.179	1.30	.543	5.437	223.179	339	92	88	4	308	332	64
7	1410	1.8	.794	228.641	1.34	.559	5.594	228.616	340	91	88	4	309	333	56
8	1420	1.8	.794	234.284	1.34	.559	5.594	234.210	339	92	88	4	308	331	53
9	1430	1.8	.794	240.011	1.34	.559	5.594	239.804	339	92	88	4	303	328	54
10	1440	1.7	.749	245.398	1.30	.543	5.437	245.398	338	91	87	4	307	329	54
11	1450	1.8	.794	250.835	1.34	.559	5.594	250.835	339	91	88	4	308	328	57
12	1500	1.9	.837	256.429	1.37	.575	5.747	256.429	339	92	88	4	311	328	59
	1510			262.176				262.176							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 8
Date: 6/20/07
Project Number:
Test Location: Unit 9
Client Name: ADA
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: Width: or
Diameter:
Source Condition: High
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: MP
Meter ID: CM8
Meter Y Value: 1.000
Pitot ID: 045
Pitot Coefficient: .84
Probe Length: 4'
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Oven
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: @ "Hg
Post-Test Nozzle Leak Check: @ "Hg
Pre-Test Pitot Leak Check: "H_2O
Post-Test Pitot Leak Check: "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.17
Static Pressure:
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: Presque Isle

Date: 6/20/07
Test Location: Stack 9
Test Method: Ontario Hydro

Test Number: 8
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.441 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	x.417 Meter Rate, Cubic Feet/ Min.	x 10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1540	1.9	.837	261.535	1.37	.574	5.747		340	87	87	4	296	327	68
2	1550	1.8	.794	267.282	1.34	.559	5.595	267.282	340	91	87	4	298	328	59
3	1600	1.8	.794	273.011	1.34	.559	5.595	272.877	339	92	87	4	275	325	56
4	1610	1.8	.794	278.976	1.34	.559	5.595	278.472	340	94	89	4	309	320	59
5	1620	1.8	.794	284.067	1.34	.559	5.595	284.067	341	92	89	4	279	324	57
6	1630	1.9	.837	289.662	1.37	.574	5.747	289.662	340	93	89	4	280	311	60
7	1640	1.7	.749	295.409	1.30	.542	5.421	295.409	340	93	89	4	305	315	62
8	1650	1.8	.794	300.83	1.34	.559	5.595	300.83	341	93	89	4	303	323	62
9	1700	1.9	.837	306.425	1.37	.574	5.747	306.425	341	92	89	4	303	325	62
10	1710	1.8	.794	312.310	1.34	.559	5.595	312.172	341	93	89	4	296	328	52
11	1720	1.8	.794	318.011	1.34	.559	5.595	317.767	341	92	89	4	303	326	51
12	1730	1.8	.794	323.362	1.34	.559	5.595	323.362	342	92	89	4	292	329	53
	1740			328.957				328.957							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 9
Date: 6/21/07
Project Number:
Test Location: Unit 9 Stack
Client Name: ADA
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: Hugh
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: MP
Meter ID: CMR
Meter Y Value: 1.000
Pitot ID: D45
Pitot Coefficient: .84
Probe Length: 4
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Owen
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure: -1.1
CO_2 %: 13
O_2 %: 6.6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: Presque Isle

Date: 6/21/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 9
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.445 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.421 Meter Rate, Cubic Feet/ Min.	x10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	720	1.7	.757	29.417	1.30	.549	5.489		333	81	81	4	289	278	68
2	730	1.8	.801	34.91	1.34	.564	5.648	34.91	334	85	85	3	295	296	53
3	740	1.7	.757	40.56	1.30	.549	5.489	40.56	334	85	82	3	296	305	51
4	750	1.7	.757	46.05	1.30	.549	5.489	46.05	334	87	83	4	297	312	52
5	800	1.7	.757	51.53	1.30	.549	5.489	51.54	335	87	83	4	296	317	53
6	810	1.7	.757	57.29	1.30	.549	5.489	57.03	336	87	83	4	296	321	56
7	820	1.7	.757	62.71	1.30	.549	5.489	62.51	337	87	84	4	297	323	56
8	830	1.8	.801	68.01	1.34	.564	5.648	69.00	337	88	84	4	302	325	57
9	840	1.7	.757	74.90	1.30	.549	5.489	73.65	337	88	84	4	301	325	54
10	850	1.8	.801	78.41	1.34	.564	5.648	79.14	336	89	85	3	300	326	56
11	900	1.6	.712	84.21	1.26	.533	5.325	84.79	336	88	85	4	301	326	55
12	910	1.7	.757	89.55	1.30	.549	5.489	90.12	336	88	85	4	303	328	58
	920			95.60				95.60							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 10
Date: 6/21/07
Project Number:
Test Location: Unit 9 Stack
Client Name: ADA
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7
Port Size: 6

Meter and Probe Data

Operator: MP
Meter ID: CM8
Meter Y Value: 1.000
Pitot ID: 045
Pitot Coefficient: .84
Probe Length: 4'
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Owen
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure:
CO_2 %: 13
O_2 %: 6.6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: Presque Isle

Date: 6/21/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 10
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.441 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.417 Meter Rate, Cubic Feet/ Min.	X10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	950	1.7	.749	95.709	1.30	.542	5.421		335	82	82	4	305	329	68
2	1000	1.7	.749	101.91	1.30	.542	5.421	101.26	334	83	81	3	305	330	50
3	1010	1.6	.705	106.42	1.26	.527	5.275	106.68	334	85	82	3	313	331	51
4	1020	1.7	.749	111.64	1.30	.542	5.421	111.95	334	86	82	3	305	333	51
5	1030	1.7	.749	116.41	1.30	.542	5.421	117.38	335	87	83	4	311	333	52
6	1040	1.8	.793	121.92	1.34	.559	5.595	122.80	334	87	83	4	303	333	54
7	1050	1.7	.749	127.91	1.30	.542	5.421	128.39	333	87	84	4	311	334	55
8	1100	1.6	.705	132.41	1.26	.527	5.275	133.82	332	87	84	4	311	333	57
9	1110	1.6	.705	139.09	1.26	.527	5.275	139.09	332	84	83	4	303	330	58
10	1120	1.6	.705	145.31	1.26	.527	5.275	144.37	331	83	81	4	303	332	59
11	1130	1.7	.749	149.64	1.30	.542	5.421	149.64	331	81	80	3	303	332	65
12	1140	1.6	.705	154.61	1.26	.527	5.275	155.06	331	82	79	3	297	334	62
	1150			160.33				160.33							

U-169

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 11
Test Location: Unit 9 Stack
Duct Shape: Circular or Rectangular
Source Condition: High
Port Type:

Date: 6/21/07
Client Name: ADA
Length: _____ Width: _____ or
Test Method: Ontario Hydro
Port Length: 7

Project Number:
Plant Name: Presque Isle
Diameter:
Flue Area:
Port Size: 6

Meter and Probe Data

Operator: MD
Pitot ID: 045
Probe Liner: Glass
Filter Number/Weight:
Pre-Test Nozzle Leak Check: @ "Hg
Pre-Test Pitot Leak Check: "H_2O

Meter ID: CM8
Pitot Coefficient: .84
Nozzle Diameter: .177
Thimble Number/Weight:
Post-Test Nozzle Leak Check: @ "Hg
Post-Test Pitot Leak Check: "H_2O

Meter Y Value: 1.000
Probe Length: 4'
Train Type: Anderson Owen

Traverse Data

Ports Sampled: 1
Total Points: 1

Points/Port: 1
Total Test Time: 120

Min./Point: 10
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
CO_2 %:
Initial Imp. Volume or Weight:
Initial Silica Weight:

Static Pressure:
O_2 %:
Final Imp. Volume or Weight:
Final Silica Weight:

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain:
Silica Weight Gain:

Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: Presque Isle

Date: 6/21/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 11
Operator: MP
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.441 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.417 Meter Rate, Cubic Feet/ Min.	×10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1220	1.5	.662	162.091	1.22	.511	5.107		332	81	81	3	319	336	68
2	1230	1.5	.662	167.19	1.22	.511	5.107	167.19	332	85	81	3	312	333	55
3	1240	1.6	.706	172.31	1.26	.527	5.275	172.31	332	87	82	3	304	334	54
4	1250	1.7	.749	177.88	1.30	.543	5.437	177.88	333	88	83	3	292	327	55
5	1300	1.6	.706	183.01	1.26	.527	5.437	183.02	333	88	84	3	294	325	54
6	1310	1.7	.749	188.71	1.30	.543	5.437	188.46	333	89	85	3	286	326	57
7	1320	1.7	.749	193.31	1.30	.543	5.437	193.89	334	89	85	3	282	322	56
8	1330	1.7	.749	198.61	1.30	.543	5.437	199.23	334	90	85	4	269	320	58
9	1340	1.5	.662	205.16	1.22	.511	5.107	204.77	334	90	85	4	257	312	57
10	1350	1.7	.749	209.52	1.30	.543	5.437	209.88	334	85	80	3	258	309	50
11	1400	1.7	.749	215.02	1.30	.543	5.437	215.31	335	89	86	4	241	301	47
12	1410	1.7	.749	220.52	1.30	.543	5.437	220.75	335	91	86	4	250	298	48
	1420			226.188				226.188							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 12
Date: 6/21/07
Project Number:
Test Location: Unit 9 Stack
Client Name: ADA
Plant Name: Presque Isle
Duct Shape: Circular or Rectangular
Length: _____ Width: _____ or
Diameter:
Source Condition: High
Test Method: Ontario Hydro
Flue Area:
Port Type:
Port Length: 7 0
Port Size: 6

Meter and Probe Data

Operator: MP
Meter ID: CM8
Meter Y Value: 1.000
Pitot ID: 045
Pitot Coefficient: .84
Probe Length: 4'
Probe Liner: Glass
Nozzle Diameter: .172
Train Type: Anderson Owen
Filter Number/Weight:
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: _____ @ _____ "Hg
Post-Test Nozzle Leak Check: _____ @ _____ "Hg
Pre-Test Pitot Leak Check: _____ "H_2O
Post-Test Pitot Leak Check: _____ "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 10
Total Points: 1
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure:
CO_2 %:
O_2 %:
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight:
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:
Client: ADA
Plant: Presque Isle

Date: 6/21/07
Test Location: Unit 9 Stack
Test Method: Ontario Hydro

Test Number: 12
Operator: MD
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	.441 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.412 Meter Rate, Cubic Feet/ Min.	x10 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1450	1.6	.705	226.320	1.26	.527	5.275		334	85	85	4	266	307	66
2	1500	1.7	.749	231.59	1.30	.543	5.437	231.59	334	88	85	3	281	310	61
3	1510	1.7	.749	237.03	1.30	.543	5.437	237.03	333	89	85	4	284	316	48
4	1520	1.7	.749	242.47	1.30	.543	5.437	242.47	333	89	85	4	269	315	44
5	1530	1.7	.749	247.68	1.30	.543	5.437	247.91	333	89	85	4	274	312	44
6	1540	1.6	.705	253.16	1.26	.527	5.275	253.34	333	88	85	3	265	311	46
7	1550	1.6	.705	258.82	1.26	.527	5.275	258.62	332	88	84	4	278	307	46
8	1600	1.7	.749	264.44	1.30	.543	5.437	263.89	332	87	83	3	272	312	48
9	1610	1.8	.794	269.44	1.34	.552	5.527	269.33	332	87	83	3	272	311	50
10	1620	1.7	.749	275.59	1.30	.543	5.437	274.86	332	86	83	3	286	318	51
11	1630	1.7	.749	280.01	1.30	.543	5.437	280.29	332	84	82	3	291	324	54
12	1640	1.6	.705	285.21	1.26	.527	5.275	285.73	332	85	82	4	293	329	54
	1650			291.01				291.01							

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies / Unit 7 Test Location:

Test ID: 1 Train A Carbon Trap ID: OL 10901

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/26/0830 Leak Check Pass/Fail Test End (Date/Time) 6/26/1130 Leak Check Pass/Fail

6/26 0830 36 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	0900		36	900		27.763	
	0930		37	900		55.431	
	1000		37	900		83.109	
	1030		37	900		109.408	
	1100		38	900		136.352	
	1130		38	900		160.250	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 1 Train B Carbon Trap ID: OL 10938

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/26/0830 Leak Check Pass/Fail Test End (Date/Time) 6/26/1130 Leak Check Pass/Fail

6/26 0830 37 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	0900		37	900		27.554	
	0930		38	900		55.774	
	1000		38	900		83.232	
	1030		38	900		110.126	
	1100		39	900		136.467	
	1130		39	900		162.338	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 2 Test Location: _____

Test ID: 2 Train A Carbon Trap ID: OL 10949

Spiked At: _____ QA/QC Signature _____

Sampled By: A. Sosca Sampling Console Ser# 1

Test Start (Date/Time): 6/06 1150 Leak Check Pass/Fail _____ Test End (Date/Time) 1450 Leak Check Pass/Fail _____

6/06 1150 38 900 0.000 1

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1200		38	900		25.992	
	1250		38	900		53.873	
	1300		39	900		78.654	
	1350		40	900		115.543	
	1450		40	900		135.941	
	1450		40	900		160.533	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location: _____

Test ID: 2 Train B Carbon Trap ID: OL 10921

Spiked At: _____ QA/QC Signature _____

Sampled By: A. Sorce Sampling Console Ser# 4

Test Start (Date/Time): 6/26/1150 Leak Check (Pass/Fail) Test End (Date/Time) 1450 Leak Check Pass/Fail

6/26 1150 39 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1220		39	900		27.168	
	1250		39	900		54.909	
	1320		40	900		79.983	
	1350		41	900		116.709	
	1420		41	900		134.666	
	1450		41	900		161.102	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 3/ Train A Carbon Trap ID: OL 10944

Spiked At: QA/QC Signature

Sampled By: A. Sure Sampling Console Ser# 1

Test Start (Date/Time): 4/26/ 1500 Leak Check Pass/Fail Test End (Date/Time) 1800 Leak Check Pass/Fail

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1500		40	900		0.000	
	1530		40	900		25.663	
	1600		41	900		52.201	
	1630		41	900		79.096	
	1700		42	900		104.283	
	1730		42	900		132.763	
	1800		43			159.770	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 3 Train B Carbon Trap ID: OL 10905

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 4

Test Start (Date/Time): 9/26/1500 Leak Check Pass/Fail Test End (Date/Time) 1700 Leak Check Pass/Fail

1500 41 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1530		41	900		24.022	
	1600		42	900		50.198	
	1630		42	900		76.662	
	1700		43	900		102.843	
	1730		43	900		129.341	
	1800		44	900		155.621	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 4 Train A Carbon Trap ID: OL 10902

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 4

Test Start (Date/Time): 6/27/0710 Leak Check Pass/Fail Test End (Date/Time) 6/27/1010 Leak Check Pass/Fail

6/27 0710 35 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	0740		35	800		24.532	
	0810		35	800		48.421	
	0840		35	800		72.251	
	0910		36	800		96.201	
	0940		36	800		120.115	
	1010		36	800		143.884	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location: _____

Test ID: 4 Train B Carbon Trap ID: OL 10913

Spiked At: _____ QA/QC Signature _____

Sampled By: A. Sorie Sampling Console Ser# 1

Test Start (Date/Time): 6/27/0710 Leak Check Pass/Fail _____ Test End (Date/Time) 6/27/1010 Leak Check Pass/Fail _____

6/27 0710 3.5 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	0740		36	900		28.360	
	0810		36	900		56.168	
	0840		36	900		83.875	
	0910		37	900		111.468	
	0940		37	900		139.045	
	1010		37	900		166.584	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 2 Test Location:

Test ID: 5 Train A Carbon Trap ID: OL 10936

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/27/1030 Leak Check (Pass/Fail) Test End (Date/Time) 6/27/1330 Leak Check Pass/Fail

6/27 1030 36 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1100		36	800		23.615	
	1130		36	800		47.321	
	1200		35	800		70.787	
	1230		34	800		94.124	
	1300		33	800		118.392	
	1330		32	800		140.508	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 5 Train B Carbon Trap ID: OL 10915

Spiked At: QA/QC Signature

Sampled By: A. Soree Sampling Console Ser# 1

Test Start (Date/Time): 6/27 / 1030 Leak Check Pass/Fail Test End (Date/Time) 6/27 / 1330 Leak Check Pass/Fail

6/27 1030 3.7 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1100		37	900		26.722	
	1130		37	900		53.445	
	1200		36	900		80.599	
	1230		35	900		107.808	
	1300		34	900		134.621	
	1330		33	900		161.615	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR)

Plant/Source: WE Energies Unit 7 Test Location: _____

Test ID: 6 Train B Carbon Trap ID: OL003083

Spiked At: 80 ng QA/QC Signature _____

Sampled By: A. Sarle Sampling Console Ser# 1

Test Start (Date/Time): 6/27/1350 Leak Check Pass/Fail Test End (Date/Time) 6/27/1650 Leak Check Pass/Fail

6/27 1350 32 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1420		32	900		25.673	
	1450		32	900		52.021	
	1520		31	850		75.864	
	1550		31	800		100.539	
	1620		30	800		126.378	
	1650		30	800		149.086	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR)

Plant/Source: WE Energies Unit 7 Test Location: _____

Test ID: 6 Train A Carbon Trap ID: OL 10904

Spiked At: _____ QA/QC Signature _____

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/27/1350 Leak Check Pass/Fail Test End (Date/Time) 6/26/1850 Leak Check Pass/Fail

6/27 1350 3.2 900 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1420		32	900		25.493	
	1450		32	900		49.312	
	1520		31	850		74.031	
	1550		30	800		99.683	
	1620		30	800		125.427	
	1650		29	800		148.140	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR)

Plant/Source: WE Energies Unit 7 Test Location: _____

Test ID: 7 Train A Carbon Trap ID: OL 10912

Spiked At: _____ QA/QC Signature _____

Sampled By: A. Sorce Sampling Console Ser# 4

Test Start (Date/Time): 6/27/1710 Leak Check (Pass/Fail) Test End (Date/Time) 6/27/2010 Leak Check Pass/Fail

6/27 1710 30 700 0.090

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1740		39	700		21.923	
	1810		30	799		42.217	
	1840		30	700		63.783	
	1910		31	700		84.645	
	1940		31	700		105.232	
	2010		31	700		124.154	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR)

Plant/Source: WE Energies Unit 7 Test Location: _____

Test ID: 7 Train B Carbon Trap ID: OL001531

Spiked At: 80 ng QA/QC Signature _____

Sampled By: A. Sorce Sampling Console Ser# 2

Test Start (Date/Time): 6/27/1710 Leak Check Pass/Fail _____ Test End (Date/Time) 6/27/2010 Leak Check Pass/Fail _____

6/27 1710 31 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1740		31	800		24.421	
	1810		31	800		50.758	
	1840		31	800		75.069	
	1910		32	800		100.832	
	1940		32	800		124.756	
	2010		32			147.339	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR)

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 8 Train A Carbon Trap ID: OL 10968

Spiked At: QA/QC Signature

Sampled By: A. Sorie Sampling Console Ser# 1

Test Start (Date/Time): 6/28 / 0700 Leak Check Pass/Fail Test End (Date/Time) 6/28 / 1000 Leak Check Pass/Fail

6/28 0700 21 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	0730		21	800		24.198	
	0800		21	800		48.713	
	0830		21	800		72.683	
	0900		22	800		96.409	
	0930		22	800		119.486	
	1000		22	800		144.095	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR)

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 8 Train B Carbon Trap ID: OL003092

Spiked At: 80 ng QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/28/0700 Leak Check Pass/Fail Test End (Date/Time) 6/28/1000 Leak Check Pass/Fail

6/28 0700 22 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	0730		22	800		24.286	
	0800		22	800		48.245	
	0830		22	800		72.697	
	0900		23	800		96.786	
	0930		23	800		120.723	
	1000		23	800		144.360	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train A

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 9 Train B Carbon Trap ID: OL 10939

Spiked At: QA/QC Signature

Sampled By: A. Sorce Sampling Console Ser# 1

Test Start (Date/Time): 6/26/1030 Leak Check (Pass/Fail) Test End (Date/Time) 6/26/1330 Leak Check Pass/Fail

6/26 1030 21 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1100		22	800		23.621	
	1130		22	800		45.835	
	1200		22	800		69.749	
	1230		22	800		93.591	
	1300		22	800		116.194	
	1330		22	800		139.412	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS

Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Unit 7 Test Location:

Test ID: 9 Train B Carbon Trap ID: OL 10958

Spiked At: QA/QC Signature

Sampled By: A. Sarce Sampling Console Ser# 1

Test Start (Date/Time): 6/26/1030 Leak Check Pass/Fail Test End (Date/Time) 6/26/1330 Leak Check Pass/Fail

6/06 1030 22 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1100		23	800		24.201	
	1130		23	800		48.641	
	1200		23	800		72.922	
	1230		23	800		96.465	
	1300		23	800		120.505	
	1330		23	800		144.669	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR)

Plant/Source: We Energies Test Location:

Test ID: 10 Train A Carbon Trap ID: OL 10940

Spiked At: QA/QC Signature

Sampled By: RS Sampling Console Ser#

Test Start (Date/Time): 6/28/1359 Leak Check (Pass/Fail) Test End (Date/Time) 6/28/1650 Leak Check Pass/Fail

6/28 1350 22 800 0.000

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
6-28	1425		22	800		23.856	
	1455		22	800		47.936	
	1525		22	800		71.315	
	1555		22	800		95.277	
	1625		22	800		119.568	
	1655		22	800		141.037	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us at 330-405-0837
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

APPENDIX K (PART 75 CAMR) Train B

Plant/Source: WE Energies Test Location: _____

Test ID: 10 Train B Carbon Trap ID: OL 10908

Spiked At: _____ QA/QC Signature _____

Sampled By: RS Sampling Console Ser# 1

Test Start (Date/Time): _____ Leak Check Pass/Fail _____ Test End (Date/Time) _____ Leak Check Pass/Fail _____

Date	Time	DUCT Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
	1425		23	800		24.145	
	1455		23	800		48.765	
	1525		23	450		63.609	
	1555		23	450		77.464	
	1625		23	450		90.952	
	1655		23	450		102.910	
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us at 330-405-0837

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Stratification Test Results Summary
WE Energies
Presque Isle
Unit 7
6/14/07

	Point No.	Time	SO_2 ppm	SO_2 ppm< 10% Pass/Fail	SO_2 ppm< 5% Pass/Fail
Port 1	1	7:01	190.8	Pass	Pass
	2	7:05	196.3	Pass	Pass
	3	7:09	196.8	Pass	Pass
Port 2	1	7:13	191.5	Pass	Pass
	2	7:17	187.3	Pass	Pass
	3	7:21	177.8	Pass	Fail
Port 3	1	7:31	188.6	Pass	Pass
	2	7:35	193.7	Pass	Pass
	3	7:39	195.9	Pass	Pass
Port 4	1	7:43	202.7	Pass	Fail
	2	7:47	193.6	Pass	Pass
	3	7:51	177.9	Pass	Fail
		Average	191.1		

Appendix V. Platt – Particulate Halogens Metals 2008

Diagnostic Particulate, Halogens, and Trace Metals Test Report

---

Performed for

ADA-ES, Inc.

At the

We Energies
Presque Isle Power Plant
Unit 8 Toxecon Inlet, Common Toxecon Inlet,
Toxecon Outlet, and Flue 8 Stack
Marquette, Michigan
November 4 and 5, 2008

Platt Environmental Services, Inc.

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Diagnostic Particulate, Halogens, and Trace Metals Test Report

---

Performed for

ADA-ES, Inc.

At the

We Energies
Presque Isle Power Plant
Unit 8 Toxecon Inlet, Common Toxecon Inlet,
Toxecon Outlet, and Flue 8 Stack
Marquette, Michigan
November 4 and 5, 2008

Prepared By

Platt Environmental Services, Inc.

Report No. M084501B

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 EXECUTIVE SUMMARY 2

3.0 TEST METHODOLOGY 3
- Method 1 Sample and Velocity Traverse Determination 4
- Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination 4
- Method 17 Particulate Determination 4
- Method 26A Hydrogen Chloride (HCl) Determination 5
- Method 29 Trace Metals Determination 5

4.0 TEST RESULTS SUMMARIES 6

5.0 CONCLUSION AND CERTIFICATION 13

APPENDIX
- Test Section Diagrams 15
- Sample Train Diagrams 19
- Calculation Nomenclature and Formulas 24
- Laboratory Sample Analysis 33
- Reference Method Test Data (Computerized Sheets) 59
- Calibration Data 86
- Field Data Sheets 103

1.0 Introduction

PLATT ENVIRONMENTAL SERVICES, INC. (PES) conducted a diagnostic particulate, halogens, and trace metals test program for ADA-ES, Inc. (ADA) on the test locations summarized below, in Table 1 at the We Energies - Presque Isle Power Plant in Marquette, Michigan on November 4 and 5, 2008. This report summarizes the results of the test program and test methods used.

Table 1

Test Overview

Test Locations	Test Dates	Test Parameter
Unit 8 Toxecon Inlet	November 4, 2008	Halogens (Method 26A)
Common Toxecon Inlet	November 4 and 5, 2008	Particulate (Method 17), Halogens (Method 26A), and Trace Metals (Method 29)
Toxecon Outlet	November 4, 2008	Particulate (Method 17) and Halogens (Method 26A)
Flue 8 Stack	November 5, 2008	Trace Metals (Method 29)

The identification of individuals associated with the test program is summarized below, in Table 2.

Table 2

Contact Information

Location	Address	Contact
Test Facility	We Energies Presque Isle Power Plant Marquette, Michigan	Jon Konings (414) 221-2430 (phone) Jon.Konings@we-energies.com
Test Coordinator	ADA-ES, Inc. 8100 SouthPark Way, Unit B Littleton, Colorado 80120-4525	Ms. Robin Stewart Manager of Contract R&D (303) 339-8863 robins@adaes.com
Testing Company Representative	Platt Environmental Services, Inc. 371 Balm Court Wood Dale, Illinois 60191	Eric L. Ehlers Senior Project Manager (630) 521-9400 (phone) (630) 521-9494 (fax) eehlers@plattenv.com

The test program was conducted by Ms. J. Macchione, and E. Osthus and Messrs. R. Sollars, M. Platt, S. Dyra, J. Howe, S. McGough, T. Mei, A. Calix, and E. Ehlers of PES.

2.0 Executive Summary

Selected results of the test program are summarized below, in Table 3 through 5. A complete summary of emission test results follows the narrative portion of this report.

Table 3

Particulate Test Results

Test Location	Parameter	mg/dscm	lbs/hr	lbs/MMBtu
Common Toxecon Inlet	Particulate	137.74	413.76	0.1157
Toxecon Outlet	Particulate	7.686	17.04	0.0066

Table 4

Halogen Test Results

Test Location	Parameter	ppm	lbs/hr	lbs/MMBtu
Unit 8 Toxecon Inlet	HCl	1.38	1.92	0.0172
	Cl_2	0.03	0.08	0.0007
	HBr*	0.01	0.03	0.0002
	Br_2*	0.005	0.03	0.0002
	HF	1.22	0.93	0.0083
Common Toxecon Inlet	HCl	1.04	4.72	0.0133
	Cl_2	0.03	0.28	0.0008
	HBr	0.16	1.60	0.0044
	Br_2*	0.005	0.10	0.0003
	HF	0.74	1.81	0.0051
Toxecon Outlet	HCl	0.96	3.24	0.0125
	Cl_2	0.02	0.15	0.0006
	HBr	0.08	0.62	0.0024
	Br_2*	0.01	0.08	0.0003
	HF	1.08	2.01	0.0077

*Non detected – Detection limits were used in the emission calculations

Table 5

Trace Metal Test Results

Test Location	Parameter	ppb	lbs/hr	lbs/TBtu
Common Toxecon Inlet	Arsenic	1.07	0.0093	28.31
	Selenium	5.27	0.0473	146.32
	Manganese	16.63	0.1063	320.97
	Beryllium	2.03	0.0020	6.46
	Cadmium	0.23	0.0027	8.78
	Chromium	5.57	0.0330	102.15
	Lead	0.40	0.0100	29.42
	Nickel	4.23	0.0283	87.33
Flue 8 Stack	Arsenic*	1.00	0.0030	26.55
	Selenium	3.73	0.0103	106.87
	Manganese*	0.80	0.0020	15.93
	Beryllium*	1.67	0.0005	5.31
	Cadmium*	0.01	0.0003	2.66
	Chromium	1.50	0.0027	28.19
	Lead*	0.40	0.0030	26.55
	Nickel	1.50	0.0030	31.99

*Non detected – Detection limits were used in the emission calculations

Method 26A testing performed at the Unit 8 Toxecon Inlet was sampled from the one available test port. Method 17/26A and Method 29 testing at the Common Toxecon Inlet was performed with a 10 foot glass lined probe, sampling the top half of the duct only.

Lead results for test run one are not included in the test average due to an apparent contamination of lead in the probe wash. Analytical results that were non detects used the detection limits in the emission calculations.

3.0 Test Methodology

Emissions testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A. Schematics of the sampling trains used and copies of field data sheets for each test run are included in the Appendix.

The following methodologies were used during the test program:

Method 1 Sample and Velocity Traverse Determination

Test measurement points were selected in accordance with Method 1. The characteristics of each measurement location are summarized below, in Table 6.

Table 6

Sample Point Selection

Location	Upstream Diameters	Downstream Diameters	Test Method	Number of Sampling Points
Unit 8 Toxecon Inlet	<0.5	<2.0	M26A	1
Toxecon Common Inlet	<0.5	<2.0	M17, M26A, M29	12
Toxecon Outlet	<0.5	<2.0	M17, M26A	24
Flue 8 Stack	>2.0	>8.0	M29	12

Method 2 Volumetric Flow Rate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate. S-type pitot tubes, differential pressure gauges, thermocouple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix.

Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

Stack gas molecular weight was determined in accordance with Method 3A. A Servomex analyzer was used to determine stack gas oxygen and carbon dioxide content and, by difference, nitrogen content. All of the equipment used was calibrated in accordance with the specifications of the Method.

Method 17 Particulate Determination

Stack gas particulate concentrations and emission rates were determined in accordance with Method 17, using a dry, pre-weighed ceramic thimble. An Environmental Supply, Inc. sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method. Particulate matter in the nozzle and gelman filter was recovered using an acetone rinse. The nozzle wash and gelman catch were analyzed by PES in accordance with the method.

Method 26A Halogen Determination

Stack gas hydrogen chloride concentrations and emission rates were determined in accordance with Method 26A. An Environmental Supply Company, Inc. sampling train was used to sample stack gas, in the manner specified in the Method. A multiple-point sample was extracted isokinetically from the gas stream and passed through dilute (0.1 N) sulfuric acid. The sample train consisted of a glass probe liner at the Unit 8 Toxecon Inlet and Common Toxecon Inlet, and a Teflon liner at the Toxecon Outlet and five impingers. The first two impingers contained the dilute sulfuric acid, the second two impingers contained a 0.1 N sodium hydroxide (NaOH) scrubber solution to remove any remaining halogens, and the fifth impinger contained silica gel to absorb any remaining moisture. A DI rinse was performed on each set of two impingers, and samples were stored in glass sample containers for transport. The dilute sulfuric acid samples were then analyzed for hydrogen chloride, hydrogen bromide, and hydrogen fluoride while the NaOH samples were analyzed for chloride and bromide by ion chromatography by TEI Analytical, Inc. of Niles, Illinois. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the appendix.

Method 29 Trace Metals Determination

Stack gas metals concentrations and emission rates were determined in accordance with Method 29. An Environmental Supply, Inc. sampling train was used to sample stack gas, in the manner specified in the Method. Analysis of the samples collected were conducted by TEI Analytical, Inc. of Niles, Illinois. Samples were analyzed for the following metals, using Inductively Coupled Argon Plasma emission spectroscopy (ICP): Arsenic, Beryllium, Cadmium, Chromium, Lead, Manganese, Nickel, and Selenium. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix.

4.0 Test Results Summaries

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Test Method: 17/26A

Source Condition	**Normal**	**Normal**	**Normal**	
Date	**11/4/08**	**11/4/08**	**11/4/08**	
Start Time	**8:35**	**11:55**	**14:05**	
End Time	**9:49**	**13:08**	**15:14**	
	Run 1	**Run 2**	**Run 3**	**Average**
Stack Conditions				
Average Gas Temperature, °F	345.7	349.5	353.4	349.5
Flue Gas Moisture, percent by volume	11.4%	12.0%	11.6%	11.7%
Average Flue Pressure, in. Hg	28.98	28.98	28.98	28.98
Gas Sample Volume, dscf	49.645	51.044	54.126	51.605
Average Gas Velocity, ft/sec	60.018	64.614	65.279	63.304
Gas Volumetric Flow Rate, acfm	1,351,666	1,455,173	1,470,152	1,425,664
Gas Volumetric Flow Rate, dscfm	759,923	809,237	817,072	795,411
Average %CO_2 by volume, dry basis	13.4	13.6	13.6	13.5
Average %O_2 by volume, dry basis	5.8	5.6	5.6	5.7
Isokinetic Variance	102.1	98.6	103.5	101.4
Filterable PM (Method 17)				
mg/dscm	91.337	122.873	199.000	137.737
mg/acm at stack conditions	119.716	158.220	254.571	177.502
grains/acf	0.0224	0.0299	0.0483	0.0335
grains/dscf	0.0399	0.0537	0.0869	0.0602
lb/hr	259.943	372.387	608.943	413.758
lb/mmBtu (Standard Fd Factor)	0.0775	0.1029	0.1666	0.1157

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Toxecon Outlet
Test Method: 17/26A

Source Condition	Normal	Normal	Normal	
Date	11/4/08	11/4/08	11/4/08	
Start Time	8:35	11:55	14:05	
End Time	9:59	13:07	15:14	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	341.1	347.0	351.9	346.7
Flue Gas Moisture, percent by volume	10.9%	12.5%	12.4%	11.9%
Average Flue Pressure, in. Hg	29.52	29.51	29.51	29.51
Gas Sample Volume, dscf	50.080	48.025	47.020	48.375
Average Gas Velocity, ft/sec	57.876	56.783	55.954	56.871
Gas Volumetric Flow Rate, acfm	1,062,597	1,042,542	1,027,308	1,044,149
Gas Volumetric Flow Rate, dscfm	615,774	588,786	577,356	593,972
Average %CO_2 by volume, dry basis	12.8	12.6	12.9	12.8
Average %O_2 by volume, dry basis	6.2	6.0	5.8	6.0
Isokinetic Variance	105.2	105.5	105.3	105.3
Filterable PM (Method 5)				
mg/dscm	5.148	12.427	5.483	7.686
mg/acm at stack conditions	7.005	16.319	7.108	10.144
grains/acf	0.0013	0.0031	0.0013	0.0019
grains/dscf	0.0022	0.0054	0.0024	0.0033
lb/hr	11.871	27.403	11.855	17.043
lb/mmBtu (Standard Fd Factor)	0.0045	0.0107	0.0047	0.0066

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Unit 8 Toxecon Inlet
Test Method: 26A

Source Condition	Normal	Normal	Normal	
Date	11/4/08	11/4/08	11/4/08	
Start Time	8:30	11:55	14:05	
End Time	9:30	12:55	15:05	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	341.3	336.9	334.7	337.6
Flue Gas Moisture, percent by volume	11.7%	14.0%	11.9%	12.5%
Average Flue Pressure, in. Hg	29.05	29.05	29.05	29.05
Gas Sample Volume, dscf	57.941	58.458	61.630	59.343
Average Gas Velocity, ft/sec	82.500	83.135	86.934	84.190
Gas Volumetric Flow Rate, acfm	428,620	431,921	451,660	437,400
Gas Volumetric Flow Rate, dscfm	242,078	238,883	256,816	245,926
Average %CO_2 by volume, dry basis	13.4	13.6	13.6	13.5
Average %O_2 by volume, dry basis	5.2	5.4	5.4	5.3
Isokinetic Variance	101.4	103.7	101.7	102.3
Hydrogen Chloride (HCl) Emissions				
ppm	1.51	1.31	1.31	1.38
ug/dscm	2285.61	1987.49	1982.60	2085.23
lb/hr	2.0720	1.7780	1.9070	1.9190
lb/mmBtu (Standard Fd Factor)	0.0187	0.0164	0.0164	0.0172
Hydrogen Bromide (HBr) Emissions				
ppm	0.01	0.01	0.01	0.01
ug/dscm	30.47	30.20	28.65	29.77
lb/hr	0.0280	0.0270	0.0280	0.0277
lb/mmBtu (Standard Fd Factor)	0.0002	0.0002	0.0002	0.0002
Hydrogen Fluoride (HF) Emissions				
ppm	1.43	1.11	1.12	1.22
ug/dscm	1188.52	924.27	934.00	1015.60
lb/hr	1.0780	0.8270	0.8980	0.9343
lb/mmBtu (Standard Fd Factor)	0.0097	0.0076	0.0077	0.0083
Chloride (Cl2) Emissions				
ppm	0.03	0.05	0.01	0.03
ug/dscm	97.52	138.94	28.65	88.37
lb/hr	0.0880	0.1240	0.0280	0.0800
lb/mmBtu (Standard Fd Factor)	0.0008	0.0011	0.0002	0.0007
Bromide (Br2) Emissions				
ppm	0.005	0.005	0.004	0.005
ug/dscm	30.47	30.20	28.65	29.77
lb/hr	0.0280	0.0270	0.0280	0.0277
lb/mmBtu (Standard Fd Factor)	0.0002	0.0002	0.0002	0.0002

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Test Method: 17/26A

Source Condition	Normal	Normal	Normal	
Date	11/4/08	11/4/08	11/4/08	
Start Time	8:35	11:55	14:05	
End Time	9:49	13:08	15:14	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	345.7	349.5	353.4	349.5
Flue Gas Moisture, percent by volume	11.4%	12.0%	11.6%	11.7%
Average Flue Pressure, in. Hg	28.98	28.98	28.98	28.98
Gas Sample Volume, dscf	49.645	51.044	54.126	51.605
Average Gas Velocity, ft/sec	60.018	64.614	65.279	63.304
Gas Volumetric Flow Rate, acfm	1,351,666	1,455,173	1,470,152	1,425,664
Gas Volumetric Flow Rate, dscfm	759,923	809,237	817,072	795,411
Average %CO_2 by volume, dry basis	13.4	13.6	13.6	13.5
Average %O_2 by volume, dry basis	5.8	5.6	5.6	5.7
Isokinetic Variance	102.1	98.6	103.5	101.4
Hydrogen Chloride (HCl) Emissions				
ppm	1.05	1.06	1.02	1.04
ug/dscm	1593.41	1605.09	1552.85	1583.78
lb/hr	4.5350	4.8650	4.7520	4.7173
lb/mmBtu (Standard Fd Factor)	0.0135	0.0134	0.0130	0.0133
Hydrogen Bromide (HBr) Emissions				
ppm	0.05	0.26	0.16	0.16
ug/dscm	156.50	878.65	548.06	527.74
lb/hr	0.4450	2.6630	1.6770	1.5950
lb/mmBtu (Standard Fd Factor)	0.0013	0.0074	0.0046	0.0044
Hydrogen Fluoride (HF) Emissions				
ppm	0.97	0.47	0.77	0.74
ug/dscm	803.82	387.44	639.41	610.22
lb/hr	2.2880	1.1740	1.9570	1.8063
lb/mmBtu (Standard Fd Factor)	0.0068	0.0032	0.0054	0.0051
Chloride (Cl2) Emissions				
ppm	0.04	0.04	0.01	0.03
ug/dscm	120.93	131.45	32.62	95.00
lb/hr	0.3440	0.3980	0.1000	0.2807
lb/mmBtu (Standard Fd Factor)	0.0010	0.0011	0.0003	0.0008
Bromide (Br2) Emissions				
ppm	0.005	0.005	0.005	0.005
ug/dscm	35.57	34.59	32.62	34.26
lb/hr	0.1010	0.1050	0.1000	0.1020
lb/mmBtu (Standard Fd Factor)	0.0003	0.0003	0.0003	0.0003

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Toxecon Outlet
Test Method: 17/26A

Source Condition	Normal	Normal	Normal	
Date	11/4/08	11/4/08	11/4/08	
Start Time	8:35	11:55	14:05	
End Time	9:59	13:07	15:14	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	341.1	347.0	351.9	346.7
Flue Gas Moisture, percent by volume	10.9%	12.5%	12.4%	11.9%
Average Flue Pressure, in. Hg	29.52	29.51	29.51	29.51
Gas Sample Volume, dscf	50.080	48.025	47.020	48.375
Average Gas Velocity, ft/sec	57.876	56.783	55.954	56.871
Gas Volumetric Flow Rate, acfm	1,062,597	1,042,542	1,027,308	1,044,149
Gas Volumetric Flow Rate, dscfm	615,774	588,786	577,356	593,972
Average %CO_2 by volume, dry basis	12.8	12.6	12.9	12.8
Average %O_2 by volume, dry basis	6.2	6.0	5.8	6.0
Isokinetic Variance	105.2	105.5	105.3	105.3
Hydrogen Chloride (HCl) Emissions				
ppm	1.00	0.89	0.99	0.96
ug/dscm	1516.10	1353.03	1494.61	1454.58
lb/hr	3.4970	2.9840	3.2320	3.2377
lb/mmBtu (Standard Fd Factor)	0.0132	0.0116	0.0127	0.0125
Hydrogen Bromide (HBr) Emissions				
ppm	0.08	0.09	0.08	0.08
ug/dscm	267.96	294.14	277.89	280.00
lb/hr	0.6180	0.6490	0.6010	0.6227
lb/mmBtu (Standard Fd Factor)	0.0023	0.0025	0.0024	0.0024
Hydrogen Fluoride (HF) Emissions				
ppm	1.07	1.29	0.89	1.08
ug/dscm	888.50	1073.60	743.55	901.88
lb/hr	2.0490	2.3680	1.6080	2.008
lb/mmBtu (Standard Fd Factor)	0.0077	0.0092	0.0063	0.0077
Chloride (Cl2) Emissions				
ppm	0.04	0.01	0.01	0.02
ug/dscm	126.93	36.77	37.55	67.08
lb/hr	0.2930	0.0810	0.0810	0.1517
lb/mmBtu (Standard Fd Factor)	0.0011	0.0003	0.0003	0.0006
Bromide (Br2) Emissions				
ppm	0.01	0.01	0.01	0.01
ug/dscm	35.26	36.77	37.55	36.53
lb/hr	0.0810	0.0810	0.0810	0.0810
lb/mmBtu (Standard Fd Factor)	0.0003	0.0003	0.0003	0.0003

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Test Method: 29

Source Condition	Normal	Normal	Normal	
Date	11/5/08	11/5/08	11/5/08	
Start Time	8:20	11:05	13:40	
End Time	10:35	13:18	15:52	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	338.8	335.5	340.2	338.2
Flue Gas Moisture, percent by volume	9.3%	6.0%	6.1%	7.1%
Average Flue Pressure, in. Hg	28.88	28.88	28.88	28.88
Gas Sample Volume, dscf	110.414	109.168	109.194	109.592
Average Gas Velocity, ft/sec	64.126	63.153	68.890	65.390
Gas Volumetric Flow Rate, acfm	1,229,028	1,210,371	1,320,322	1,253,240
Gas Volumetric Flow Rate, dscfm	711,619	729,018	789,528	743,388
Average %CO_2 by volume, dry basis	13.5	13.5	13.2	13.4
Average %O_2 by volume, dry basis	6.0	5.6	5.8	5.8
Isokinetic Variance	103.2	99.6	92.0	98.3
Arsenic (Ar) Emissions				
ppb	1.50	0.70	1.00	1.07
ug/dscm	4.64	2.10	3.23	3.32
lb/hr	0.0120	0.0060	0.0100	0.0093
lb/TBtu (Standard Fd Factor)	39.88	17.61	27.44	28.31
Selenium (Se)				
ppb	6.30	7.50	2.00	5.27
ug/dscm	20.53	24.78	6.47	17.26
lb/hr	0.0550	0.0680	0.0190	0.0473
lb/TBtu (Standard Fd Factor)	176.57	207.51	54.88	146.32
Manganese (Mn)				
ppb	8.70	23.70	17.50	16.63
ug/dscm	19.86	54.12	39.94	37.97
lb/hr	0.0530	0.1480	0.1180	0.1063
lb/TBtu (Standard Fd Factor)	170.79	453.21	338.91	320.97
Beryllium (Be)				
ppb	1.00	2.90	2.20	2.03
ug/dscm	0.38	1.10	0.81	0.76
lb/hr	0.0010	0.0030	0.0020	0.0020
lb/TBtu (Standard Fd Factor)	3.30	9.21	6.86	6.46
Cadmium (Cd)				
ppb	0.50	0.10	0.10	0.23
ug/dscm	2.43	0.32	0.32	1.02
lb/hr	0.0060	0.0010	0.0010	0.0027
lb/TBtu (Standard Fd Factor)	20.90	2.71	2.74	8.78
Chromium (Cr)				
ppb	6.30	7.30	3.10	5.57
ug/dscm	13.69	15.79	6.66	12.05
lb/hr	0.0360	0.0430	0.0200	0.0330
lb/TBtu (Standard Fd Factor)	117.71	132.20	56.53	102.15
Lead (Pb)				
ppb	17.10	0.50	0.30	0.40
ug/dscm	147.22	3.98	3.01	3.50
lb/hr	0.3920	0.0110	0.0090	0.0100
lb/TBtu (Standard Fd Factor)	1265.96	33.32	25.52	29.42
Nickel (Ni)				
ppb	4.00	5.20	3.50	4.23
ug/dscm	9.85	12.58	8.47	10.30
lb/hr	0.0260	0.0340	0.0250	0.0283
lb/TBtu (Standard Fd Factor)	84.71	105.38	71.90	87.33

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Flue 8 Stack
Test Method: 29

Source Condition	Normal	Normal	Normal	
Date	11/5/08	11/5/08	11/5/08	
Start Time	8:20	11:05	13:40	
End Time	10:30	13:13	15:47	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	331.4	331.5	334.3	332.4
Flue Gas Moisture, percent by volume	11.4%	11.4%	5.9%	9.6%
Average Flue Pressure, in. Hg	29.14	29.14	28.98	29.09
Gas Sample Volume, dscf	113.066	116.768	114.105	114.646
Average Gas Velocity, ft/sec	89.911	92.595	89.841	90.782
Gas Volumetric Flow Rate, acfm	382,387	393,798	382,087	386,091
Gas Volumetric Flow Rate, dscfm	220,216	226,686	231,601	226,168
Average %CO_2 by volume, dry basis	12.6	12.5	13.2	12.8
Average %O_2 by volume, dry basis	6.1	6.2	5.8	6.0
Isokinetic Variance	101.6	101.9	97.5	100.3
Arsenic (Ar) Emissions				
ppb	1.00	1.00	1.00	1.00
ug/dscm	3.12	3.02	3.09	3.08
lb/hr	0.0030	0.0030	0.0030	0.0030
lb/TBtu (Standard Fd Factor)	27.04	26.36	26.26	26.55
Selenium (Se)				
ppb	1.90	7.20	2.10	3.73
ug/dscm	6.25	23.74	7.03	12.34
lb/hr	0.0050	0.0200	0.0060	0.0103
lb/TBtu (Standard Fd Factor)	54.08	206.93	59.61	106.87
Manganese (Mn)				
ppb	0.80	0.80	0.80	0.80
ug/dscm	1.87	1.81	1.86	1.85
lb/hr	0.0020	0.0020	0.0020	0.0020
lb/TBtu (Standard Fd Factor)	16.22	15.82	15.76	15.93
Beryllium (Be)				
ppb	1.70	1.60	1.70	1.67
ug/dscm	0.62	0.60	0.62	0.61
lb/hr	0.0005	0.0005	0.0005	0.0005
lb/TBtu (Standard Fd Factor)	5.41	5.27	5.25	5.31
Cadmium (Cd)				
ppb	0.10	0.10	0.10	0.10
ug/dscm	0.31	0.30	0.31	0.31
lb/hr	0.0003	0.0003	0.0003	0.0003
lb/TBtu (Standard Fd Factor)	2.70	2.64	2.63	2.66
Chromium (Cr)				
ppb	1.70	1.70	1.10	1.50
ug/dscm	3.75	3.63	2.41	3.26
lb/hr	0.0030	0.0030	0.0020	0.0027
lb/TBtu (Standard Fd Factor)	32.45	31.63	20.48	28.19
Lead (Pb)				
ppb	0.40	0.40	0.40	0.40
ug/dscm	3.12	3.02	3.09	3.08
lb/hr	0.0030	0.0030	0.0030	0.0030
lb/TBtu (Standard Fd Factor)	27.04	26.36	26.26	26.55
Nickel (Ni)				
ppb	1.70	1.60	1.20	1.50
ug/dscm	4.22	3.87	3.03	3.71
lb/hr	0.0030	0.0030	0.0030	0.0030
lb/TBtu (Standard Fd Factor)	36.50	33.74	25.74	31.99

5.0 Conclusion and Certification

PLATT ENVIRONMENTAL SERVICES is pleased to have been of service to ADA-ES, Inc. If you have any questions regarding this test report, please do not hesitate to contact us at 630-521-9400.

CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

PLATT ENVIRONMENTAL SERVICES

_____ Project Manager

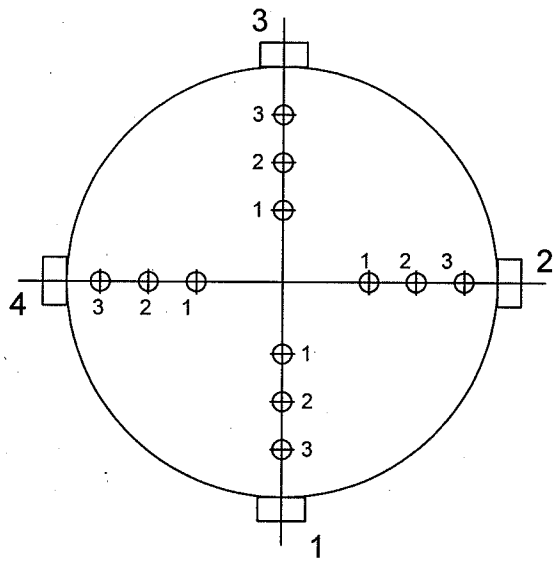
Eric L. Ehlers

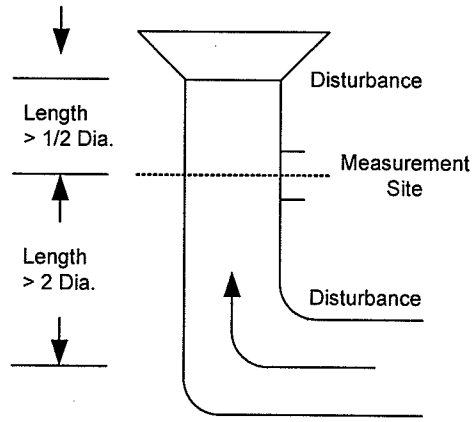
_____ Quality Assurance

Scott W. Banach

Appendix

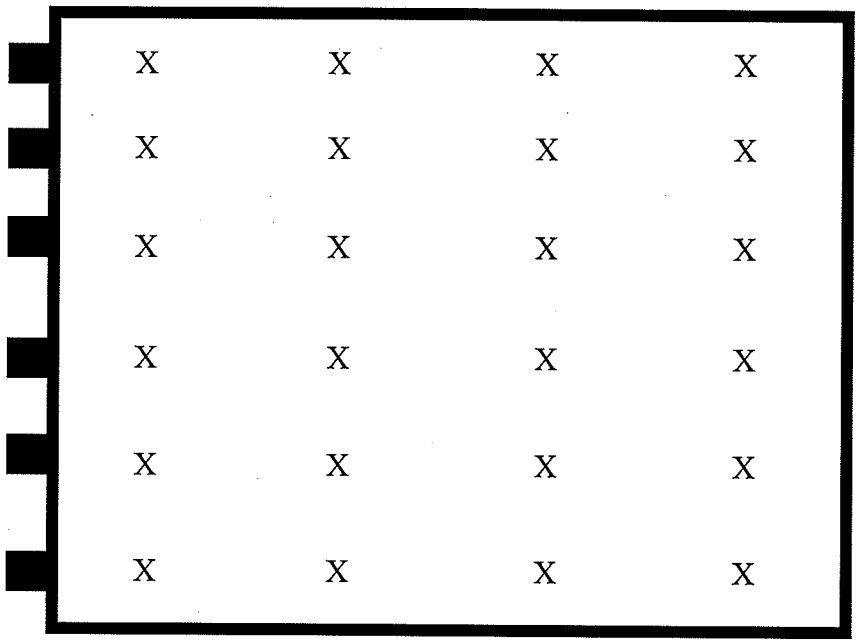
EQUAL AREA TRAVERSE FOR ROUND DUCTS





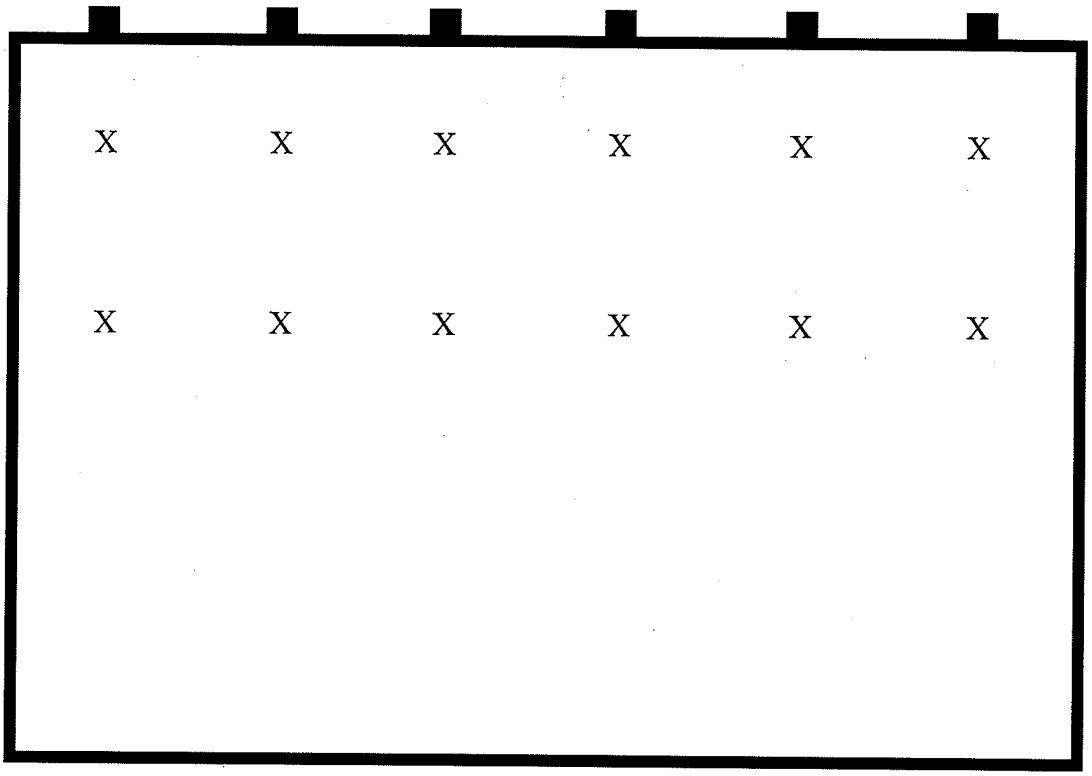
Job:	ADA – We Energies Presque Isle Power Plant
Date:	November 5, 2008
Unit No:	Flue 8
Test Location:	Stack
Duct Diameter:	9.5 Feet
Duct Area:	70.882 Square Feet
No. Points Across Diameter:	6
No. of Ports:	4
Port Length:	6 Inches

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



Job:	ADA-We Energies Presque Isle Power Plant
Date:	November 4, 2008
Test Location:	Toxecon Outlet
Duct Length:	17 Feet
Duct Width:	18 Feet
Duct Area:	306 Square Feet
Test Ports:	6
Test Points:	24

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



Job: ADA-We Energies Presque Isle Power Plant

Date: November 4 and 5, 2008

Test Location: Toxecon Inlet

Duct Length: 18.17 Feet

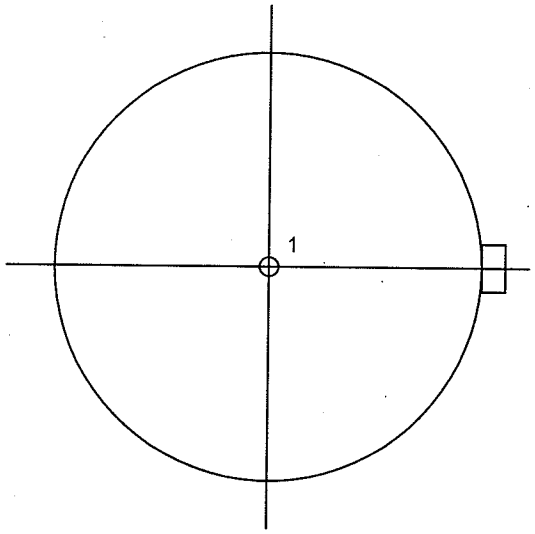
Duct Width: 17.58 Feet

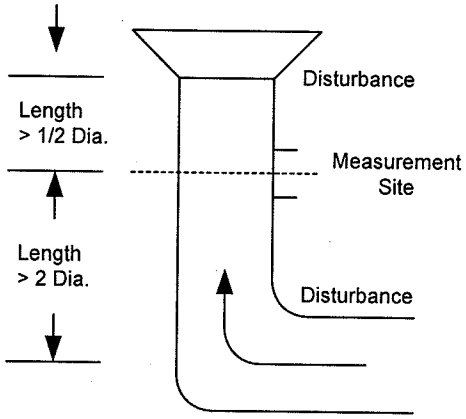
Duct Area: 319.429 Square Feet

Test Ports: 6

Test Points: 12

GASEOUS TRAVERSE FOR ROUND DUCTS





Job: ADA-We Energies Presque Isle Power Plant

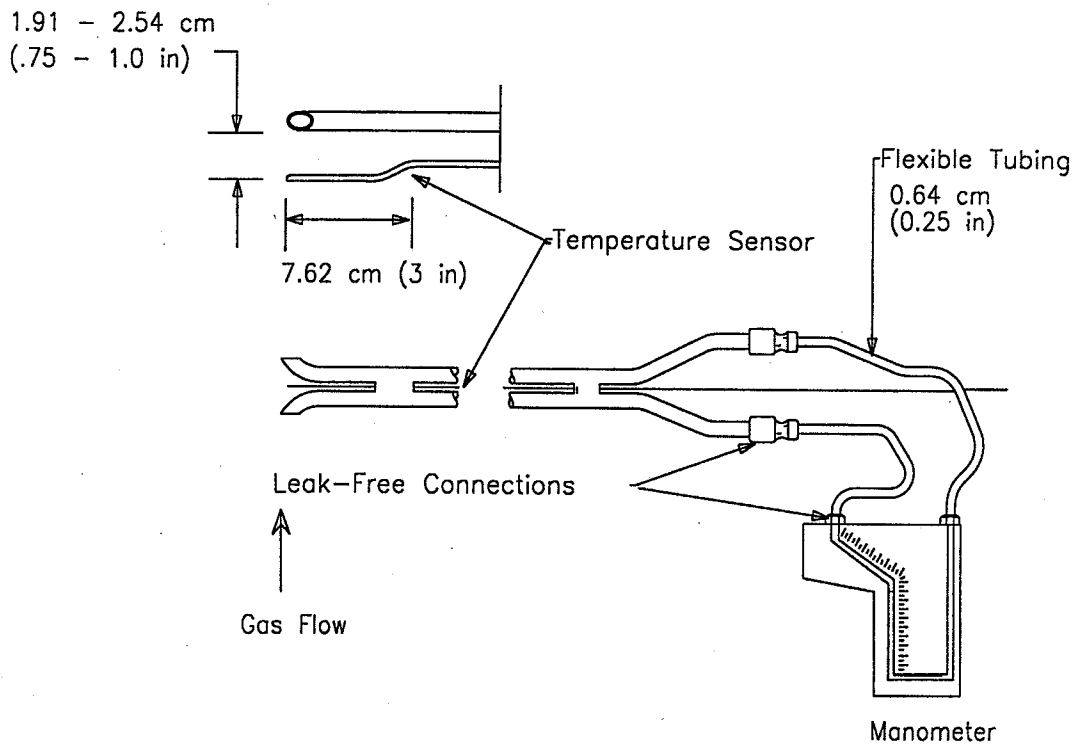
Date: November 4, 2008

Test Location: Unit 8 Toxecon Inlet

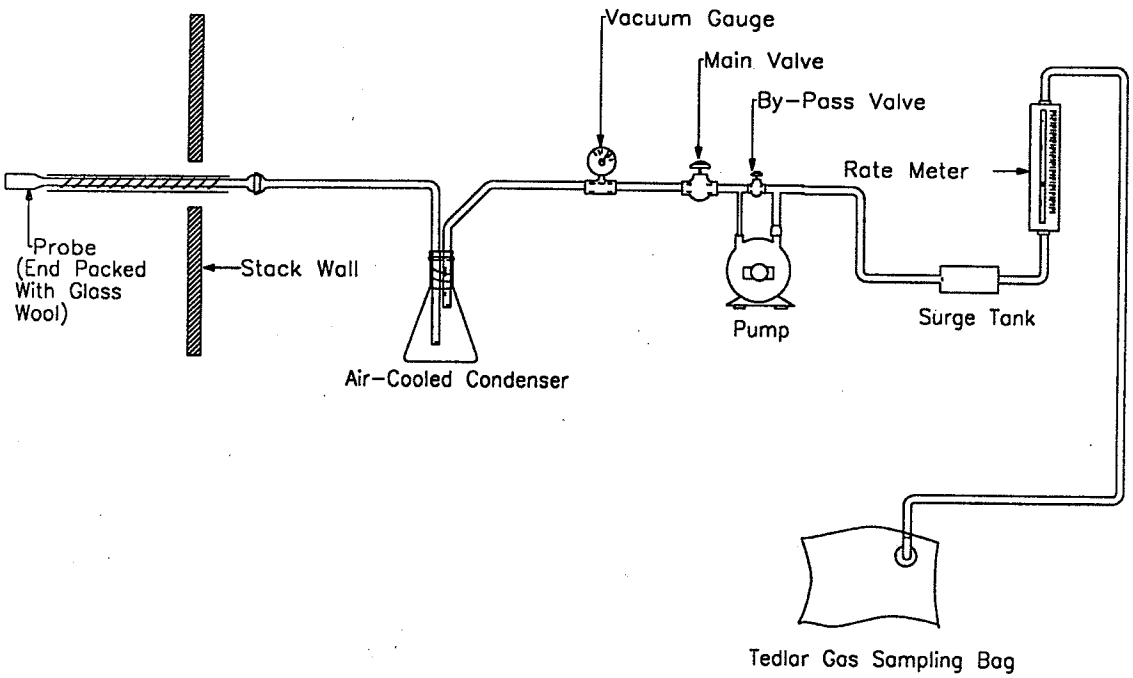
Test Ports: 1

Test Points: 1

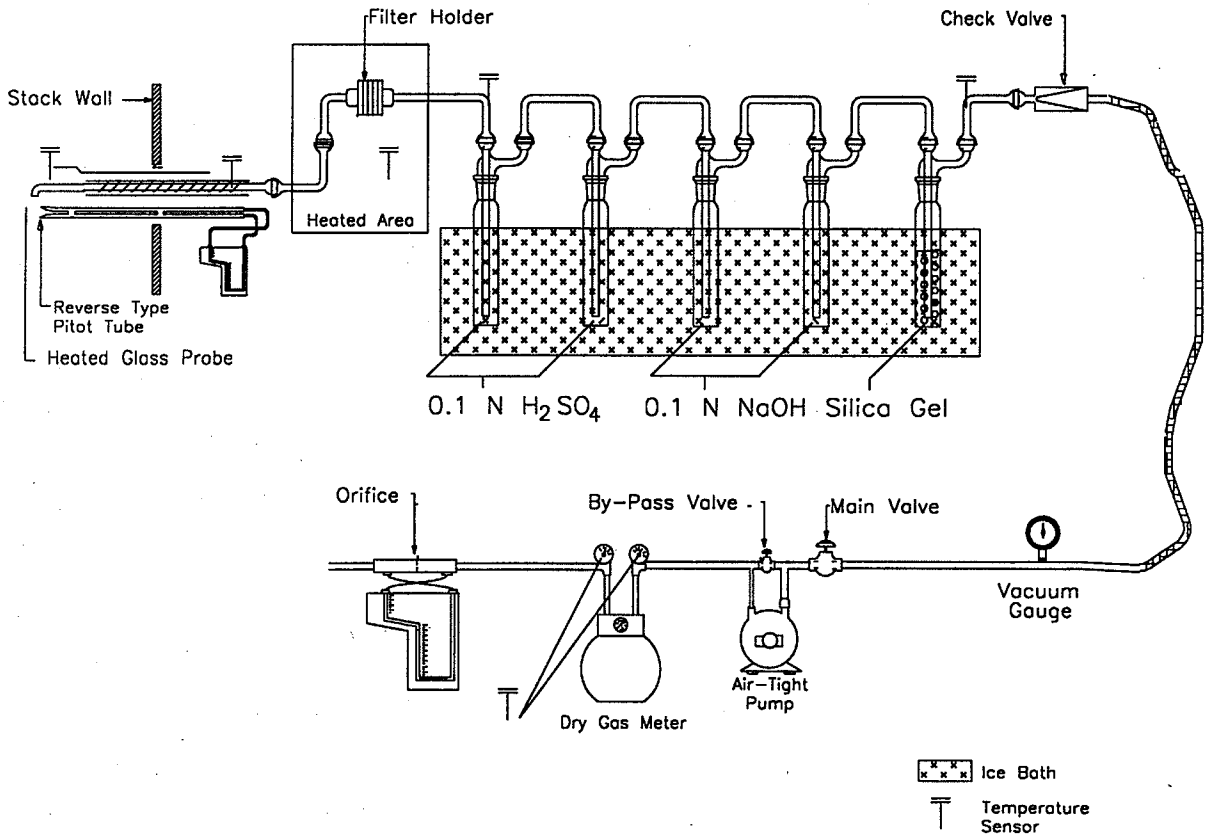
USEPA Method 2 - S-Type Pitot Tube Diagram



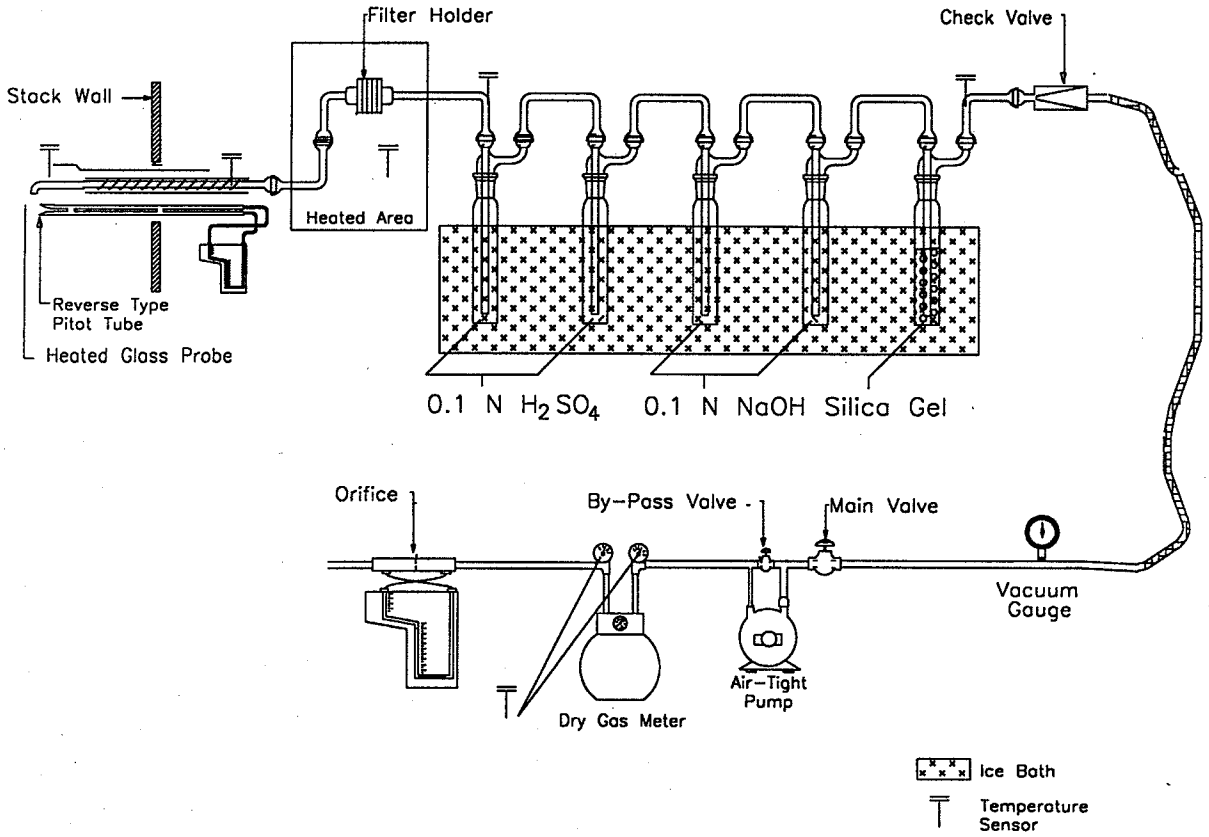
USEPA Method 3 - Integrated Oxygen/Carbon Dioxide Sample Train Diagram



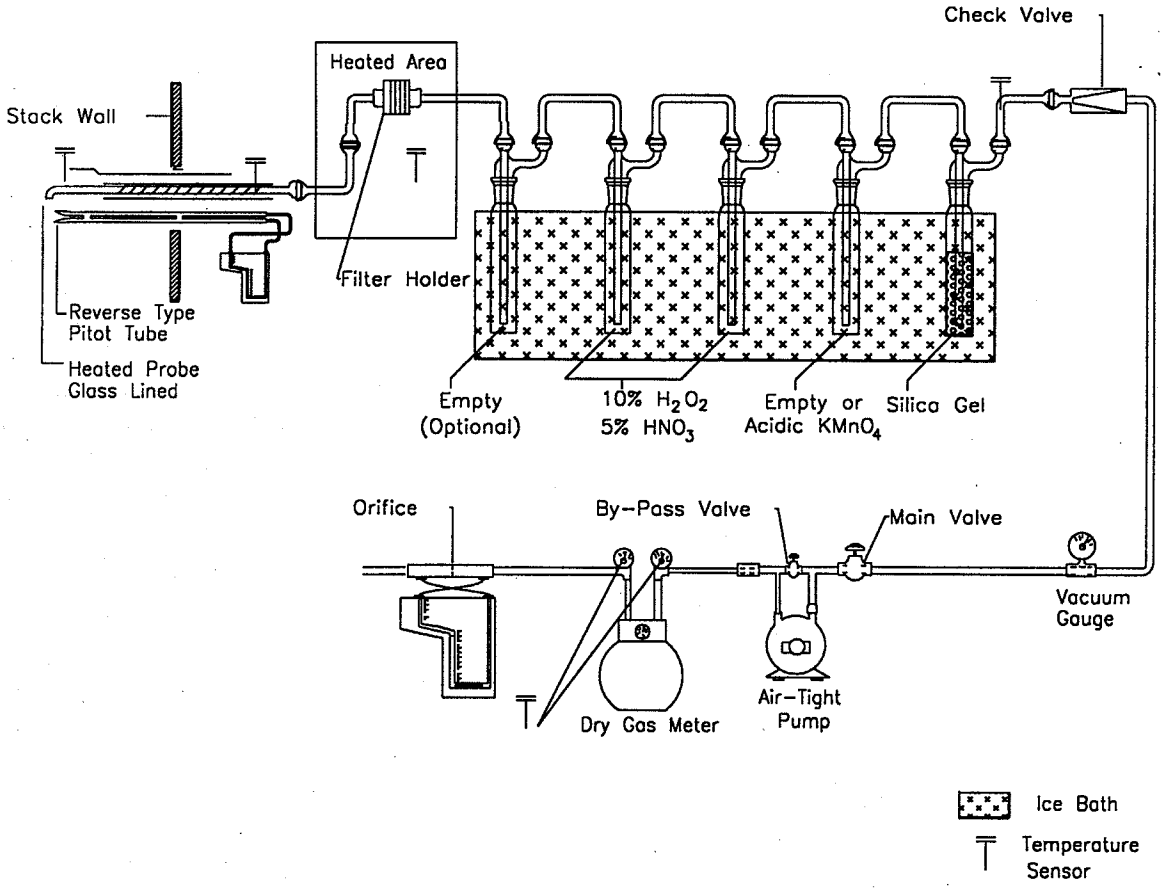
USEPA Method 17/26A – Combined Particulate and Halides Sample Train Diagram



USEPA Method 26A – HCl Sample Train Diagram



USEPA Method 29 – Trace Metal Emissions Sample Train Diagram



Coal Emission Rate Calculations

A pollutant emission rate (E), expressed as pounds of pollutant per million Btu heat input from the fuel combusted can be calculated by several methods as follows:

A. $C = C_s/7000$ where, C = pollutant concentration, lb/dscf
c_s = pollutant concentration, grains/dscf

B. If fuel flow is monitored and the fuel combusted during the test is sampled and analyzed for gross calorific value, then:

$$E = \frac{Q_{sd}C}{\text{fuel flow rate (lb/hr) GCV}} \times 10^6$$

where, E = lbs per million Btu
GCV = gross calorific value, Btu/lb
Q_{sd} = dry volumetric gas flow at standard conditions, dscf/hr

C. If an integrated gas sample is taken during the test and analyzed for $\%CO_2$ or $\%O_2$, dry basis by volume, with an approved USEPA Method 3 or 3A gas analyzer, then

$$E = C F_c \frac{100}{(\%CO_2)} \text{ or, } E = C F \frac{20.9}{(20.9 - \%O_2)} \quad \text{where,}$$

$\%CO_2$ and $\%O_2$ are expressed as percent values:

F_c = a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the fuel combusted, 1840 scf CO_2/million Btu for sub-bituminous or 1800 scf/million Btu for bituminous.
F = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted, 9820 dscf/million Btu for sub-bituminous or 9780 dscf/million Btu for bituminous.

D. If fuel sample increments are taken and composited during the test and an ultimate analysis is performed and the GCV is determined, then

$$F_c = \frac{321 \times 10^3 (\%C)}{GCV} \text{ where, } \%C = \text{carbon content by weight expressed as percent}$$

$$F = \frac{[3.64(\%H) + 1.53(\%C) + 0.57(\%S) + 0.14(\%N) - 0.46(\%O_2)]}{GCV} \times 10^6$$

1. H = Hydrogen, percent
2. C = Carbon, percent
3. S = Sulfur, percent
4. N = Nitrogen, percent
5. O = Oxygen, percent

PLATT ENVIRONMENTAL SERVICES, INC.

Calculations for Hydrogen Chloride By Method 26 or 26A

Concentration

$$\frac{\text{lbs HCl}}{\text{dscf}} = \frac{\mu\text{g HCl in sample}}{4.536 \times 10^8 \times \text{dscf}}$$

where:

$4.536 \times 10^8 = \mu\text{g/lb}$

dscf = Volume of gas sampled

$$\mu g/\text{lb HCl} = \mu g \text{ Cl} \times \frac{36.453}{35.453}$$

Parts Per Million

$$\text{ppm HCl} = \frac{\text{lbs HCl}}{\text{dscf}} \div \frac{36.453}{385 \times 10^6}$$

where:

385 = Volume of 1 lb mole of gas at 68°F and 29.92 in. Hg

10^6 = Conversion of ppm v/v

Emission Rate

lbs HCl/dscf × dscfm × 60 min/hr = lbs/hr HCl

PLATT ENVIRONMENTAL SERVICES, INC.

Trace Metal (Including Mercury) Sample Calculations

Concentration

$$\frac{\mu g}{m^3} = \frac{\mu g \text{ of trace metal}}{\text{dscf volume sampled} \times 0.02832 \frac{m^3}{ft^3}}$$

Emission Rate

$$\frac{\mu g \text{ of sample} \times \frac{1 \times 10^{-6} \text{ grams}}{\mu g}}{453.6 gr/lb} = \text{lbs of trace metal}$$

$$\frac{\text{lbs of trace metal}}{Vm(std)sample} \times dscfm \times 60 \frac{min}{hr} = \text{lbs of trace metal/hr}$$

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Run: 1
Date: 11/4/2008

Dry Molecular Weight

$$Md = 0.44 \times (\%CO_2) + 0.32 \times (\%O_2) + 0.28 \times \%N_2$$

$\%CO_2$ = 13.4 $\%O_2$ = 5.8 $\%N_2$ = 80.8

Md = 30.38

Wet Molecular Weight

$$Ms = Md \times (1-Bws) + (18.0 \times Bws)$$

Md = 30.38 Bws = 0.114

Ms = 28.96

Meter Volume at Standard Conditions

$$Vm(std) = 17.647 \times Y \times Vm \times \frac{(Pbar + DH/13.6)}{Tm}$$

Y = 1.003 Vm = 51.708 Pbar = 29.20
DH = 2.16 Tm = 541.3

Vm(std) = 49.645

Volume of Water Vapor Condensed

$$Vw(std) = 0.0471 \times (\text{net } H_2O \text{ gain})$$

Net H_2O = 136.0

Vw(std) = 6.406

Moisture Content

$$Bws = \frac{Vwc(std)}{Vwc(std) + Vm(std)}$$

Vw(std) = 6.406 Vm(std) = 49.645

Bws = 0.114

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Run: 1
Date: 11/4/2008

Average Duct Velocity

$$Vs = 85.49 \times Cp \times \text{Sqrt DP (avg)} \times (Ts\ (avg) / (Ps \times Ms))^{1/2}$$

Cp = 0.840 Ts (avg) = 805.7 Sqrt DP (avg): 0.853
Ps = 28.98 Ms = 28.96

Vs = 60.02

Volumetric Flow Rate (Actual Basis)

$$Q = Vs \times A \times 60$$

Vs = 60.02 A = 375.349

Q = 1351666

Volumetric Flow Rate (Standard Basis)

$$Qstd = 17.647 \times Q \times \frac{Ps}{Ts\ (avg)}$$

Q = 1351666 Ps = 28.98 Ts (avg) = 805.7

Qstd = 857975

Volumetric Flow Rate (Standard Dry Basis)

$$Qstd(dry) = Qstd \times (1-Bws)$$

Qstd = 857975 Bws = 0.114

Qstd(dry) = 759923

Isokinetic Variation:

$$\%ISO = \frac{0.0945 \times Ts \times Vm(std)}{Vs \times \theta \times An \times Ps \times (1-Bws)}$$

Ts = 805.7 Vm(std) = 51.708 Vs = 60.018
An = 0.0004005 θ = 60.0 Ps = 28.98
Bws = 0.114

%ISO = 102.1

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Run: 1
Date: 11/4/2008

PM Concentration:
This example represents the filterable fraction. For other fractions, use the obtained m_n for that particulate fraction.

$$Co = \frac{m_n \times 15.43}{Vm(std)}$$

m_n (g) = 0.1284 Vm(std) = 49.645

Co = 0.0399 gr/dscf

PM Emission Rate:

$$ER\ lb/hr = \frac{Co}{7000} \times Qstd(dry) \times 60$$

$$ER\ lb/mmBtu = \frac{Co}{7000} \times Fd\ (dscf/mmBtu) \times \frac{20.9}{20.9 - O2\%}$$

Co = 0.0399 Qstd(dry) = 759923

ER lb/hr = 259.943 lb/hr

ER lb/mmBtu = 0.0775 lb/mmBtu

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Toxecon Outlet
Run: 1
Date: 11/4/2008

Dry Molecular Weight

$$Md = 0.44 \times (\%CO_2) + 0.32 \times (\%O_2) + 0.28 \times \%N_2$$

$\%CO_2$ = 12.8 $\%O_2$ = 6.2 $\%N_2$ = 81.0

Md = 30.30

Wet Molecular Weight

$$Ms = Md \times (1-Bws) + (18.0 \times Bws)$$

Md = 30.30 Bws = 0.109

Ms = 28.96

Meter Volume at Standard Conditions

$$Vm(std) = 17.647 \times Y \times Vm \times \frac{(Pbar + DH/13.6)}{Tm}$$

Y = 1.015 Vm = 50.204 Pbar = 29.23
DH = 1.93 Tm = 527.4

Vm(std) = 50.080

Volume of Water Vapor Condensed

$$Vw(std) = 0.0471 \times (\text{net } H_2O \text{ gain})$$

Net H_2O = 130.0

Vw(std) = 6.123

Moisture Content

$$Bws = \frac{Vwc(std)}{Vwc(std) + Vm(std)}$$

Vw(std) = 6.123 Vm(std) = 50.080

Bws = 0.109

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Toxecon Outlet
Run: 1
Date: 11/4/2008

Average Duct Velocity

$$Vs = 85.49 \times Cp \times \text{Sqrt DP (avg)} \times (Ts\ (avg) / (Ps \times Ms))^{1/2}$$

Cp = 0.840 Ts (avg) = 801.1 Sqrt DP (avg): 0.833
Ps = 29.52 Ms = 28.96

Vs = 57.88

Volumetric Flow Rate (Actual Basis)

$$Q = Vs \times A \times 60$$

Vs = 57.88 A = 306.000

Q = 1062597

Volumetric Flow Rate (Standard Basis)

$$Qstd = 17.647 \times Q \times \frac{Ps}{Ts\ (avg)}$$

Q = 1062597 Ps = 29.52 Ts (avg) = 801.1

Qstd = 691061

Volumetric Flow Rate (Standard Dry Basis)

$$Qstd(dry) = Qstd \times (1-Bws)$$

Qstd = 691061 Bws = 0.109

Qstd(dry) = 615774

Isokinetic Variation:

$$\%ISO = \frac{0.0945 \times Ts \times Vm(std)}{Vs \times \theta \times An \times Ps \times (1-Bws)}$$

Ts = 801.1 Vm(std) = 50.204 Vs = 57.876
An = 0.0003947 θ = 60.0 Ps = 29.52
Bws = 0.109

%ISO = 105.2

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Toxecon Outlet
Run: 1
Date: 11/4/2008

PM Concentration:
This example represents the filterable fraction. For other fractions, use the obtained m_n for that particulate fraction.

$$Co = \frac{m_n \times 15.43}{Vm(std)}$$

m_n (g) = 0.0073 Vm(std) = 50.080

Co = 0.0022 gr/dscf

PM Emission Rate:

$$ER\ lb/hr = \frac{Co}{7000} \times Qstd(dry) \times 60$$

$$ER\ lb/mmBtu = \frac{Co}{7000} \times Fd\ (dscf/mmBtu) \times \frac{20.9}{20.9 - O2\%}$$

Co = 0.0022 Qstd(dry) = 615774

ER lb/hr = 11.871 lb/hr

ER lb/mmBtu = 0.0045 lb/mmBtu

Platt Environmental Services, Inc

Chain-of-Custody Form P.O. #802110

Project Number: M084501	Date Results Required: Standard
Client: ADA	TAT Required: standard
Plant/Test Location: We Energies-PIPP	Project Supervisor: ELE

Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
001	11-4-08	Unit 8 #1 Toxecon Inlet H_2SO_4	1	TE1	M26A (HCl, HBr, HF)	
002	11-4-08	Unit 8 #1 Toxecon Inlet NaOH	1		M26A (Cl, Br)	
003	11-4-08	Unit 8 #2 Toxecon Inlet H_2SO_4	1		M26A (HCl, HBr, HF)	
004	11-4-08	Unit 8 #2 Toxecon Inlet NaOH	1		M26A (Cl, Br)	
005	11-4-08	Unit 8 #3 Toxecon Inlet H_2SO_4	1		M26A (HCl, HBr, HF)	
006	11-4-08	Unit 8 #3 Toxecon Inlet NaOH	1		M26A (Cl, Br)	
007	11-4-08	#1 Toxecon Inlet H_2SO_4	1		M26A (HCl, HBr, HF)	
008	11-4-08	#1 Toxecon Inlet NaOH	1		M26A (Cl, Br)	
009	11-4-08	#2 Toxecon Inlet H_2SO_4	1		M26A (HCl, HBr, HF)	
010	11-4-08	#2 Toxecon Inlet NaOH	1		M26A (Cl, Br)	
011	11-4-08	#3 Toxecon Inlet H_2SO_4	1		M26A (HCl, HBr, HF)	
012	11-4-08	#3 Toxecon Inlet NaOH	1		M26A (Cl, Br)	
013	11-4-08	#1 Toxecon Outlet H_2SO_4	1		M26A (HCl, HBr, HF)	
014	11-4-08	#1 Toxecon Outlet NaOH	1		M26A (Cl, Br)	
015	11-4-08	#2 Toxecon Outlet H_2SO_4	1		M26A (HCl, HBr, HF)	
016	11-4-08	#2 Toxecon Outlet NaOH	1		M26A (Cl, Br)	
017	11-4-08	#3 Toxecon Outlet H_2SO_4	1		M26A (HCl, HBr, HF)	
018	11-4-08	#3 Toxecon Outlet NaOH	1		M26A (Cl, Br)	
019	11-4-08	H_2SO_4 blank	1		M26A (HCl, HBr, HF)	
020	11-4-08	NaOH blank	1		M26A (Cl, Br)	

Delivered to Lab by:	Date/Time:	Received by:	Date/Time:	Processed by:	Date/Time:
[signature]	11/11/08 12:30	[signature]	11/11/08 1301		

Laboratory Notes:

Platt Environmental Services, Inc

Chain-of-Custody Form

P.O. #802110

Project Number:	Date Results Required:
Client:	TAT Required:
Plant/Test Location:	Project Supervisor:

Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
021	11-4-08	DI blank	1	TEI	M26A (HCl, HBr, HF, Cl, Br)	
022	11-5-08	#1 Toxecon Inlet Filter & Probe wash	2		M29 *	
023	11-5-08	#1 Toxecon Inlet HNO_3/H_2O_2	~~2~~ 1		M29 *	
024	11-5-08	#2 Toxecon Inlet Filter & Probe wash	2		M29 *	
025	11-5-08	#2 Toxecon Inlet HNO_3/H_2O_2	2		M29 *	
026	11-5-08	#3 Toxecon Inlet Filter & Probe wash	2		M29 *	
027	11-5-08	#3 Toxecon Inlet HNO_3/H_2O_2	2		M29 *	
028	11-5-08	Unit 8 #1 filter & Probe wash	2		M29 *	
029	11-5-08	Unit 8 #1 HNO_3/H_2O_2	1		M29 *	
030	11-5-08	Unit 8 #2 filter & Probe wash	2		M29 *	
031	11-5-08	Unit 8 #2 HNO_3/H_2O_2	2		M29 *	
032	11-5-08	Unit 8 #3 filter & Probe wash	2		M29 *	
033	11-5-08	Unit 8 #3 HNO_3/H_2O_2	1		M29 *	
034	11-5-08	Nitric Peroxide blank	1		M29 *	
035	11-5-08	0.1 N HNO_3 blank	1		M29 *	
036	11-5-08	Filter blank	3		M29 *	
037						
038						
039						
040						

Delivered to Lab by:	Date/Time:	Received by:	Date/Time:	Processed by:	Date/Time:
		[signature]	11/11/08 1301		

Laboratory Notes: * Target Metals → Arsenic, Selenium, Manganese, Beryllium, Cadmium, Chromium, Lead, Nickel.

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Analysis Date: 11/13/2008 **Analyst:** MDH

Description	ID#	vol.	Initial Weight	Final Weight	Net Weight Gain
Test No. 1					
Filter	378		7.4290	7.5536	0.1246
Acetone Wash	2322	50 mls	2.6197	2.6235	0.0038
Acetone Blank					0.0000
Total Acetone Fraction					0.0038
Total Front Half Weight					**0.1284**
Test No. 2					
Filter	423		7.4854	7.6502	0.1648
Acetone Wash	2323	50 mls	2.6113	2.6241	0.0128
Acetone Blank					0.0000
Total Acetone Fraction					0.0128
Total Front Half Weight					**0.1776**
Test No. 3					
Filter	429		7.5207	7.8225	0.3018
Acetone Wash	2324	40 mls	2.6157	2.6189	0.0032
Acetone Blank					0.0000
Total Acetone Fraction					0.0032
Total Front Half Weight					**0.3050**
Blank Summary					
Acetone Wash	2328	50 mls	2.6077	2.6077	0.0000

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Toxecon Outlet
Analysis Date: 11/13/2008 **Analyst:** MDH

Description	ID#	vol.	Initial Weight	Final Weight	Net Weight Gain
Test No. 1					
Filter	424		7.4294	7.4353	0.0059
Acetone Wash	2325	45 mls	2.6103	2.6117	0.0014
Acetone Blank					0.0000
Total Acetone Fraction					0.0014
Total Front Half Weight					**0.0073**
Test No. 2					
Filter	425		7.2313	7.2470	0.0157
Acetone Wash	2326	40 mls	2.6199	2.6211	0.0012
Acetone Blank					0.0000
Total Acetone Fraction					0.0012
Total Front Half Weight					**0.0169**
Test No. 3					
Filter	388		7.3901	7.3971	0.0070
Acetone Wash	2327	40 mls	2.6197	2.6200	0.0003
Acetone Blank					0.0000
Total Acetone Fraction					0.0003
Total Front Half Weight					**0.0073**
Blank Summary					
Acetone Wash	2328	50 mls	2.6077	2.6077	0.0000

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79150
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79150 Sample: 001

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	<0.05	mg	11/17/2008
HCl (M26A)	3.75	mg	11/17/2008
HF (M26A)	1.95	mg	11/17/2008

TEI Number: 79151 Sample: 003

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	<0.05	mg	11/17/2008
HCl (M26A)	3.29	mg	11/17/2008
HF (M26A)	1.53	mg	11/17/2008

TEI Number: 79152 Sample: 005

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	<0.05	mg	11/17/2008
HCl (M26A)	3.46	mg	11/17/2008
HF (M26A)	1.63	mg	11/17/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79150
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79153 Sample: 007

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	0.22	mg	11/17/2008
HCl (M26A)	2.24	mg	11/17/2008
HF (M26A)	1.13	mg	11/17/2008

TEI Number: 79154 Sample: 009

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	1.27	mg	11/17/2008
HCl (M26A)	2.32	mg	11/17/2008
HF (M26A)	0.56	mg	11/17/2008

TEI Number: 79155 Sample: 011

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	0.84	mg	11/20/2008
HCl (M26A)	2.38	mg	11/17/2008
HF (M26A)	0.98	mg	11/17/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79150
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79156 Sample: 013

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	0.38	mg	11/20/2008
HCl (M26A)	2.15	mg	11/18/2008
HF (M26A)	1.26	mg	11/18/2008

TEI Number: 79157 Sample: 015

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	0.40	mg	11/20/2008
HCl (M26A)	1.84	mg	11/18/2008
HF (M26A)	1.46	mg	11/20/2008

TEI Number: 79158 Sample: 017

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	0.37	mg	11/20/2008
HCl (M26A)	1.99	mg	11/18/2008
HF (M26A)	0.99	mg	11/20/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79150
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79159 Sample: 019

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	<0.05	mg	11/21/2008
HCl (M26A)	<0.05	mg	11/18/2008
HF (M26A)	<0.05	mg	11/18/2008

TEI Number: 79160 Sample: 021

TEST	RESULTS		DATE PERFORMED
HBr (M26A)	<0.05	mg	11/21/2008
HCl (M26A)	<0.05	mg	11/18/2008
HF (M26A)	<0.05	mg	11/18/2008

TEI Number: 79161 Sample: 002

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	0.16	mg	11/21/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79150
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79162 Sample: 004

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	0.23	mg	11/21/2008

TEI Number: 79163 Sample: 006

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	<0.05	mg	11/21/2008

TEI Number: 79164 Sample: 008

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	0.17	mg	11/21/2008

TEI Number: 79165 Sample: 010

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	0.19	mg	11/18/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79150
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79166 Sample: 012

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	<0.05	mg	11/18/2008

TEI Number: 79167 Sample: 014

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	0.18	mg	11/18/2008

TEI Number: 79168 Sample: 016

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	<0.05	mg	11/21/2008

TEI Number: 79169 Sample: 018

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	<0.05	mg	11/18/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79150
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79170 Sample: 020

TEST	RESULTS		DATE PERFORMED
Bromine (M26A)	<0.05	mg	11/21/2008
Chlorine (M26A)	<0.05	mg	11/18/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79171 Sample: 022

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/12/2008
Arsenic (7010)	6.6	ug	11/26/2008
Beryllium (6010C)	1.2	ug	11/19/2008
Cadmium (6010C)	3.3	ug	11/19/2008
Chromium (6010C)	25.0	ug	11/19/2008
Lead (7010)	12.3	ug	11/26/2008
Manganese (6010C)	41.8	ug	11/19/2008
Nickel (6010C)	18.4	ug	11/19/2008
Selenium (7010)	53.0	ug	11/26/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79172 Sample: 023

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	7.9	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	7.6	ug	11/19/2008
Chromium (6010C)	22.8	ug	11/19/2008
Lead (6010C)	448	ug	11/19/2008
Manganese (6010C)	20.3	ug	11/19/2008
Nickel (6010C)	12.4	ug	11/19/2008
Selenium (6010C)	11.2	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79173 Sample: 024

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/12/2008
Arsenic (7010)	6.5	ug	11/26/2008
Beryllium (6010C)	3.4	ug	11/19/2008
Cadmium (6010C)	4.8	ug	11/19/2008
Chromium (6010C)	39.2	ug	11/19/2008
Lead (7010)	12.3	ug	11/26/2008
Manganese (6010C)	163	ug	11/19/2008
Nickel (6010C)	24.1	ug	11/19/2008
Selenium (7010)	64.4	ug	11/26/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79174 Sample: 025

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	<5	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	<1	ug	11/19/2008
Chromium (6010C)	14.6	ug	11/19/2008
Lead (6010C)	<5	ug	11/19/2008
Manganese (6010C)	4.3	ug	11/19/2008
Nickel (6010C)	14.8	ug	11/19/2008
Selenium (6010C)	12.2	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79175 Sample: 026

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/12/2008
Arsenic (7010)	<5	ug	11/26/2008
Beryllium (6010C)	2.5	ug	11/19/2008
Cadmium (6010C)	4.4	ug	11/19/2008
Chromium (6010C)	21.6	ug	11/19/2008
Lead (7010)	9.3	ug	11/26/2008
Manganese (6010C)	119	ug	11/19/2008
Nickel (6010C)	17.6	ug	11/19/2008
Selenium (7010)	<10	ug	11/26/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79176 Sample: 027

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	<5	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	<1	ug	11/19/2008
Chromium (6010C)	4.0	ug	11/19/2008
Lead (6010C)	<5	ug	11/19/2008
Manganese (6010C)	4.5	ug	11/19/2008
Nickel (6010C)	8.6	ug	11/19/2008
Selenium (6010C)	<10	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79177 Sample: 028

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/12/2008
Arsenic (7010)	<5	ug	11/26/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	3.1	ug	11/19/2008
Chromium (6010C)	9.8	ug	11/19/2008
Lead (7010)	<5	ug	11/26/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	10.2	ug	11/19/2008
Selenium (7010)	<10	ug	11/26/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79178 Sample: 029

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	<5	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	<1	ug	11/19/2008
Chromium (6010C)	7.2	ug	11/19/2008
Lead (6010C)	<5	ug	11/19/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	3.3	ug	11/19/2008
Selenium (6010C)	<10	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79179 Sample: 030

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/12/2008
Arsenic (7010)	<5	ug	11/26/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	3.1	ug	11/19/2008
Chromium (6010C)	8.8	ug	11/19/2008
Lead (7010)	<5	ug	11/26/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	9.0	ug	11/19/2008
Selenium (7010)	<10	ug	11/26/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79180 Sample: 031

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	<5	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	<1	ug	11/19/2008
Chromium (6010C)	8.2	ug	11/19/2008
Lead (6010C)	<5	ug	11/19/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	3.8	ug	11/19/2008
Selenium (6010C)	78.5	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79181 Sample: 032

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/12/2008
Arsenic (7010)	<5	ug	11/26/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	2.6	ug	11/19/2008
Chromium (6010C)	12.8	ug	11/19/2008
Lead (7010)	<5	ug	11/26/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	9.8	ug	11/19/2008
Selenium (7010)	<10	ug	11/26/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79182 Sample: 033

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	<5	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	<1	ug	11/19/2008
Chromium (6010C)	<3	ug	11/19/2008
Lead (6010C)	<5	ug	11/19/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	<3	ug	11/19/2008
Selenium (6010C)	22.7	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79183 Sample: 034

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	<5	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	<1	ug	11/19/2008
Chromium (6010C)	<3	ug	11/19/2008
Lead (6010C)	<5	ug	11/19/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	<3	ug	11/19/2008
Selenium (6010C)	<10	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79184 Sample: 035

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/14/2008
Arsenic (6010C)	<5	ug	11/19/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	<1	ug	11/19/2008
Chromium (6010C)	<3	ug	11/19/2008
Lead (6010C)	<5	ug	11/19/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	<3	ug	11/19/2008
Selenium (6010C)	<10	ug	11/19/2008

Gayle E. O'Neill, Ph.D.

Jim Platt
Platt Environmental Services Inc.
371 Balm Court
Wood Dale, IL 60191

Report #: 79171
Report Date: 11/24/2008
Sample Received:
11/11/08 13:01

M084501

TEI Number: 79185 Sample: 036

TEST	RESULTS		DATE PERFORMED
Preparation (M-29)			11/12/2008
Arsenic (7010)	<5	ug	11/26/2008
Beryllium (6010C)	<1	ug	11/19/2008
Cadmium (6010C)	7.9	ug	11/19/2008
Chromium (6010C)	5.0	ug	11/19/2008
Lead (7010)	<5	ug	11/26/2008
Manganese (6010C)	<3	ug	11/19/2008
Nickel (6010C)	<3	ug	11/19/2008
Selenium (7010)	<10	ug	11/26/2008

Gayle E. O'Neill, Ph.D.

Company:	ADA-ES, Inc.	
Plant:	We Energies - Presque Isle Power Plant	
Test Location:	Unit 8 Toxecon Inlet	
Test Method:	26A	
Test Engineer:	S. Dyra	
Test Technician:	J. Macchione	
lb/mmBtu Emissions by:	Standard	
Type of Fuel Firing:	Coal, Sub-Bituminous	
Standard Fuel Factor Fd, dscf/mmBtu:	9820	
Temp ID:	CM-6	
Meter ID:	CM-6	
Pitot ID:	096A	
Pitot Tube Coefficient:	0.840	
Probe Length:	7.0	**ft**
Probe Liner Material:	Glass	
Nozzle Diameter:	0.250	**in.**
Nozzle Kit ID Number:	3	
Meter Calibration Factor (Y):	0.993	
Meter Orifice Setting (Delta H):	1.554	
Sample Plane:	Horizontal	
Port Length:	24.00	**in.**
Port Size (diameter):	4.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	10.5	**ft**
Duct Area:	86.590	**Sq. Ft.**
Number of Ports Sampled:	1	
Number of Points per Port:	1	
Minutes per Point:	60.0	
Total Number of Traverse Points:	1	
Test Length:	60	**min.**
Train Type:	Hot Box	
Source Condition:	Normal	
# of Runs	3	

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power I
Location: Unit 8 Toxecon Inlet
Test Method: 26A

		Run 1	Run 2	Run 3
Identify Analyte:	Hydrogen Chloride (HCl)			
Molecular Weight:	36.45			
mg (net) collected:		3.75	3.29	3.46
Identify Analyte:	Hydrogen Bromide (HBr)			
Molecular Weight:	80.9			
mg (net) collected:		0.05	0.05	0.05
Identify Analyte:	Hydrogen Fluoride (HF)			
Molecular Weight:	19.99			
mg (net) collected:		1.95	1.53	1.63
Identify Analyte:	Chloride (Cl2)			
Molecular Weight:	70.9			
mg (net) collected:		0.16	0.23	0.05
Identify Analyte:	Bromide (Br2)			
Molecular Weight:	159.8			
mg (net) collected:		0.05	0.05	0.05
Identify Analyte:				
Molecular Weight:				
mg (net) collected:				
Identify Analyte:				
Molecular Weight:				
mg (net) collected:				
Identify Analyte:				
Molecular Weight:				
mg (net) collected:				
Identify Analyte:				
Molecular Weight:				
mg (net) collected:				

Run 1-Method 26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Unit 8 Toxecon Inlet
Source Condition: Normal

Date: 11/4/08
Start Time: 8:30
End Time: 9:30

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.77	in. H_2O	Static Pressure	-2.00	in. H_2O
Meter Temperature, Tm:	98.1	°F	Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP:	1.176	in. H_2O	Carbon Dioxide:	13.40	%
Stack Temperature, Ts:	341.3	°F	Oxygen:	5.20	%
Meter Volume, Vm:	62.762	ft^3	Nitrogen:	81.40	%
Meter Volume, Vmstd:	57.941	dscf	Gas Weight dry, Md:	30.352	lb/lb mole
Meter Volume, Vwstd:	7.696	wscf	Gas Weight wet, Ms:	28.904	lb/lb mole
Isokinetic Variance:	101.4	%I	Excess Air:	31.922	%
			Gas Velocity, Vs:	82.500	fps
Test Length	60.00	in mins.	Volumetric Flow:	428,620	acfm
Nozzle Diameter	0.250	in inches	Volumetric Flow:	242,078	dscfm
Barometric Pressure	29.20	in Hg	Volumetric Flow:	274,233	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3905.0	ml	Silica Initial Wt.	0.0	
Final Impinger Content:	4068.4	ml	Silica Final Wt.	0.0	
Difference:	163.4		Difference:	0.0	
Total Water Gain:	163.4		Moisture, Bws:	0.117	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	8:30:00	1.40	2.80	41.832	1.183	334	90	90	5.218	83.003
1-1	8:35:00	1.30	2.60	47.050	1.140	336	95	90	5.030	79.984
1-1	8:40:00	1.30	2.60	52.080	1.140	338	101	91	5.070	79.984
1-1	8:45:00	1.40	2.80	57.150	1.183	341	102	92	5.250	83.003
1-1	8:50:00	1.40	2.80	62.400	1.183	342	103	93	5.260	83.003
1-1	8:55:00	1.40	2.80	67.660	1.183	343	104	94	5.240	83.003
1-1	9:00:00	1.40	2.80	72.900	1.183	343	105	94	5.260	83.003
1-1	9:05:00	1.40	2.80	78.160	1.183	343	106	95	5.280	83.003
1-1	9:10:00	1.40	2.80	83.440	1.183	344	106	95	5.290	83.003
1-1	9:15:00	1.40	2.80	88.730	1.183	344	107	96	5.290	83.003
1-1	9:20:00	1.40	2.80	94.020	1.183	344	107	96	5.290	83.003
1-1	9:25:00	1.40	2.80	99.310	1.183	344	107	96	5.284	83.003
	9:30:00			104.594						
Total				62.762			102.8	93.5	62.762	
Average			2.77		1.176	341.3	98.1			

Run 2-Method 26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Unit 8 Toxecon Inlet
Source Condition: Normal

Date: 11/4/08
Start Time: 11:55
End Time: 12:55

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.80	in. H_2O	Static Pressure	-2.00	in. H_2O
Meter Temperature, Tm:	99.9	°F	Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP:	1.183	in. H_2O	Carbon Dioxide:	13.60	%
Stack Temperature, Ts:	336.9	°F	Oxygen:	5.40	%
Meter Volume, Vm:	63.516	cf	Nitrogen:	81.0	%
Meter Volume, Vmstd:	58.458	dscf	Gas Weight dry, Md:	30.392	lb/lb mole
Meter Volume, Vwstd:	9.542	wscf	Gas Weight wet, Ms:	28.653	lb/lb mole
Isokinetic Variance:	103.7	%I	Excess Air:	33.784	%
			Gas Velocity, Vs:	83.135	fps
Test Length	60.00	in mins.	Volumetric Flow:	431,921	acfm
Nozzle Diameter	0.250	in inches	Volumetric Flow:	238,883	dscfm
Barometric Pressure	29.20	in Hg	Volumetric Flow:	277,877	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3509.0	ml	Silica Initial Wt.	0.0
Final Impinger Content:	3711.6	ml	Silica Final Wt.	0.0
Difference:	202.6		Difference:	0.0
Total Water Gain:	202.6		Moisture, Bws:	0.140

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	11:55:00	1.40	2.80	9.723	1.183	336	98	97	5.297	83.135
1-1	12:00:00	1.40	2.80	15.020	1.183	338	100	98	5.270	83.135
1-1	12:05:00	1.40	2.80	20.290	1.183	338	102	98	5.280	83.135
1-1	12:10:00	1.40	2.80	25.570	1.183	338	103	97	5.290	83.135
1-1	12:15:00	1.40	2.80	30.860	1.183	338	104	97	5.290	83.135
1-1	12:20:00	1.40	2.80	36.150	1.183	337	103	97	5.280	83.135
1-1	12:25:00	1.40	2.80	41.430	1.183	337	103	97	5.290	83.135
1-1	12:30:00	1.40	2.80	46.720	1.183	337	103	97	5.300	83.135
1-1	12:35:00	1.40	2.80	52.020	1.183	336	103	97	5.310	83.135
1-1	12:40:00	1.40	2.80	57.330	1.183	336	104	97	5.300	83.135
1-1	12:45:00	1.40	2.80	62.630	1.183	336	104	97	5.300	83.135
1-1	12:50:00	1.40	2.80	67.930	1.183	336	104	97	5.309	83.135
	12:55:00			73.239						
Total				63.516			102.6	97.2	63.516	
Average			2.80		1.183	336.9	99.9			

Run 3-Method 26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Unit 8 Toxecon Inlet
Source Condition: Normal

Date: 11/4/08
Start Time: 14:05
End Time: 15:05

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	3.10	in. H_2O	Static Pressure	-2.00	in. H_2O
Meter Temperature, Tm:	100.5	°F	Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP:	1.245	in. H_2O	Carbon Dioxide:	13.60	%
Stack Temperature, Ts:	334.7	°F	Oxygen:	5.40	%
Meter Volume, Vm:	66.992	cf	Nitrogen:	81	%
Meter Volume, Vmstd:	61.630	dscf	Gas Weight dry, Md:	30.392	lb/lb mole
Meter Volume, Vwstd:	8.299	wscf	Gas Weight wet, Ms:	28.921	lb/lb mole
Isokinetic Variance:	101.7	%I	Excess Air:	33.784	%
			Gas Velocity, Vs:	86.934	fps
Test Length	60.00	in mins.	Volumetric Flow:	451,660	acfm
Nozzle Diameter	0.250	in inches	Volumetric Flow:	256,816	dscfm
Barometric Pressure	29.20	in Hg	Volumetric Flow:	291,399	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3924.2	ml	Silica Initial Wt.	0.0
Final Impinger Content:	4100.4	ml	Silica Final Wt.	0.0
Difference:	176.2		Difference:	0.0
Total Water Gain:	176.2		Moisture, Bws:	0.119

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	14:05:00	1.50	3.00	73.445	1.225	333	96	96	5.455	85.532
1-1	14:10:00	1.60	3.20	78.900	1.265	333	102	96	5.670	88.337
1-1	14:15:00	1.60	3.20	84.570	1.265	335	104	96	5.670	88.337
1-1	14:20:00	1.60	3.20	90.240	1.265	336	104	97	5.660	88.337
1-1	14:25:00	1.50	3.00	95.900	1.225	334	104	97	5.460	85.532
1-1	14:30:00	1.60	3.20	101.360	1.265	334	104	97	5.670	88.337
1-1	14:35:00	1.50	3.00	107.030	1.225	335	105	97	5.520	85.532
1-1	14:40:00	1.50	3.00	112.550	1.225	335	105	98	5.490	85.532
1-1	14:45:00	1.50	3.00	118.040	1.225	335	105	98	5.530	85.532
1-1	14:50:00	1.50	3.00	123.570	1.225	336	106	98	5.500	85.532
1-1	14:55:00	1.60	3.20	129.070	1.265	335	106	98	5.680	88.337
1-1	15:00:00	1.60	3.20	134.750	1.265	335	106	98	5.687	88.337
	15:05:00			140.437						
Total				66.992			103.9	97.2	66.992	
Average			3.10		1.245	334.7	100.5			

Company:	ADA-ES, Inc.	
Plant:	We Energies - Presque Isle Power Plant	
Test Location:	Common Toxecon Inlet	
Test Method:	17/26A	
Test Engineer:	M. Platt	
Test Technician:	J. Howe/A. Calix	
lb/mmBtu Emissions by:	Standard	
Type of Fuel Firing:	Coal, Sub-Bituminous	
Standard Fuel Factor Fd, dscf/mmBtu:	9820	
Temp ID:	CM-17	
Meter ID:	CM-17	
Pitot ID:	081A	
Pitot Tube Coefficient:	0.840	
Probe Length:	18.0	**ft**
Probe Liner Material:	Teflon	
Nozzle Diameter:	0.271	**in.**
Nozzle Kit ID Number:	2	
Meter Calibration Factor (Y):	1.003	
Meter Orifice Setting (Delta H):	1.681	
Sample Plane:	Vertical	
Port Length:	42.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Rectangular	
Length	19.17	**ft**
Width	19.58	**ft**
Duct Area:	375.349	**Sq. Ft.**
Number of Ports Sampled:	6	
Number of Points per Port:	4	
Minutes per Point:	2.5	
Total Number of Traverse Points:	24	
Test Length:	60	**min.**
Train Type:	Hot Box	
Source Condition:	Normal	
# of Runs	3	

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Common Toxecon Inlet
Test Method: 17/26A

RUN 1

	Filterable	Condensable
Sample ID:		
Item:	**Filter**	
PM, grams (net) collected:	0.1284	

RUN 2

	Filterable	Condensable	Total
Sample ID:			
Item:	**Filter**		
PM, grams (net) collected:	0.1776		

RUN 3

	Filterable	Condensable	Total
Sample ID:			
Item:	**Filter**		
PM, grams (net) collected:	0.3050		

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power I
Location: Common Toxecon Inlet
Test Method: 17/26A

		Run 1	Run 2	Run 3
Identify Analyte:	Hydrogen Chloride (HCl)			
Molecular Weight:	36.45			
mg (net) collected:		2.24	2.32	2.38
Identify Analyte:	Hydrogen Bromide (HBr)			
Molecular Weight:	80.9			
mg (net) collected:		0.22	1.27	0.84
Identify Analyte:	Hydrogen Fluoride (HF)			
Molecular Weight:	19.99			
mg (net) collected:		1.13	0.56	0.98
Identify Analyte:	Chloride (Cl2)			
Molecular Weight:	70.9			
mg (net) collected:		0.17	0.19	0.05
Identify Analyte:	Bromide (Br2)			
Molecular Weight:	159.8			
mg (net) collected:		0.05	0.05	0.05

Run 1-Method 17/26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Source Condition: Normal

Date: 11/4/08
Start Time: 8:35
End Time: 9:49

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.16	in. H_2O	Static Pressure	-3.00	in. H_2O
Meter Temperature, Tm:	81.3	°F	Flue Pressure (Ps):	28.98	in. Hg. abs.
Sqrt ΔP:	0.853	in. H_2O	Carbon Dioxide:	13.40	%
Stack Temperature, Ts:	345.7	°F	Oxygen:	5.80	%
Meter Volume, Vm:	51.708	ft^3	Nitrogen:	80.80	%
Meter Volume, Vmstd:	49.645	dscf	Gas Weight dry, Md:	30.376	lb/lb mole
Meter Volume, Vwstd:	6.406	wscf	Gas Weight wet, Ms:	28.962	lb/lb mole
Isokinetic Variance:	102.1	%I	Excess Air:	37.344	%
			Gas Velocity, Vs:	60.018	fps
Test Length	60.00	in mins.	Volumetric Flow:	1,351,666	acfm
Nozzle Diameter	0.271	in inches	Volumetric Flow:	759,923	dscfm
Barometric Pressure	29.20	in Hg	Volumetric Flow:	857,975	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3705.4	ml	Silica Initial Wt.	0.0
Final Impinger Content:	3841.4	ml	Silica Final Wt.	0.0
Difference:	136.0		Difference:	0.0
Total Water Gain:	136.0		Moisture, Bws:	0.114

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	8:35:00	0.70	2.00	307.242	0.837	340	77	75	2.118	58.866
1-2	8:37:30	0.70	2.00	309.360	0.837	340	78	75	2.110	58.866
1-3	8:40:00	0.44	1.30	311.470	0.663	340	81	75	1.670	46.670
1-4	8:42:30	0.35	1.00	313.140	0.592	341	82	75	1.490	41.625
	8:45:00			314.630						
2-1	8:48:00	0.98	2.90	314.630	0.990	342	82	75	2.500	69.651
2-2	8:50:30	0.84	2.50	317.130	0.917	346	84	76	2.320	64.485
2-3	8:53:00	0.44	1.30	319.450	0.663	343	85	76	1.670	46.670
2-4	8:55:30	0.29	0.85	321.120	0.539	343	85	76	1.360	37.889
	8:58:00			322.480						
3-1	9:00:00	0.90	2.60	322.480	0.949	343	85	78	2.400	66.748
3-2	9:02:30	1.00	2.90	324.880	1.000	344	86	77	2.530	70.358
3-3	9:05:00	0.91	2.60	327.410	0.954	345	87	78	2.410	67.118
3-4	9:07:30	0.87	2.50	329.820	0.933	345	87	78	2.360	65.626
	9:10:00			332.180						
4-1	9:12:00	1.00	2.90	332.180	1.000	348	87	78	2.530	70.358
4-2	9:14:30	0.99	2.90	334.710	0.995	348	87	78	2.510	70.006
4-3	9:17:00	0.89	2.60	337.220	0.943	348	87	79	2.380	66.376
4-4	9:19:30	0.83	2.40	339.600	0.911	349	87	79	2.300	64.100
	9:22:00			341.900						
5-1	9:25:00	0.95	2.80	341.900	0.975	349	87	80	2.780	68.577
5-2	9:27:30	0.94	2.70	344.680	0.970	349	87	79	2.130	68.215
5-3	9:30:00	0.72	2.10	346.810	0.849	349	87	79	2.140	59.701
5-4	9:32:30	0.44	1.30	348.950	0.663	348	87	79	1.670	46.670
	9:35:00			350.620						
6-1	9:39:00	0.65	1.90	350.620	0.806	349	86	79	2.040	56.725
6-2	9:41:30	0.74	2.10	352.660	0.860	349	86	79	2.170	60.525
6-3	9:44:00	0.73	2.10	354.830	0.854	350	86	79	2.160	60.114
6-4	9:46:30	0.60	1.70	356.990	0.775	348	86	79	1.960	54.499
	9:49:00			358.950						
Total				51.708			85.0	77.5	51.708	
Average			2.16		0.853	345.7	81.3			

Run 2-Method 17/26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Common Toxecon Inlet
Source Condition: Normal

Date: 11/4/08
Start Time: 11:55
End Time: 13:08

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.51	in. H_2O	Static Pressure	-3.00	in. H_2O
Meter Temperature, Tm:	89.1	°F	Flue Pressure (Ps):	28.98	in. Hg. abs.
Sqrt ΔP:	0.915	in. H_2O	Carbon Dioxide:	13.60	%
Stack Temperature, Ts:	349.5	°F	Oxygen:	5.60	%
Meter Volume, Vm:	53.888	cf	Nitrogen:	80.8	%
Meter Volume, Vmstd:	51.044	dscf	Gas Weight dry, Md:	30.400	lb/lb mole
Meter Volume, Vwstd:	6.943	wscf	Gas Weight wet, Ms:	28.915	lb/lb mole
Isokinetic Variance:	98.6	%I	Excess Air:	35.598	%
			Gas Velocity, Vs:	64.614	fps
Test Length	60.00	in mins.	Volumetric Flow:	1,455,173	acfm
Nozzle Diameter	0.271	in inches	Volumetric Flow:	809,237	dscfm
Barometric Pressure	29.20	in Hg	Volumetric Flow:	919,302	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3631.8	ml	Silica Initial Wt.	0.0
Final Impinger Content:	3779.2	ml	Silica Final Wt.	0.0
Difference:	147.4		Difference:	0.0
Total Water Gain:	147.4		Moisture, Bws:	0.120

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	11:55:00	0.86	2.50	399.791	0.927	347	88	82	2.329	65.455
1-2	12:00:00	0.80	2.40	402.120	0.894	347	92	83	4.610	63.130
	12:05:00			406.730						
2-1	12:07:00	0.87	2.60	406.730	0.933	350	92	83	4.810	65.834
2-2	12:12:00	0.70	2.10	411.540	0.837	349	94	84	4.310	59.053
	12:17:00			415.850						
3-1	12:19:00	0.85	2.50	415.850	0.922	352	93	84	4.750	65.073
3-2	12:24:00	0.76	2.20	420.600	0.872	350	95	85	4.490	61.532
	12:29:00			425.090						
4-1	12:33:00	0.83	2.50	425.090	0.911	351	94	85	4.410	64.303
4-2	12:38:00	1.00	3.00	429.500	1.000	350	94	86	5.160	70.582
	12:43:00			434.660						
5-1	12:46:00	0.74	2.20	434.660	0.860	351	94	86	4.430	60.717
5-2	12:51:00	0.60	1.80	439.090	0.775	351	95	86	3.990	54.673
	12:56:00			443.080						
6-1	12:58:00	1.20	3.60	443.080	1.095	349	95	87	5.650	77.319
6-2	13:03:00	0.92	2.70	448.730	0.959	347	94	87	4.949	67.700
	13:08:00			453.679						
Total				53.888			93.3	84.8	53.888	
Average			2.51		0.915	349.5	89.1			

Run 3-Method 17/26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Common Toxecon Inlet
Source Condition: Normal

Date: 11/4/08
Start Time: 14:05
End Time: 15:14

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.56	in. H_2O	Static Pressure	-3.00	in. H_2O
Meter Temperature, Tm:	94.3	°F	Flue Pressure (Ps):	28.98	in. Hg. abs.
Sqrt ΔP:	0.923	in. H_2O	Carbon Dioxide:	13.60	%
Stack Temperature, Ts:	353.4	°F	Oxygen:	5.60	%
Meter Volume, Vm:	57.672	cf	Nitrogen:	80.8	%
Meter Volume, Vmstd:	54.126	dscf	Gas Weight dry, Md:	30.400	lb/lb mole
Meter Volume, Vwstd:	7.103	wscf	Gas Weight wet, Ms:	28.962	lb/lb mole
Isokinetic Variance:	103.5	%I	Excess Air:	35.598	%
			Gas Velocity, Vs:	65.279	fps
Test Length	60.00	in mins.	Volumetric Flow:	1,470,152	acfm
Nozzle Diameter	0.271	in inches	Volumetric Flow:	817,072	dscfm
Barometric Pressure	29.20	in Hg	Volumetric Flow:	924,293	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3702.4	ml	Silica Initial Wt.	0.0
Final Impinger Content:	3853.2	ml	Silica Final Wt.	0.0
Difference:	150.8		Difference:	0.0
Total Water Gain:	150.8		Moisture, Bws:	0.116

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	14:05:00	1.10	3.30	464.042	1.049	351	91	87	5.458	74.147
1-2	14:10:00	0.74	2.20	469.500	0.860	349	95	87	4.480	60.815
	14:15:00			473.980						
2-1	14:16:00	0.91	2.70	473.980	0.954	354	96	88	4.970	67.440
2-2	14:21:00	0.61	1.80	478.950	0.781	356	99	88	4.060	55.215
	14:26:00			483.010						
3-1	14:28:00	0.96	2.90	483.010	0.980	355	97	88	5.100	69.268
3-2	14:33:00	0.98	2.90	488.110	0.990	353	99	89	5.150	69.986
	14:38:00			493.260						
4-1	14:40:00	0.80	2.40	493.260	0.894	354	96	91	4.650	63.233
4-2	14:45:00	0.70	2.10	497.910	0.837	353	97	91	4.350	59.149
	14:50:00			502.260						
5-1	14:52:00	0.88	2.60	502.260	0.938	354	101	92	4.880	66.319
5-2	14:57:00	0.72	2.10	507.140	0.849	355	101	93	4.420	59.988
	15:02:00			511.560						
6-1	15:04:00	0.92	2.80	511.560	0.959	353	102	95	4.990	67.809
6-2	15:09:00	0.98	2.90	516.550	0.990	354	103	96	5.164	69.986
	15:14:00			521.714						
Total				57.672			98.1	90.4	57.672	
Average			2.56		0.923	353.4	94.3			

Company:	ADA-ES, Inc.	
Plant:	We Energies - Presque Isle Power Plant	
Test Location:	Toxecon Outlet	
Test Method:	17/26A	
Test Engineer:	E. Osthus	
Test Technician:	R. Sollars/S. McGough	
lb/mmBtu Emissions by:	Standard	
Type of Fuel Firing:	Coal, Sub-Bituminous	
Standard Fuel Factor Fd, dscf/mmBtu:	9820	
Temp ID:	CM-4	
Meter ID:	CM-4	
Pitot ID:	038A	
Pitot Tube Coefficient:	0.840	
Probe Length:	16.0	**ft**
Probe Liner Material:	Teflon	
Nozzle Diameter:	0.269	**in.**
Nozzle Kit ID Number:	2	
Meter Calibration Factor (Y):	1.015	
Meter Orifice Setting (Delta H):	1.548	
Sample Plane:	Horizontal	
Port Length:	7.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Rectangular	
Length	17	**ft**
Width	18	**ft**
Duct Area:	306.000	**Sq. Ft.**
Number of Ports Sampled:	6	
Number of Points per Port:	4	
Minutes per Point:	2.5	
Total Number of Traverse Points:	24	
Test Length:	60	**min.**
Train Type:	Hot Box	
Source Condition:	Normal	
# of Runs	3	

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Toxecon Outlet
Test Method: 17/26A

	RUN 1	
	Filterable	Condensable
Sample ID:		
Item:	Filter	
PM, grams (net) collected:	0.0073	

	RUN 2		
	Filterable	Condensable	Total
Sample ID:			
Item:	Filter		
PM, grams (net) collected:	0.0169		

	RUN 3		
	Filterable	Condensable	Total
Sample ID:			
Item:	Filter		
PM, grams (net) collected:	0.0073		

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power
Location: Toxecon Outlet
Test Method: 17/26A

		Run 1	Run 2	Run 3
Identify Analyte:	Hydrogen Chloride (HCl)			
Molecular Weight:	36.45			
mg (net) collected:		2.15	1.84	1.99
Identify Analyte:	Hydrogen Bromide (HBr)			
Molecular Weight:	80.9			
mg (net) collected:		0.38	0.4	0.37
Identify Analyte:	Hydrogen Fluoride (HF)			
Molecular Weight:	19.99			
mg (net) collected:		1.26	1.46	0.99
Identify Analyte:	Chloride (Cl2)			
Molecular Weight:	70.9			
mg (net) collected:		0.18	0.05	0.05
Identify Analyte:	Bromide (Br2)			
Molecular Weight:	159.8			
mg (net) collected:		0.05	0.05	0.05

Run 1-Method 17/26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Toxecon Outlet
Source Condition: Normal

Date: 11/4/08
Start Time: 8:35
End Time: 9:59

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.93	in. H_2O	Static Pressure	4.00	in. H_2O
Meter Temperature, Tm:	67.4	°F	Flue Pressure (Ps):	29.52	in. Hg. abs.
Sqrt ΔP:	0.833	in. H_2O	Carbon Dioxide:	12.80	%
Stack Temperature, Ts:	341.1	°F	Oxygen:	6.20	%
Meter Volume, Vm:	50.204	ft^3	Nitrogen:	81.00	%
Meter Volume, Vmstd:	50.080	dscf	Gas Weight dry, Md:	30.296	lb/lb mole
Meter Volume, Vwstd:	6.123	wscf	Gas Weight wet, Ms:	28.956	lb/lb mole
Isokinetic Variance:	105.2	%I	Excess Air:	40.832	%
			Gas Velocity, Vs:	57.876	fps
Test Length	60.00	in mins.	Volumetric Flow:	1,062,597	acfm
Nozzle Diameter	0.269	in inches	Volumetric Flow:	615,774	dscfm
Barometric Pressure	29.23	in Hg	Volumetric Flow:	691,061	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3816.6	ml	Silica Initial Wt.	0.0
Final Impinger Content:	3946.6	ml	Silica Final Wt.	0.0
Difference:	130.0		Difference:	0.0
Total Water Gain:	130.0		Moisture, Bws:	0.109

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	8:35:00	0.51	1.40	9.613	0.714	335	63	64	1.807	49.644
1-2	8:37:30	1.00	2.70	11.420	1.000	337	64	64	2.490	69.516
1-3	8:40:00	1.60	4.30	13.910	1.265	339	65	64	3.190	87.931
1-4	8:42:30	1.30	3.50	17.100	1.140	338	66	64	2.860	79.260
	8:45:00			19.960						
2-1	8:48:00	0.58	1.50	19.960	0.762	338	65	64	1.910	52.942
2-2	8:50:30	1.00	2.70	21.870	1.000	338	66	64	2.520	69.516
2-3	8:53:00	0.98	2.60	24.390	0.990	340	67	64	2.460	68.817
2-4	8:55:30	1.00	2.70	26.850	1.000	340	68	64	2.540	69.516
	8:58:00			29.390						
3-1	9:10:00	0.99	2.60	29.390	0.995	340	67	65	2.510	69.167
3-2	9:12:30	0.90	2.40	31.900	0.949	342	68	65	2.360	65.949
3-3	9:15:00	0.87	2.30	34.260	0.933	343	69	65	2.350	64.840
3-4	9:17:30	0.63	1.70	36.610	0.794	344	70	65	2.009	55.176
	9:20:00			38.619						
4-1	9:24:00	0.43	1.10	38.619	0.656	342	70	65	1.641	45.585
4-2	9:26:30	0.69	1.80	40.260	0.831	344	71	66	2.080	57.744
4-3	9:29:00	0.52	1.40	42.340	0.721	344	72	66	1.840	50.129
4-4	9:31:30	0.45	1.20	44.180	0.671	343	72	66	1.667	46.633
	9:34:00			45.847						
5-1	9:37:00	0.56	1.50	45.847	0.748	342	71	66	1.873	52.021
5-2	9:39:30	0.58	1.50	47.720	0.762	344	72	67	1.920	52.942
5-3	9:42:00	0.30	0.80	49.640	0.548	343	73	67	1.370	38.075
5-4	9:44:30	0.44	1.20	51.010	0.663	343	73	67	1.669	46.112
	9:47:00			52.679						
6-1	9:49:00	0.50	1.30	52.679	0.707	342	72	67	1.781	49.155
6-2	9:51:30	0.35	0.93	54.460	0.592	343	73	67	1.510	41.126
6-3	9:54:00	0.62	1.60	55.970	0.787	342	73	67	1.950	54.737
6-4	9:56:30	0.57	1.50	57.920	0.755	341	74	68	1.897	52.483
	9:59:00			59.817						
Total				50.204			69.3	65.5	50.204	
Average			1.93		0.833	341.1	67.4			

Run 2-Method 17/26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Toxecon Outlet
Source Condition: Normal

Date: 11/4/08
Start Time: 11:55
End Time: 13:07

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.82	in. H_2O	Static Pressure	3.80	in. H_2O
Meter Temperature, Tm:	75.3	°F	Flue Pressure (Ps):	29.51	in. Hg. abs.
Sqrt ΔP:	0.810	in. H_2O	Carbon Dioxide:	12.60	%
Stack Temperature, Ts:	347.0	°F	Oxygen:	6.00	%
Meter Volume, Vm:	48.881	cf	Nitrogen:	81.4	%
Meter Volume, Vmstd:	48.025	dscf	Gas Weight dry, Md:	30.256	lb/lb mole
Meter Volume, Vwstd:	6.848	wscf	Gas Weight wet, Ms:	28.726	lb/lb mole
Isokinetic Variance:	105.5	%I	Excess Air:	38.736	%
			Gas Velocity, Vs:	56.783	fps
Test Length	60.00	in mins.	Volumetric Flow:	1,042,542	acfm
Nozzle Diameter	0.269	in inches	Volumetric Flow:	588,786	dscfm
Barometric Pressure	29.23	in Hg	Volumetric Flow:	672,747	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3674.2	ml	Silica Initial Wt.	0.0	
Final Impinger Content:	3819.6	ml	Silica Final Wt.	0.0	
Difference:	145.4		Difference:	0.0	
Total Water Gain:	145.4		Moisture, Bws:	0.125	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	11:55:00	0.84	2.20	64.100	0.917	343	69	68	2.280	64.217
1-2	11:57:30	1.30	3.50	66.380	1.140	345	75	71	2.900	79.888
1-3	12:00:00	1.00	2.70	69.280	1.000	346	78	71	2.510	70.066
1-4	12:02:30	1.10	2.90	71.790	1.049	346	78	71	2.641	73.486
	12:05:00			74.431						
2-1	12:07:00	0.55	1.50	74.431	0.742	347	78	72	1.879	51.963
2-2	12:09:30	0.91	2.40	76.310	0.954	347	78	72	2.360	66.839
2-3	12:12:00	0.99	2.60	78.670	0.995	347	78	72	2.520	69.715
2-4	12:14:30	0.93	2.50	81.190	0.964	349	79	72	2.423	67.570
	12:17:00			83.613						
3-1	12:21:00	0.66	1.80	83.613	0.812	348	78	73	2.047	56.922
3-2	12:23:30	0.93	2.50	85.660	0.964	348	78	73	2.410	67.570
3-3	12:26:00	0.89	2.40	88.070	0.943	349	79	73	2.370	66.101
3-4	12:28:30	0.48	1.30	90.440	0.693	349	79	73	1.745	48.543
	12:31:00			92.185						
4-1	12:33:00	0.30	0.80	92.185	0.548	347	78	73	1.375	38.377
4-2	12:35:30	0.56	1.50	93.560	0.748	347	78	73	1.870	52.433
4-3	12:38:00	0.57	1.50	95.430	0.755	347	79	73	1.910	52.899
4-4	12:40:30	0.37	0.98	97.340	0.608	348	79	73	1.525	42.620
	12:43:00			98.865						
5-1	12:45:00	0.58	1.50	98.865	0.762	348	78	73	1.925	53.361
5-2	12:47:30	0.51	1.40	100.790	0.714	347	79	74	1.780	50.037
5-3	12:50:00	0.50	1.30	102.570	0.707	347	79	74	1.780	49.544
5-4	12:52:30	0.37	0.98	104.350	0.608	347	79	74	1.527	42.620
	12:55:00			105.877						
6-1	12:57:00	0.41	1.10	105.877	0.640	347	78	74	1.623	44.864
6-2	12:59:30	0.55	1.50	107.500	0.742	347	79	74	1.850	51.963
6-3	13:02:00	0.61	1.60	109.350	0.781	346	79	74	1.960	54.724
6-4	13:04:30	0.44	1.20	111.310	0.663	346	80	74	1.671	46.477
	13:07:00			112.981						
Total				48.881			78.0	72.7	48.881	
Average			1.82		0.810	347.0	75.3			

Run 3-Method 17/26A

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Toxecon Outlet
Source Condition: Normal

Date: 11/4/08
Start Time: 14:05
End Time: 15:14

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	1.79	In. H_2O	Static Pressure	3.80	in. H_2O
Meter Temperature, Tm:	77.4	°F	Flue Pressure (Ps):	29.51	in. Hg. abs.
Sqrt ΔP:	0.797	In. H_2O	Carbon Dioxide:	12.90	%
Stack Temperature, Ts:	351.9	°F	Oxygen:	5.80	%
Meter Volume, Vm:	48.050	cf	Nitrogen:	81.3	%
Meter Volume, Vmstd:	47.020	dscf	Gas Weight dry, Md:	30.296	lb/lb mole
Meter Volume, Vwstd:	6.641	wscf	Gas Weight wet, Ms:	28.774	lb/lb mole
Isokinetic Variance:	105.3	%I	Excess Air:	37.029	%
			Gas Velocity, Vs:	55.954	fps
Test Length	60.00	in mins.	Volumetric Flow:	1,027,308	acfm
Nozzle Diameter	0.269	in inches	Volumetric Flow:	577,356	dscfm
Barometric Pressure	29.23	in Hg	Volumetric Flow:	658,902	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3833.2	ml	Silica Initial Wt.	0.0	
Final Impinger Content:	3974.2	ml	Silica Final Wt.	0.0	
Difference:	141.0		Difference:	0.0	
Total Water Gain:	141.0		Moisture, Bws:	0.124	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	14:05:00	1.10	2.90	13.590	1.049	352	75	73	2.640	73.649
1-2	14:07:30	0.85	2.30	16.230	0.922	353	76	74	2.340	64.741
1-3	14:10:00	1.00	2.70	18.570	1.000	353	78	74	1.480	70.221
1-4	14:12:30	1.80	4.80	20.050	1.342	355	79	74	4.379	94.212
	14:15:00			24.429						
2-1	14:17:00	0.77	2.00	24.429	0.877	353	80	74	2.211	61.619
2-2	14:19:30	0.96	2.60	26.640	0.980	353	80	74	2.450	68.802
2-3	14:22:00	0.71	1.90	29.090	0.843	354	80	74	2.090	59.169
2-4	14:24:30	1.00	2.70	31.180	1.000	354	80	75	2.545	70.221
	14:27:00			33.725						
3-1	14:29:00	0.81	2.20	33.725	0.900	352	81	75	2.265	63.199
3-2	14:31:30	0.60	1.60	35.990	0.775	353	80	75	1.945	54.393
3-3	14:34:00	0.86	2.30	37.935	0.927	354	81	75	2.355	65.120
3-4	14:36:30	0.58	1.50	40.290	0.762	354	81	75	1.886	53.479
	14:39:00			42.176						
4-1	14:40:00	0.40	1.10	42.176	0.632	350	80	75	1.584	44.412
4-2	14:42:30	0.45	1.20	43.760	0.671	352	80	75	1.690	47.106
4-3	14:45:00	0.46	1.20	45.450	0.678	352	81	75	1.710	47.626
4-4	14:47:30	0.33	0.88	47.160	0.574	354	81	75	1.439	40.339
	14:50:00			48.599						
5-1	14:52:00	0.52	1.40	48.599	0.721	349	80	75	1.801	50.637
5-2	14:54:30	0.35	0.93	50.400	0.592	351	81	75	1.460	41.543
5-3	14:57:00	0.45	1.20	51.860	0.671	351	81	76	1.720	47.106
5-4	14:59:30	0.30	0.80	53.580	0.548	351	81	76	1.375	38.462
	15:02:00			54.955						
6-1	15:04:00	0.52	1.40	54.955	0.721	346	80	76	1.805	50.637
6-2	15:06:30	0.47	1.20	56.760	0.686	350	81	76	1.710	48.141
6-3	15:09:00	0.34	0.90	58.470	0.583	350	81	76	1.480	40.946
6-4	15:11:30	0.45	1.20	59.950	0.671	350	81	76	1.690	47.106
	15:14:00			61.640						
Total				48.050			80.0	74.9	48.050	
Average			1.79		0.797	351.9	77.4			

Company:	ADA-ES, Inc.	
Plant:	We Energies - Presque Isle Power Plant	
Test Location:	Common Toxecon Inlet	
Test Method:	29	
Test Engineer:	M. Platt	
Test Technician:	J. Howe/A. Calix	
lb/mmBtu Emissions by:	Standard	
Type of Fuel Firing:	Coal, Sub-Bituminous	
Standard Fuel Factor Fd, dscf/mmBtu:	9820	
Temp ID:	CM-17	
Meter ID:	CM-17	
Pitot ID:	001A	
Pitot Tube Coefficient:	0.840	
Probe Length:	10.0	**ft**
Probe Liner Material:	Glass	
Nozzle Diameter:	0.271	**in.**
Nozzle Kit ID Number:	2	
Meter Calibration Factor (Y):	1.003	
Meter Orifice Setting (Delta H):	1.681	
Sample Plane:	Vertical	
Port Length:	42.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Rectangular	
Length	18.17	**ft**
Width	17.58	**ft**
Duct Area:	319.429	**Sq. Ft.**
Number of Ports Sampled:	6	
Number of Points per Port:	2	
Minutes per Point:	10.0	
Total Number of Traverse Points:	12	
Test Length:	120	**min.**
Train Type:	Hot Box	
Source Condition:	Normal	
# of Runs	3	

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power I
Location: Common Toxecon Inlet
Test Method: 29

		Run 1	Run 2	Run 3
Identify Analyte:	Arsenic (Ar)			
Molecular Weight:	74.92			
mg (net) collected:		0.0145	0.0065	0.005
Identify Analyte:	Selenium (Se)			
Molecular Weight:	78.96			
mg (net) collected:		0.0642	0.0766	0.01
Identify Analyte:	Manganese (Mn)			
Molecular Weight:	54.94			
mg (net) collected:		0.0621	0.1673	0.1235
Identify Analyte:	Beryllium (Be)			
Molecular Weight:	9.01			
mg (net) collected:		0.0012	0.0034	0.0025
Identify Analyte:	Cadmium (Cd)			
Molecular Weight:	112.4			
mg (net) collected:		0.0076	0.001	0.001
Identify Analyte:	Chromium (Cr)			
Molecular Weight:	51.99			
mg (net) collected:		0.0428	0.0488	0.0206
Identify Analyte:	Lead (Pb)			
Molecular Weight:	207.19			
mg (net) collected:		0.4603	0.0123	0.0093
Identify Analyte:	Nickel (Ni)			
Molecular Weight:	58.71			
mg (net) collected:		0.0308	0.0389	0.0262
Identify Analyte:				
Molecular Weight:				
mg (net) collected:				

Run 1-Method 29

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Common Toxecon Inlet
Source Condition: Normal

Date: 11/5/08
Start Time: 8:20
End Time: 10:35

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.65	in. H_2O	Static Pressure	-3.00	in. H_2O
Meter Temperature, Tm:	79.3	°F	Flue Pressure (Ps):	28.88	in. Hg. abs.
Sqrt ΔP:	0.918	in. H_2O	Carbon Dioxide:	13.50	%
Stack Temperature, Ts:	338.8	°F	Oxygen:	6.00	%
Meter Volume, Vm:	114.843	ft^3	Nitrogen:	80.50	%
Meter Volume, Vmstd:	110.414	dscf	Gas Weight dry, Md:	30.400	lb/lb mole
Meter Volume, Vwstd:	11.257	wscf	Gas Weight wet, Ms:	29.253	lb/lb mole
Isokinetic Variance:	103.2	%I	Excess Air:	39.339	%
			Gas Velocity, Vs:	64.126	fps
Test Length	120.00	in mins.	Volumetric Flow:	1,229,028	acfm
Nozzle Diameter	0.271	in inches	Volumetric Flow:	711,619	dscfm
Barometric Pressure	29.10	in Hg	Volumetric Flow:	784,170	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3022.8	ml	Silica Initial Wt.	0.0	
Final Impinger Content:	3261.8	ml	Silica Final Wt.	0.0	
Difference:	239.0		Difference:	0.0	
Total Water Gain:	239.0		Moisture, Bws:	0.093	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	8:20:00	0.91	2.80	525.137	0.954	331	72	68	4.973	66.611
1-1	8:25:00	0.90	2.80	530.110	0.949	333	72	68	4.940	66.244
1-2	8:30:00	0.89	2.70	535.050	0.943	334	74	71	4.920	65.875
1-2	8:35:00	0.90	2.80	539.970	0.949	335	76	71	4.950	66.244
	8:40:00			544.920						
2-1	8:44:00	0.74	2.30	544.920	0.860	335	79	71	4.480	60.067
2-1	8:49:00	0.86	2.60	549.400	0.927	337	82	71	4.830	64.755
2-2	8:54:00	0.85	2.60	554.230	0.922	337	83	72	4.800	64.377
2-2	8:59:00	0.88	2.70	559.030	0.938	339	85	72	4.890	65.503
	9:04:00			563.920						
3-1	9:06:00	0.78	2.40	563.920	0.883	341	85	73	4.600	61.669
3-1	9:11:00	0.74	2.30	568.520	0.860	341	86	74	4.490	60.067
3-2	9:16:00	0.76	2.30	573.010	0.872	341	86	74	4.540	60.874
3-2	9:21:00	0.78	2.40	577.550	0.883	341	87	75	4.600	61.669
	9:26:00			582.150						
4-1	9:28:00	1.10	3.40	582.150	1.049	342	86	76	5.460	73.235
4-1	9:33:00	0.94	2.90	587.610	0.970	342	86	77	5.050	67.700
4-2	9:38:00	1.00	3.10	592.660	1.000	342	87	77	5.210	69.827
4-2	9:43:00	1.10	3.40	597.870	1.049	343	88	78	5.470	73.235
	9:48:00			603.340						
5-1	9:52:00	0.46	1.40	603.340	0.678	340	86	78	3.530	47.359
5-1	9:57:00	0.48	1.50	606.870	0.693	340	86	78	3.610	48.377
5-2	10:02:00	0.44	1.30	610.480	0.663	340	87	78	3.450	46.318
5-2	10:07:00	0.44	1.30	613.930	0.663	339	87	79	3.460	46.318
	10:12:00			617.390						
6-1	10:15:00	1.10	3.40	617.390	1.049	339	87	78	5.460	73.235
6-1	10:20:00	1.20	3.70	622.850	1.095	339	88	79	5.710	76.491
6-2	10:25:00	1.20	3.70	628.560	1.095	339	88	79	5.710	76.491
6-2	10:30:00	1.20	3.70	634.270	1.095	340	88	79	5.710	76.491
	10:35:00			639.980						
Total				114.843			83.8	74.8	114.843	
Average			2.65		0.918	338.8	79.3			

Run 2-Method 29

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Common Toxecon Inlet
Source Condition: Normal

Date: 11/5/08
Start Time: 11:05
End Time: 13:18

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.63	in. H_2O	Static Pressure	-3.00	in. H_2O
Meter Temperature, Tm:	86.6	°F	Flue Pressure (Ps):	28.88	in. Hg. abs.
Sqrt ΔP:	0.912	in. H_2O	Carbon Dioxide:	13.50	%
Stack Temperature, Ts:	335.5	°F	Oxygen:	5.60	%
Meter Volume, Vm:	115.086	cf	Nitrogen:	80.9	%
Meter Volume, Vmstd:	109.168	dscf	Gas Weight dry, Md:	30.384	lb/lb mole
Meter Volume, Vwstd:	6.943	wscf	Gas Weight wet, Ms:	29.644	lb/lb mole
Isokinetic Variance:	99.6	%I	Excess Air:	35.538	%
			Gas Velocity, Vs:	63.153	fps
Test Length	120.00	in mins.	Volumetric Flow:	1,210,371	acfm
Nozzle Diameter	0.271	in inches	Volumetric Flow:	729,018	dscfm
Barometric Pressure	29.10	in Hg	Volumetric Flow:	775,380	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3631.8	ml	Silica Initial Wt.	0.0	
Final Impinger Content:	3779.2	ml	Silica Final Wt.	0.0	
Difference:	147.4		Difference:	0.0	
Total Water Gain:	147.4		Moisture, Bws:	0.060	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	11:05:00	1.20	3.70	642.664	1.095	337	80	79	5.756	75.833
1-1	11:10:00	1.20	3.70	648.420	1.095	335	86	79	5.770	75.833
1-2	11:15:00	1.10	3.40	654.190	1.049	334	89	79	5.520	72.604
1-2	11:20:00	1.10	3.40	659.710	1.049	334	91	80	5.520	72.604
	11:25:00			665.230						
2-1	11:27:00	0.50	1.50	665.230	0.707	333	89	80	3.750	48.950
2-1	11:32:00	0.50	1.50	668.980	0.707	334	90	81	3.750	48.950
2-2	11:37:00	0.47	1.40	672.730	0.686	334	91	81	3.640	47.459
2-2	11:42:00	0.49	1.50	676.370	0.700	334	91	81	3.710	48.458
	11:47:00			680.080						
3-1	11:49:00	0.80	2.50	680.080	0.894	334	90	81	4.740	61.917
3-1	11:54:00	0.81	2.60	684.820	0.900	334	91	81	4.415	62.303
3-2	11:59:00	0.80	2.50	689.235	0.894	336	92	82	5.115	61.917
3-2	12:04:00	0.83	2.60	694.350	0.911	337	93	82	4.830	63.068
	12:09:00			699.180						
4-1	12:13:00	0.81	2.60	699.180	0.900	337	90	81	4.780	62.303
4-1	12:18:00	0.80	2.50	703.960	0.894	338	92	83	4.740	61.917
4-2	12:23:00	0.83	2.60	708.700	0.911	338	93	84	4.840	63.068
4-2	12:28:00	0.80	2.50	713.540	0.894	337	94	83	4.750	61.917
	12:33:00			718.290						
5-1	12:36:00	0.80	2.50	718.290	0.894	336	92	83	4.740	61.917
5-1	12:41:00	0.85	2.70	723.030	0.922	336	93	84	4.890	63.823
5-2	12:46:00	0.88	2.80	727.920	0.938	336	94	84	4.980	64.939
5-2	12:51:00	0.90	2.80	732.900	0.949	336	94	84	4.130	65.673
	12:56:00			737.030						
6-1	12:58:00	1.00	3.10	737.030	1.000	336	93	84	5.310	69.226
6-1	13:03:00	0.95	3.00	742.340	0.975	336	93	84	5.170	67.473
6-2	13:08:00	0.93	2.90	747.510	0.964	335	94	84	5.120	66.759
6-2	13:13:00	0.93	2.90	752.630	0.964	336	94	84	5.120	66.759
	13:18:00			757.750						
Total				115.086			91.2	82.0	115.086	
Average			2.63		0.912	335.5	86.6			

Run 3-Method 29

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Common Toxecon Inlet
Source Condition: Normal

Date: 11/5/08
Start Time: 13:40
End Time: 15:52

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.60	in. H_2O	Static Pressure	-3.00	in. H_2O
Meter Temperature, Tm:	89.2	°F	Flue Pressure (Ps):	28.88	in. Hg. abs.
Sqrt ΔP:	0.991	in. H_2O	Carbon Dioxide:	13.20	%
Stack Temperature, Ts:	340.2	°F	Oxygen:	5.80	%
Meter Volume, Vm:	115.670	cf	Nitrogen:	81	%
Meter Volume, Vmstd:	109.194	dscf	Gas Weight dry, Md:	30.344	lb/lb mole
Meter Volume, Vwstd:	7.103	wscf	Gas Weight wet, Ms:	29.590	lb/lb mole
Isokinetic Variance:	92.0	%I	Excess Air:	37.218	%
			Gas Velocity, Vs:	68.890	fps
Test Length	120.00	in mins.	Volumetric Flow:	1,320,322	acfm
Nozzle Diameter	0.271	in inches	Volumetric Flow:	789,528	dscfm
Barometric Pressure	29.10	in Hg	Volumetric Flow:	840,884	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3702.4	ml	Silica Initial Wt.	0.0
Final Impinger Content:	3853.2	ml	Silica Final Wt.	0.0
Difference:	150.8		Difference:	0.0
Total Water Gain:	150.8		Moisture, Bws:	0.061

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	13:40:00	0.96	3.00	758.160	0.980	335	85	83	5.200	68.087
1-1	13:45:00	0.96	3.00	763.360	0.980	335	90	84	5.200	68.087
1-2	13:50:00	0.97	3.00	768.560	0.985	336	92	84	5.220	68.441
1-2	13:55:00	0.97	3.00	773.780	0.985	336	93	84	5.230	68.441
	14:00:00			779.010						
2-1	14:03:00	0.80	2.50	779.010	0.894	336	93	84	4.740	62.155
2-1	14:08:00	8.40	2.60	783.750	2.898	337	93	85	4.860	201.404
2-2	14:13:00	0.80	2.50	788.610	0.894	337	94	85	4.750	62.155
2-2	14:18:00	0.84	2.60	793.360	0.917	338	94	85	4.870	63.690
	14:23:00			798.230						
3-1	14:25:00	0.81	2.50	798.230	0.900	339	93	85	4.770	62.542
3-1	14:30:00	0.78	2.40	803.000	0.883	340	94	85	4.680	61.373
3-2	14:35:00	0.76	2.40	807.680	0.872	340	94	85	4.620	60.581
3-2	14:40:00	0.74	2.30	812.300	0.860	341	95	86	4.560	59.778
	14:45:00			816.860						
4-1	14:47:00	0.89	2.80	816.860	0.943	341	93	86	5.000	65.558
4-1	14:52:00	0.92	2.90	821.860	0.959	342	94	86	5.060	66.653
4-2	14:57:00	0.91	2.80	826.920	0.954	342	95	86	5.060	66.290
4-2	15:02:00	0.94	2.90	831.980	0.970	344	94	86	5.140	67.374
	15:07:00			837.120						
5-1	15:10:00	0.41	1.30	837.120	0.640	341	93	86	3.400	44.496
5-1	15:15:00	0.48	1.50	840.520	0.693	344	93	86	3.670	48.145
5-2	15:20:00	0.58	1.80	844.190	0.762	343	94	86	4.040	52.923
5-2	15:25:00	0.60	1.90	848.230	0.775	345	95	86	4.110	53.828
	15:30:00			852.340						
6-1	15:32:00	1.00	3.10	852.340	1.000	344	93	86	5.310	69.491
6-1	15:37:00	1.00	3.10	857.650	1.000	344	95	86	5.310	69.491
6-2	15:42:00	1.10	3.50	862.960	1.049	343	93	86	5.560	72.883
6-2	15:47:00	1.00	3.10	868.520	1.000	342	93	86	5.310	69.491
	15:52:00			873.830						
Total				115.670			93.1	85.3	115.670	
Average			2.60		0.991	340.2	89.2			

Company:	ADA-ES, Inc.	
Plant:	We Energies - Presque Isle Power Plant	
Test Location:	Flue 8 Stack	
Test Method:	29	
Test Engineer:	S. Dyra	
Test Technician:	S. McGough	
lb/mmBtu Emissions by:	Standard	
Type of Fuel Firing:	Coal, Sub-Bituminous	
Standard Fuel Factor Fd, dscf/mmBtu:	9820	
Temp ID:	CM-10	
Meter ID:	CM-10	
Pitot ID:	014A	
Pitot Tube Coefficient:	0.840	
Probe Length:	4.0	**ft**
Probe Liner Material:	Glass	
Nozzle Diameter:	0.234	**in.**
Nozzle Kit ID Number:	3	
Meter Calibration Factor (Y):	0.998	
Meter Orifice Setting (Delta H):	1.541	
Sample Plane:	Horizontal	
Port Length:	6.00	**in.**
Port Size (diameter):	6.00	**in.**
Port Type:	Flange	
Duct Shape:	Circular	
Diameter	9.5	**ft**
Duct Area:	70.882	**Sq. Ft.**
Number of Ports Sampled:	4	
Number of Points per Port:	3	
Minutes per Point:	10.0	
Total Number of Traverse Points:	12	
Test Length:	120	**min.**
Train Type:	Anderson Box	
Source Condition:	Normal	
# of Runs	3	

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power I
Location: Flue 8 Stack
Test Method: 29

		Run 1	Run 2	Run 3
Identify Analyte:	Arsenic (Ar)			
Molecular Weight:	74.92			
mg (net) collected:		0.01	0.01	0.01
Identify Analyte:	Selenium (Se)			
Molecular Weight:	78.96			
mg (net) collected:		0.02	0.0785	0.0227
Identify Analyte:	Manganese (Mn)			
Molecular Weight:	54.94			
mg (net) collected:		0.006	0.006	0.006
Identify Analyte:	Beryllium (Be)			
Molecular Weight:	9.01			
mg (net) collected:		0.002	0.002	0.002
Identify Analyte:	Cadmium (Cd)			
Molecular Weight:	112.4			
mg (net) collected:		0.001	0.001	0.001
Identify Analyte:	Chromium (Cr)			
Molecular Weight:	51.99			
mg (net) collected:		0.012	0.012	0.0078
Identify Analyte:	Lead (Pb)			
Molecular Weight:	207.19			
mg (net) collected:		0.01	0.01	0.01
Identify Analyte:	Nickel (Ni)			
Molecular Weight:	58.71			
mg (net) collected:		0.0135	0.0128	0.0098
Identify Analyte:				
Molecular Weight:				
mg (net) collected:				

Run 1-Method 29

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Test Location: Flue 8 Stack
Source Condition: Normal

Date: 11/5/08
Start Time: 8:20
End Time: 10:30

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.54	in. H_2O	Static Pressure	-0.80	in. H_2O
Meter Temperature, Tm:	90.7	°F	Flue Pressure (Ps):	29.14	in. Hg. abs.
Sqrt ΔP:	1.291	in. H_2O	Carbon Dioxide:	12.60	%
Stack Temperature, Ts:	331.4	°F	Oxygen:	6.10	%
Meter Volume, Vm:	120.315	ft^3	Nitrogen:	81.30	%
Meter Volume, Vmstd:	113.066	dscf	Gas Weight dry, Md:	30.260	lb/lb mole
Meter Volume, Vwstd:	14.507	wscf	Gas Weight wet, Ms:	28.866	lb/lb mole
Isokinetic Variance:	101.6	%I	Excess Air:	39.705	%
			Gas Velocity, Vs:	89.911	fps
Test Length:	120.00	in mins.	Volumetric Flow:	382.387	acfm
Nozzle Diameter:	0.234	in inches	Volumetric Flow:	220.216	dscfm
Barometric Pressure:	29.20	in Hg	Volumetric Flow:	248.471	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	2839.8	ml	Silica Initial Wt.	0.0	
Final Impinger Content:	3147.8	ml	Silica Final Wt.	0.0	
Difference:	308.0		Difference:	0.0	
Total Water Gain:	308.0		Moisture, Bws:	0.114	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	8:20:00	1.70	2.60	92.115	1.304	325	83	82	5.005	90.819
1-1	8:25:00	1.70	2.60	97.120	1.304	326	86	81	5.090	90.819
1-2	8:30:00	1.70	2.60	102.210	1.304	326	88	83	5.040	90.819
1-2	8:35:00	1.70	2.60	107.250	1.304	327	90	83	5.100	90.819
1-3	8:40:00	1.70	2.60	112.350	1.304	327	92	84	5.000	90.819
1-3	8:45:00	1.60	2.40	117.350	1.265	327	93	85	4.980	88.107
	8:50:00			122.330						
2-1	8:54:00	1.60	2.40	122.330	1.265	329	94	86	4.820	88.107
2-1	8:59:00	1.50	2.30	127.150	1.225	330	94	86	4.800	85.309
2-2	9:04:00	1.70	2.60	131.950	1.304	331	92	87	5.060	90.819
2-2	9:09:00	1.70	2.60	137.010	1.304	332	95	87	5.080	90.819
2-3	9:14:00	1.70	2.60	142.090	1.304	332	96	88	5.100	90.819
2-3	9:19:00	1.70	2.60	147.190	1.304	333	96	88	5.060	90.819
	9:24:00			152.250						
3-1	9:27:00	1.70	2.60	152.250	1.304	333	96	89	5.070	90.819
3-1	9:32:00	1.70	2.60	157.320	1.304	334	96	88	5.030	90.819
3-2	9:37:00	1.70	2.60	162.350	1.304	334	96	89	5.070	90.819
3-2	9:42:00	1.70	2.60	167.420	1.304	335	96	89	5.060	90.819
3-3	9:47:00	1.70	2.60	172.480	1.304	335	96	89	5.060	90.819
3-3	9:52:00	1.60	2.40	177.560	1.265	334	98	90	4.960	88.107
	9:57:00			182.520						
4-1	10:00:00	1.60	2.40	182.520	1.265	334	96	90	4.900	88.107
4-1	10:05:00	1.60	2.40	187.420	1.265	334	97	90	4.880	88.107
4-2	10:10:00	1.60	2.40	192.300	1.265	334	98	90	4.880	88.107
4-2	10:15:00	1.70	2.60	197.180	1.304	334	98	90	5.100	90.819
4-3	10:20:00	1.70	2.60	202.280	1.304	334	97	90	5.100	90.819
4-3	10:25:00	1.70	2.60	207.380	1.304	334	98	90	5.050	90.819
	10:30:00			212.430						
Total				120.315			94.2	87.3	120.315	
Average			2.54		1.291	331.4	90.7			

Run 2-Method 29

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Flue 8 Stack
Source Condition: Normal

Date: 11/5/08
Start Time: 11:05
End Time: 13:13

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.68	in. H_2O	Static Pressure:	-0.80	in. H_2O
Meter Temperature, Tm:	92.3	°F	Flue Pressure (Ps):	29.14	in. Hg. abs.
Sqrt ΔP:	1.329	in. H_2O	Carbon Dioxide:	12.50	%
Stack Temperature, Ts:	331.5	°F	Oxygen:	6.20	%
Meter Volume, Vm:	124.555	cf	Nitrogen:	81.3	%
Meter Volume, Vmstd:	116.768	dscf	Gas Weight dry, Md:	30.248	lb/lb mole
Meter Volume, Vwstd:	15.034	wscf	Gas Weight wet, Ms:	28.851	lb/lb mole
Isokinetic Variance:	101.9	%I	Excess Air:	40.621	%
			Gas Velocity, Vs:	92.595	fps
Test Length:	120.00	in mins.	Volumetric Flow:	393.798	acfm
Nozzle Diameter:	0.234	in inches	Volumetric Flow:	226.686	dscfm
Barometric Pressure:	29.20	in Hg	Volumetric Flow:	255.873	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	2833.0	ml	Silica Initial Wt.	0.0
Final Impinger Content:	3152.2	ml	Silica Final Wt.	0.0
Difference:	319.2		Difference:	0.0
Total Water Gain:	319.2		Moisture, Bws:	0.114

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	11:05:00	1.80	2.70	15.325	1.342	333	87	87	5.095	93.478
1-1	11:10:00	1.80	2.70	20.420	1.342	333	91	88	5.370	93.478
1-2	11:15:00	1.80	2.70	25.790	1.342	332	93	87	5.160	93.478
1-2	11:20:00	1.70	2.60	30.950	1.304	332	95	88	5.030	90.845
1-3	11:25:00	1.70	2.60	35.980	1.304	331	95	88	5.100	90.845
1-3	11:30:00	1.70	2.60	41.080	1.304	331	96	88	5.220	90.845
	11:35:00			46.300						
2-1	11:37:00	1.70	2.60	46.300	1.304	330	93	88	5.080	90.845
2-1	11:42:00	1.70	2.60	51.380	1.304	330	96	89	5.010	90.845
2-2	11:47:00	1.70	2.60	56.390	1.304	330	96	89	5.110	90.845
2-2	11:52:00	1.70	2.60	61.500	1.304	330	96	89	5.090	90.845
2-3	11:57:00	1.70	2.60	66.590	1.304	330	96	89	5.110	90.845
2-3	12:02:00	1.70	2.60	71.700	1.304	330	96	89	5.110	90.845
	12:07:00			76.810						
3-1	12:10:00	1.70	2.60	76.810	1.304	331	93	90	5.110	90.845
3-1	12:15:00	1.80	2.70	81.920	1.342	332	96	90	5.130	93.478
3-2	12:20:00	1.80	2.70	87.050	1.342	332	97	90	5.300	93.478
3-2	12:25:00	1.80	2.70	92.350	1.342	332	97	90	5.250	93.478
3-3	12:30:00	1.80	2.70	97.600	1.342	332	97	90	5.290	93.478
3-3	12:35:00	1.80	2.70	102.890	1.342	332	97	90	5.250	93.478
	12:40:00			108.140						
4-1	12:43:00	1.80	2.70	108.140	1.342	332	95	90	5.210	93.478
4-1	12:48:00	1.80	2.70	113.350	1.342	332	96	90	5.240	93.478
4-2	12:53:00	1.80	2.70	118.590	1.342	332	97	90	5.230	93.478
4-2	12:58:00	1.90	2.90	123.820	1.378	332	97	90	5.390	96.040
4-3	13:03:00	1.90	2.90	129.210	1.378	332	98	90	5.410	96.040
4-3	13:08:00	1.80	2.70	134.620	1.342	332	98	91	5.260	93.478
	13:13:00			139.880						
Total				124.555			95.3	89.2	124.555	
Average			2.68		1.329	331.5	92.3			

Run 3-Method 29

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Flue 8 Stack
Source Condition: Normal

Date: 11/5/08
Start Time: 13:40
End Time: 15:47

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH:	2.58	in. H_2O	Static Pressure:	-3.00	in. H_2O
Meter Temperature, Tm:	93.7	°F	Flue Pressure (Ps):	28.98	in. Hg. abs.
Sqrt ΔP:	1.301	in. H_2O	Carbon Dioxide:	13.20	%
Stack Temperature, Ts:	334.3	°F	Oxygen:	5.80	%
Meter Volume, Vm:	122.054	cf	Nitrogen:	81	%
Meter Volume, Vmstd:	114.105	dscf	Gas Weight dry, Md:	30.344	lb/lb mole
Meter Volume, Vwstd:	7.103	wscf	Gas Weight wet, Ms:	29.621	lb/lb mole
Isokinetic Variance:	97.5	%I	Excess Air:	37.218	%
			Gas Velocity, Vs:	89.841	fps
Test Length:	120.00	in mins	Volumetric Flow:	382,087	acfm
Nozzle Diameter:	0.234	in inches	Volumetric Flow:	231,601	dscfm
Barometric Pressure:	29.20	in Hg	Volumetric Flow:	246,017	scfm

MOISTURE DETERMINATION					
Initial Impinger Content:	3702.4	ml	Silica Initial Wt.	0.0	
Final Impinger Content:	3853.2	ml	Silica Final Wt.	0.0	
Difference:	150.8		Difference:	0.0	
Total Water Gain:	150.8		Moisture, Bws:	0.059	

Port-Point No.	Clock Time	Velocity Head Δp in. H2O	Orifice ΔH in. H2O	Actual Meter Vol. ft^3	Sqrt. Δp	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Collected Vol. ft^3	Point Vel ft/sec
1-1	13:40:00	1.70	2.60	40.230	1.304	331	89	90	5.060	90.065
1-1	13:45:00	1.70	2.60	45.290	1.304	331	90	89	5.100	90.065
1-2	13:50:00	1.70	2.60	50.390	1.304	331	91	89	5.080	90.065
1-2	13:55:00	1.70	2.60	55.470	1.304	331	94	89	5.110	90.065
1-3	14:00:00	1.60	2.40	60.580	1.265	331	95	89	4.960	87.376
1-3	14:05:00	1.60	2.40	65.540	1.265	331	96	89	4.950	87.376
	14:10:00			70.490						
2-1	14:13:00	1.70	2.60	70.490	1.304	332	95	90	5.100	90.065
2-1	14:18:00	1.70	2.60	75.590	1.304	332	96	90	5.080	90.065
2-2	14:23:00	1.70	2.60	80.670	1.304	333	97	90	5.120	90.065
2-2	14:28:00	1.70	2.60	85.790	1.304	333	98	91	5.130	90.065
2-3	14:33:00	1.70	2.60	90.920	1.304	333	98	91	5.110	90.065
2-3	14:38:00	1.70	2.60	96.030	1.304	334	98	91	4.970	90.065
	14:43:00			101.000						
3-1	14:45:00	1.70	2.60	101.000	1.304	334	94	91	5.130	90.065
3-1	14:50:00	1.70	2.60	106.130	1.304	334	98	92	5.090	90.065
3-2	14:55:00	1.70	2.60	111.220	1.304	335	98	91	5.110	90.065
3-2	15:00:00	1.70	2.60	116.330	1.304	335	99	92	5.130	90.065
3-3	15:05:00	1.70	2.60	121.460	1.304	336	99	92	5.120	90.065
3-3	15:10:00	1.70	2.60	126.580	1.304	336	99	92	5.100	90.065
	15:15:00			131.680						
4-1	15:17:00	1.70	2.60	131.680	1.304	337	96	92	5.080	90.065
4-1	15:22:00	1.70	2.60	136.760	1.304	337	98	92	5.090	90.065
4-2	15:27:00	1.70	2.60	141.850	1.304	338	99	92	5.080	90.065
4-2	15:32:00	1.70	2.60	146.930	1.304	339	99	92	5.100	90.065
4-3	15:37:00	1.70	2.60	152.030	1.304	339	99	93	5.110	90.065
4-3	15:42:00	1.70	2.60	157.140	1.304	339	99	93	5.144	90.065
	15:47:00			162.284						
Total				122.054			96.4	90.9	122.054	
Average			2.58		1.301	334.3	93.7			

PLATT ENVIRONMENTAL SERVICES, INC.

Procedures for Calibration

Dry Gas Meters

The test meters are calibrated according to Method 5, Section 5.3 and "Procedures for Calibrating and Using Dry Gas Volume Meters as Calibration Standards" by P.R. Westlin and R.T. Shigehara, March 10, 1978.

Analytical Balance

The accuracy of the analytical balance is checked with Class S, Stainless Steel Type 303 weights manufactured by F. Hopken and Son, Jersey City, New Jersey.

Temperature Sensing Devices

The potentiometer and thermocouples are calibrated utilizing a NBS traceable millivolt source.

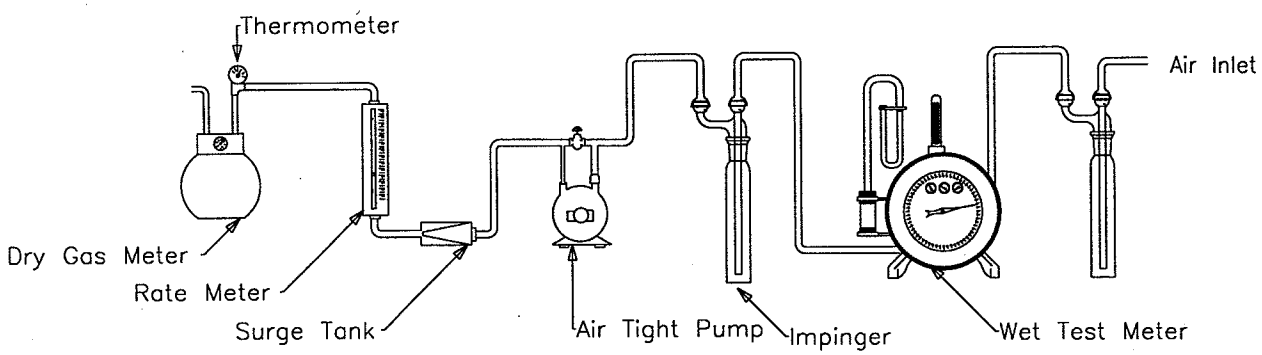
Nozzles

The nozzles are measured according to Method 5, Section 5.1.

Pitot Tubes

The pitot tubes used during this test program are fabricated according to the specification described and illustrated in the Code of Federal Regulations, Title 40, Part 60, Appendix A, Methods 1 through 5 as published in the Federal Register, Volume 42, No. 160; hereafter referred to by the appropriate method number. The pitot tubes comply with the alignment specifications in Method 2, Section 4; and the pitot tube assemblies are in compliance with specifications in the same section.

Dry Gas Meter Calibration Sample Train Diagram



Meter Box Calibration

Dry Gas Meter No.	CM6	Date:	October 27, 2008
Standard Meter No.	9605804	Calibrated By:	S. Sands
Standard Meter (Y)	0.9938	Barometric Pressure:	29.36

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			67.628	110.440	53	58	57					
Initial			58.746	101.423	53	57	57					
Difference	1	0.20	8.882	9.017	53	58	57	57	32	17	0.993	1.451
Final			73.544	116.450	53	60	57					
Initial			67.628	110.440	53	57	57					
Difference	2	0.50	5.916	6.010	53	59	57	58	14	12	0.992	1.580
Final			80.136	123.157	53	62	58					
Initial			73.544	116.450	53	60	57					
Difference	3	0.70	6.592	6.707	53	61	58	59	13	23	0.993	1.578
Final			90.046	133.223	53	64	58					
Initial			80.136	123.157	53	63	58					
Difference	4	0.90	9.910	10.066	53	64	58	61	17	33	0.997	1.539
Final			97.985	141.305	54	63	59					
Initial			90.046	133.223	54	59	59					
Difference	5	1.20	7.939	8.082	54	61	59	60	12	0	0.991	1.503
Final			58.746	101.423	52	63	56					
Initial			50.670	93.210	53	61	56					
Difference	6	2.00	8.076	8.213	53	62	56	59	10	0	0.991	1.674
									Average		**0.993**	**1.554**

Stack Temperature Sensor Calibration

Meter Box # : CM6 *Name :* S. Sands

Ambient Temperature : 58.3 °F *Date :* October 27, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	-3	0.7
250	248	0.3
600	600	0.0
1200	1207	0.4

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Meter Box Calibration

Dry Gas Meter No.	CM17	Date:	October 27, 2008
Standard Meter No.	9605804	Calibrated By:	M. Platt
Standard Meter (Y)	0.9938	Barometric Pressure:	29.45

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			90.750	263.956	63	66	69					
Initial			83.585	256.755	63	65	68					
Difference	1	0.20	7.165	7.201	63	66	69	67	26	16	1.002	1.501
Final			97.167	270.408	63	67	70					
Initial			90.985	264.171	64	66	68					
Difference	2	0.50	6.182	6.237	64	67	69	68	15	2	0.998	1.652
Final			104.249	277.529	64	67	72					
Initial			97.303	270.537	64	67	69					
Difference	3	0.70	6.946	6.992	64	67	71	69	14	20	1.001	1.665
Final			111.847	285.159	64	68	73					
Initial			104.374	277.655	64	67	71					
Difference	4	0.90	7.473	7.504	64	68	72	70	13	44	1.005	1.695
Final			118.235	291.575	64	68	73					
Initial			111.993	285.296	64	68	71					
Difference	5	1.20	6.242	6.279	64	68	72	70	10	11	1.002	1.780
Final			83.373	256.541	63	65	72					
Initial			76.576	249.774	63	64	68					
Difference	6	2.00	6.797	6.767	63	65	70	67	8	37	1.008	1.794
									Average		**1.003**	**1.681**

Stack Temperature Sensor Calibration

Meter Box # : CM17 *Name :* M. Platt

Ambient Temperature : 62.2 °F *Date :* October 27, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	2	0.4
250	253	0.4
600	603	0.3
1200	1207	0.4

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Meter Box Calibration

Dry Gas Meter No.	CM 4	Date:	October 24, 2008
Standard Meter No.	9605804	Calibrated By:	M. Platt
Standard Meter (Y)	1.0008	Barometric Pressure:	29.29

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			877.822	405.611	62	67	65					
Initial			864.361	392.300	62	68	65					
Difference	1	0.20	13.461	13.311	62	68	65	66	50	17	1.019	1.563
Final			96.162	23.887	63	70	67					
Initial			77.822	5.611	62	67	65					
Difference	2	0.50	18.340	18.276	63	69	66	67	42	54	1.011	1.532
Final			18.377	45.522	62	70	66					
Initial			12.120	39.336	62	68	65					
Difference	3	0.70	6.257	6.186	62	69	66	67	12	27	1.020	1.549
Final			36.489	63.466	62	71	67					
Initial			18.458	45.559	62	69	66					
Difference	4	0.90	18.031	17.907	62	70	67	68	31	43	1.017	1.554
Final			44.465	71.446	62	70	66					
Initial			36.489	63.466	62	67	67					
Difference	5	1.20	7.976	7.980	62	69	67	68	12	2	1.007	1.526
Final			864.202	392.143	61	71	65					
Initial			855.533	383.554	61	68	63					
Difference	6	2.00	8.669	8.589	61	70	64	67	10	16	1.015	1.563
									Average		**1.015**	**1.548**

Stack Temperature Sensor Calibration

Meter Box # : CM 4 *Name :* M. Platt

Ambient Temperature : 63.1 °F *Date :* October 24, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	0	0.0
250	250	0.0
600	599	0.1
1200	1201	0.1

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

V-97

Meter Box Calibration

Dry Gas Meter No.	CM10	Date:	October 29, 2008
Standard Meter No.	9605804	Calibrated By:	M .Platt
Standard Meter (Y)	0.9938	Barometric Pressure:	29.42

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			158.750	32.711	64	71	69					
Initial			152.299	26.167	63	71	68					
Difference	1	0.20	6.451	6.544	64	71	69	70	22	52	0.997	1.400
Final			166.025	40.160	64	73	70					
Initial			158.994	33.014	64	71	69					
Difference	2	0.50	7.031	7.146	64	72	70	71	16	11	0.995	1.476
Final			181.467	55.770	65	73	70					
Initial			166.185	40.303	65	69	69					
Difference	3	0.70	15.282	15.467	65	71	70	70	30	17	0.996	1.539
Final			206.756	81.430	65	76	72					
Initial			181.616	55.921	65	73	70					
Difference	4	0.90	25.140	25.509	65	75	71	73	44	43	0.998	1.586
Final			212.745	87.524	65	76	73					
Initial			206.908	81.586	65	75	73					
Difference	5	1.20	5.837	5.938	65	76	73	74	9	12	0.997	1.656
Final			152.080	25.703	62	74	67					
Initial			140.824	14.412	62	71	66					
Difference	6	2.00	11.256	11.291	62	73	67	70	13	29	1.006	1.590
									Average		**0.998**	**1.541**

Stack Temperature Sensor Calibration

Meter Box # : CM10 *Name :* M .Platt

Ambient Temperature : 62.4 °F *Date :* October 29, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	2	0.4
250	255	0.7
600	607	0.7
1200	1215	0.9

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Unit 8 Toxecon Inlet
Test Method: 26A

	Run Time (min):	Vm (dscf):	Tm (oR):	Pbar ("Hg):	DHavg ("H2O):	Md:	Orifice DH@i:	Meter Yi:	Yqa:	Calibration Status:
Test Run 1	60	57.94	558.13	29.20	2.77	30.352	1.554	0.9930	1.051	
Test Run 2	60	58.46	559.88	29.20	2.80	30.392	1.554	0.9930	1.049	
Test Run 3	60	61.63	560.54	29.20	3.10	30.392	1.554	0.9930	1.047	**Pass**
Test Run 4	60			29.20						
								0.9930	1.049	

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Common Toxecon Inlet
Test Method: 29

	Run Time (min):	Vm (dscf):	Tm (oR):	Pbar ("Hg):	DHavg ("H2O):	Md:	Orifice DH@I:	Meter Yi:	Yqa:	Calibration Status:
Test Run 1	120	110.41	539.31	29.10	2.65	30.4	1.681	1.0030	1.021	
Test Run 2	120	109.17	546.60	29.10	2.63	30.384	1.681	1.0030	1.037	
Test Run 3	120	109.19	549.21	29.10	2.60	30.344	1.681	1.0030	1.034	**Pass**
Test Run 4	120			29.10						
								1.0030	1.031	

Company: ADA-ES, Inc.
Plant: We Energies - Presque Isle Power Plant
Location: Flue 8 Stack
Test Method: 29

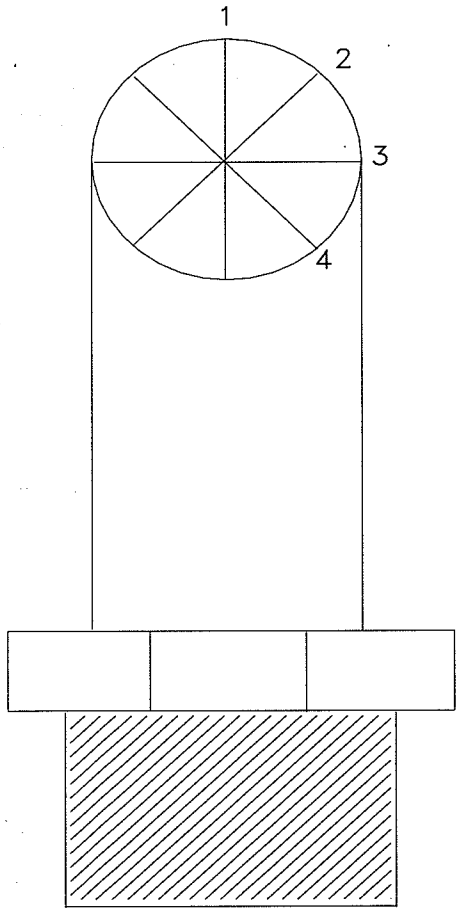
	Run Time (min):	Vm (dscf):	Tm (oR):	Pbar ("Hg):	DHavg ("H2O):	Md:	Orifice DH@1:	Meter Yi:	Yqa:	Calibration Status:
Test Run 1	120	113.07	550.73	29.20	2.54	30.26	1.541	0.9980	1.031	
Test Run 2	120	116.77	552.25	29.20	2.68	30.248	1.541	0.9980	1.026	
Test Run 3	120	114.10	553.67	29.20	2.58	30.344	1.541	0.9980	1.032	**Pass**
Test Run 4	120			29.20						
								0.9980	1.030	

Nozzle Calibration

Date: 10/1/2008

Nozzle ID No.: 2 (9M)

Analyst: AC



0.267	1
0.276	2
0.269	3
0.271	4

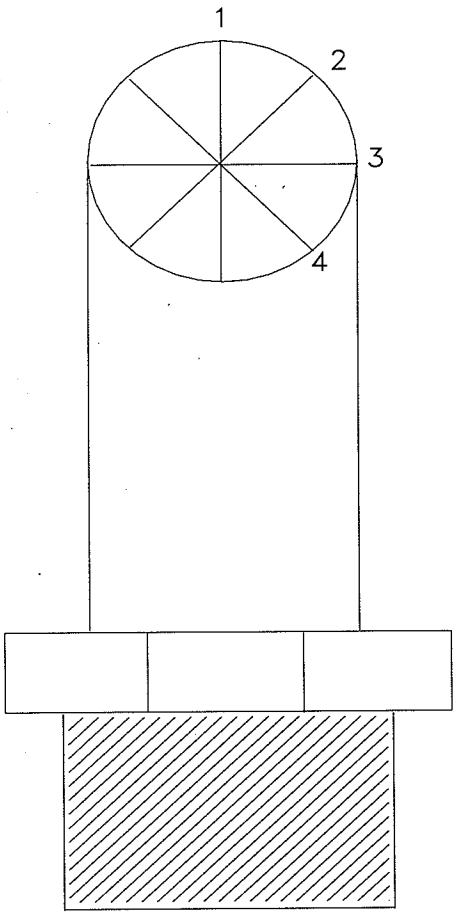
Average
0.271

Nozzle Calibration

Date: 10/1/2008

Nozzle ID No.: 2 (8)

Analyst: AC



0.233	1
0.233	2
0.236	3
0.233	4

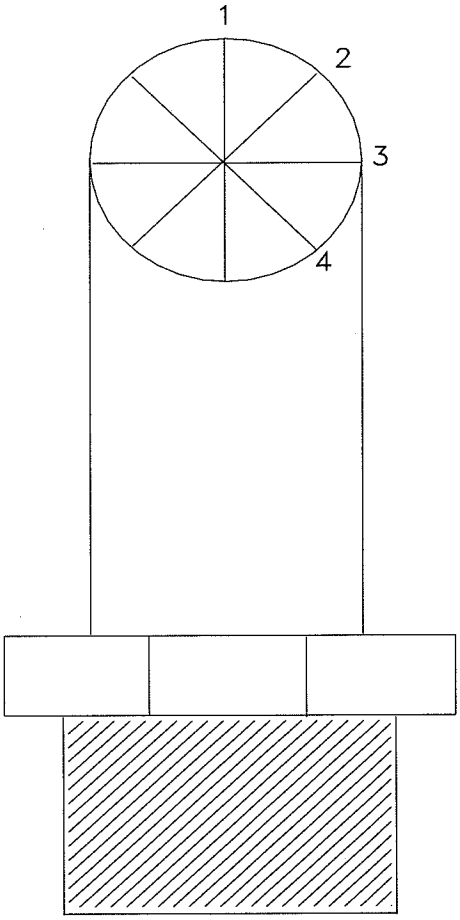
Average
0.234

Nozzle Calibration

Date: 10/3/2008

Nozzle ID No.: 10

Analyst: AC



0.270	1
0.267	2
0.268	3
0.269	4

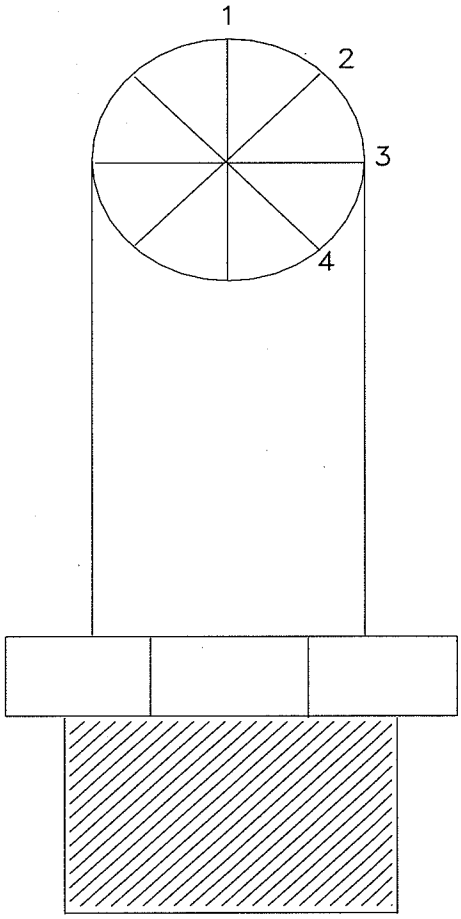
Average
0.269

Nozzle Calibration

Date: 10/3/2008

Nozzle ID No.: N/A

Analyst: AC



0.248	1
0.252	2
0.251	3
0.250	4

Average
0.250

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: #1
Date: 11/4/08
Project Number: M084501
Test Location: UNIT 8 TOXICON INLET
Client Name: NE GRAPHITES
Plant Name: PRESQUE ISLE
Duct Shape: Circular or Rectangular
Length: N/A Width: N/A or
Diameter: N/A
Source Condition: NORMAL
Test Method: M26A
Flue Area: N/A
Port Type: FLANGE
Port Length: 24
Port Size: 4

Meter and Probe Data

Operator: SD
Meter ID: CM6
Meter Y Value: .993 / ΔH 1.554
Pitot ID: 096A
Pitot Coefficient: .840
Probe Length: 7'
Probe Liner: GLASS
Nozzle Diameter: .250
Train Type: HTS
Filter Number/Weight: N/A
Thimble Number/Weight: N/A
Pre-Test Nozzle Leak Check: .005 @ 12 "Hg
Post-Test Nozzle Leak Check: .005 @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 4 "H_2O
Post-Test Pitot Leak Check: ✓ @ 4 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 60
Total Points: 1
Total Test Time: 60
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure: -2
CO_2 %: 13.4
O_2 %: 5.2
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3905.0
Final Imp. Volume or Weight: 4068.4
Imp. Volume or Weight Gain: 163.4
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:		Date:	11/4/08	Test Number:	#1
Client:	WE Energies	Test Location:	UNIT 8 DUCT	Operator:	SD Test Tech: JM
Plant:	Presque Isle	Test Method:	M 26A	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	2.0 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.886 Meter Rate, Cubic Feet/Min.	×5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	8:30	1.4	2.8	41.832	1.183		5.208		324	90	90	2	250	252	60
1-1	8:35	1.3	2.6	47.05	1.140		5.035	47.040	336	95	90	3	250	250	58
1-1	8:40	1.3	2.6	52.08	1.140		5.061	52.075	338	101	91	3	250	250	57
1-1	8:45	1.4	2.8	57.15	1.183		5.251	57.136	341	102	92	4	250	250	56
1-1	8:50	1.4	2.8	62.40	1.183		5.257	62.382	342	103	93	4	250	250	56
1-1	8:55	1.4	2.8	67.66	1.183		5.264	67.645	343	104	94	4	251	250	57
1-1	9:00	1.4	2.8	72.90	1.183		5.268	72.908	343	105	94	4	250	250	57
1-1	9:05	1.4	2.8	78.16	1.183		5.278	78.176	343	106	95	4	250	250	58
1-1	9:10	1.4	2.8	83.44	1.183		5.274	83.454	344	106	95	4	249	250	59
V-1	9:15	1.4	2.8	88.73	1.183		5.284	88.729	344	107	96	4	250	251	60
1-1	9:20	1.4	2.8	94.02	1.183		5.284	94.012	344	107	96	4	250	250	61
1-1	9:25	1.4	2.8	99.31	1.183		5.284	99.296	344	107	96	4	250	250	62
	9:30			104.094				104.580							

M084501B

104

Platt Environmental

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: #2
Date: 11/4/08
Project Number: M084501
Test Location: UNIT 8 TOXICON INLET
Client Name: WE ENERGIES
Plant Name: PERIOUE ISLE
Duct Shape: Circular or Rectangular
Length: N/A Width: N/A or
Diameter: N/A
Source Condition: Normal
Test Method: M 26A
Flue Area: N/A
Port Type: FLANGE
Port Length: 24"
Port Size: 4"

Meter and Probe Data

Operator: SD
Meter ID: CM6
Meter Y Value: .993/1.554
Pitot ID: 0916A
Pitot Coefficient: .840
Probe Length: 7'
Probe Liner: GLASS
Nozzle Diameter: .250
Train Type: HOT BOX
Filter Number/Weight: N/A
Thimble Number/Weight: N/A
Pre-Test Nozzle Leak Check: .002 @ 10 "Hg
Post-Test Nozzle Leak Check: .000 @ 8 "Hg
Pre-Test Pitot Leak Check: ✓ @ 4 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3.5 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 60
Total Points: 1
Total Test Time: 60
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
Static Pressure: -2
CO_2 %: 13.6
O_2 %: 5.4
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3509.0
Final Imp. Volume or Weight: 3711.6
Imp. Volume or Weight Gain: 202.6
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/4/08 | Test Number: #2

Client: WE ENERGIES | Test Location: UNIT 8 | Operator: SD

Plant: PERRIS ISLE | Test Method: M 26 A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	2.0 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.895 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	11:55	1.4	2.8	9.723	1.183		5.272		336	98	97	4	250	259	60
1-1	12:00	1.4	2.8	15.02	1.183		5.280	14.995	338	100	98	4	250	251	57
1-1	12:05	1.4	2.8	20.29	1.183		5.289	20.276	338	102	98	4	250	252	56
1-1	12:10	1.4	2.8	25.57	1.183		5.289	25.565	338	103	97	4	251	253	56
1-1	12:15	1.4	2.8	30.86	1.183		5.284	30.852	338	104	97	4	250	252	57
1-1	12:20	1.4	2.8	36.15	1.183		5.293	36.149	337	103	97	4	252	251	57
1-1	12:25	1.4	2.8	41.43	1.183		5.293	41.441	337	103	97	5	250	250	58
1-1	12:30	1.4	2.8	46.72	1.183		5.293	46.734	337	103	97	5	251	250	58
1-1	12:35	1.4	2.8	52.02	1.183		5.296	52.027	336	103	97	5	251	253	59
1-1	12:40	1.4	2.8	57.33	1.183		5.301	57.323	336	104	97	5	250	252	60
1-1	12:45	1.4	2.8	62.63	1.183		5.301	62.624	336	104	97	5	251	251	61
1-1	12:50	1.4	2.8	67.93	1.183		5.301	67.925	336	104	97	5	250	251	63
	12:55			73.239				73.226							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: #3
Date: 11/4/08
Project Number: M084501
Test Location: UNIT 8 TOXICON INLET
Client Name: WE ENERGIES
Plant Name: PRESQUE ISLE
Duct Shape: Circular or Rectangular
Length: N/A Width: N/A or
Diameter: N/A
Source Condition: Normal
Test Method: M 26A
Flue Area: N/A
Port Type: FLANGE
Port Length: 24"
Port Size: 4"

Meter and Probe Data

Operator: SD
Meter ID: CM 6
Meter Y Value: .993 / (1.552)
Pitot ID: 016A
Pitot Coefficient: .840
Probe Length: 7'
Probe Liner: GLASS
Nozzle Diameter: .250
Train Type: Hot Box
Filter Number/Weight: N/A
Thimble Number/Weight: N/A
Pre-Test Nozzle Leak Check: .005 @ 12 "Hg
Post-Test Nozzle Leak Check: .002 @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3.4 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3.6 "H_2O

Traverse Data

Ports Sampled: 1
Points/Port: 1
Min./Point: 60
Total Points: 1
Total Test Time: 60
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.2
Static Pressure: -2
CO_2 %: 12.6
O_2 %: 5.6
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3924.2
Final Imp. Volume or Weight: 4100.4
Imp. Volume or Weight Gain: 176.2
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/4/08 | Test Number: #3

Client: WE ENERGIES | Test Location: UNIT 8 DUCT | Operator: SD

Plant: PRESQUE ISLE | Test Method: M 26 A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	14:05	1.5	3.0	73.445	1.225		5.453		332	96	96	4	250	252	61
1-1	14:10	1.6	3.2	78.90	1.265		5.662	78.898	333	102	96	5	251	251	58
1-1	14:15	1.6	3.2	84.57	1.265		5.665	84.560	335	104	96	5	250	251	56
1-1	14:20	1.6	3.2	90.22	1.265		5.667	90.226	336	104	97	5	251	252	56
1-1	14:25	1.5	3.0	95.90	1.225		5.494	95.893	334	104	97	5	250	251	57
1-1	14:30	1.6	3.2	101.36	1.265		5.674	101.386	334	104	97	5	250	250	57
1-1	14:35	1.5	3.0	107.03	1.225		5.495	107.060	335	105	97	5	250	251	58
1-1	14:40	1.5	3.0	112.55	1.225		5.500	112.556	335	105	98	5	251	250	59
1-1	14:45	1.5	3.0	118.04	1.225		5.500	118.056	335	105	98	5	250	251	60
1-1	14:50	1.5	3.0	123.57	1.225		5.502	123.556	336	106	98	5	251	249	60
1-1	14:55	1.6	3.2	129.07	1.265		5.686	129.058	335	106	98	5	250	251	61
1-1	15:00	1.6	3.2	134.75	1.265		5.686	134.743	335	106	98	5	250	250	62
	15:05			140.437				140.429							

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT:

UNIT NO:

LOCATION: UNIT 8 ~~[illegible]~~ INLET SD

DATE: 11/04/08

TEST NO: #1

METHOD: 26A

WEIGHED/MEASURED BY:

BALANCE ID:

O_2 CO_2

~~6.6~~% ~~12.2~~%

5.2 13.4

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	844.4	745.2		
IMPINGER 2	912.6	888.0		
IMPINGER 3	755.6	741.0		
IMPINGER 4	730.2	726.4		
IMPINGER 5	825.6	804.4		
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

4068.4	3905.0	163.4
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT: _____

UNIT NO: _____

LOCATION: Unit 8 toxecon inlet SD

DATE: 11/04/08

TEST NO: #2

METHOD: 26A

WEIGHED/MEASURED BY: _____

BALANCE ID: _____

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	832.6	694.4		
IMPINGER 2	723.0	678.6		
IMPINGER 3	711.4	709.8		
IMPINGER 4	677.4	674.6		
IMPINGER 5	767.2	751.6		
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

3711.6	3509.0	202.6
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

5.4 CO_2
13.6 O_2

MERCURY SORBENT TRAP FIELD DATA SHEET

Project: _____ Date: _____
Sampling Location: _____
Source Condition: _____ Barometric Pressure:I _____
Dry Gas Meter No. _____ Y = _____ Static Pressure _____

Test Engineer: _____

68 TOXECON Inlet SD Test #3

Sample Train A			
Clock Time 24 hour	Meter Volume (V_m) liters FINAL	Inlet Meter Temp. (t_m) °F INITIAL	Outlet Meter Temp. (t_m) °F
1	871.4	743.2	
2	911.6	889.2	
3	752.4	745.4	
4	723.4	720.8	
5	841.6	825.6	
Total/Average			

Sample Train B			
Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. Gain (t_m) °F
	4100.4	3924.2	176.2
Total/Average			

264 11/04/08

5.6 O_2
13.6 CO_2

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 1
Test Location: Toxecon Inlet (Common)
Duct Shape: Circular or Rectangular
Source Condition: Normal
Port Type: Flange

Date: 11/4/08
Client Name: ADA
Length: 19.17' Width: 17.58' or
Test Method: 1/2 26A
Port Length: 42"

Project Number: M084501
Plant Name: Ink Energies - Presque Isle
Diameter: —
Flue Area: 337.013 Sq. Feet
Port Size: 6"

Meter and Probe Data

Operator: MPLT
Pitot ID: 081A
Probe Liner: Teflon
Filter Number/Weight: 378 | 7.4290

Meter ID: CM17
Pitot Coefficient: 0.840
Nozzle Diameter: .271

Meter Y Value: 1.003
Probe Length: 18ft
Train Type: Other (Gelman)
Thimble Number/Weight: —

Pre-Test Nozzle Leak Check: 0.002 @ 7 "Hg
Pre-Test Pitot Leak Check: 0 @ 6 "H_2O

Post-Test Nozzle Leak Check: .002 @ 16 "Hg
Post-Test Pitot Leak Check: 0 @ 7 "H_2O

Traverse Data

Ports Sampled: 6
Total Points: 24

Points/Port: 4
Total Test Time: 60

Min./Point: 2.5
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
CO_2 %: 13.4
Initial Imp. Volume or Weight: 3705.4
Initial Silica Weight: N/A

Static Pressure: -3
O_2 %: 5.8
Final Imp. Volume or Weight: 3841.4
Final Silica Weight: N/A

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain: 136.0
Silica Weight Gain: N/A

Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

70.75"
128.27"
185.78"
243.29"

M084501B

V-116
112

Platt Environmental

30.36

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/6/18 | Test Number: 1

Client: ADA | Test Location: Toxecon Inlet (Common) | Operator: MPLY | Test Tech: JHow/AC

Plant: We Energies Presque Isle | Test Method: 17/26A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	X 2.963 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	X1.013 Meter Rate, Cubic Feet/ Min.	X 2.5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	835	.70	2.0	307.242	.836	.847	2.118	—	340	77	75	6	N/A	N/A	61
2	837.5	.70	2.0	309.36	.836	.847	2.118	309.36	340	78	75	6			60
3	840	.44	1.3	311.47	.663	.671	1.679	311.47	340	81	75	5			58
4	842.5	.35	1.0	313.14	.591	.599	1.498	313.14	341	82	75	5			57
	845			314.63				314.63							
2-1	848	.98	2.9	314.63	.989	1.00	2.507	—	342	82	75	6			60
2	850.5	.84	2.5	317.13	.916	.928	2.321	317.13	346	84	76	7			59
3	853	.44	1.3	319.45	.663	.671	1.679	319.45	343	85	76	6			57
4	855.5	.29	.85	321.12	.538	.545	1.363	321.12	343	85	76	4			56
	858			322.48				322.48							
3-1	900	.90	2.6	322.48	.948	.961	2.402	—	343	85	78	8			62
2	902.5	1.0	2.9	324.88	1.00	1.013	2.532	324.88	344	86	77	9			61
3	905	.91	2.6	327.41	.953	.966	2.415	327.41	345	87	78	9			58
4	907.5	.87	2.5	329.82	.932	.944	2.362	329.82	345	87	78	9			57
	910			332.18				332.18							
4-1	912	1.0	2.9	332.18	1.00	1.013	2.532	—	348	87	78	10			61
2	914.5	.99	2.9	334.71	.994	1.00	2.519	334.71	348	87	78	9			62
3	917	.89	2.6	337.22	.943	.955	2.389	337.22	348	87	79	9			61
4	919.5	.83	2.4	339.60	.911	.922	2.307	339.60	349	87	79	9			60
	922			341.90				341.90							
5-1	925	.95	2.8	341.90	.974	.978	2.468	—	349	87	80	8			61
2	927.5	.94	2.7	344.60	.969	.982	2.455	344.36	349	87	79	9			61
3	930	.72	2.1	346.81	.848	.859	2.148	346.81	349	87	79	9			60
4	932.5	.44	1.3	348.95	.663	.671	1.679	348.95	348	87	79	9			58
	935			350.62				350.62							
6-1	939	.65	1.9	350.62	.806	.816	2.041	—	349	86	79	8			60
2	941.5	.74	2.1	352.66	.860	.871	2.178	352.66	349	86	79	9			61
3	944	.73	2.1	354.83	.854	.865	2.163	354.83	350	86	79	9			63
4	946.5	.60	1.7	356.99	.774	.784	1.960	356.99	348	86	79	9			64
	949			358.95				358.95							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 2
Date: 11/4/08
Project Number: M084501
Test Location: Torrecon Inlet (Common)
Client Name: ADA
Plant Name: We Energies-Presque Isle
Duct Shape: Circular or Rectangular
Length: 18.17' Width: 12.58' or
Diameter:
Source Condition: Normal
Test Method: 1/2/6A
Flue Area: 337.013 Sq. Feet
Port Type: Flange
Port Length: 42"
Port Size: 6"

Meter and Probe Data

Operator: MPLT
Meter ID: CM17
Meter Y Value: 1.003
Pitot ID: 001A
Pitot Coefficient: 0.840
Probe Length: 10ft
Probe Liner: Glass
Nozzle Diameter: .271
Train Type: Other (Gelman)
Filter Number/Weight: 423 / 7.4854
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: .002 @ 9 "Hg
Post-Test Nozzle Leak Check: .002 @ 16 "Hg
Pre-Test Pitot Leak Check: 0 @ 3 "H_2O
Post-Test Pitot Leak Check: 0 @ 4 "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 4
Min./Point: 2.5
Total Points: 24
Total Test Time: 60
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.2
Static Pressure: -3
CO_2 %: 13
O_2 %: 5
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3631.8
Final Imp. Volume or Weight: 3779.2
Imp. Volume or Weight Gain: 147.4
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N): S10-18

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/4/08 | Test Number: 2

Client: ADA | Test Location: Toxecon Inlet (Common) | Operator: MPLT | Test Tech: JHow/AC

Plant: We Energies Presque Isle | Test Method: 17/26A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	x3.018 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	x1.032 Meter Rate, Cubic Feet/Min.	x5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1155	.86	2.5	399.791	.921	.933	2.334	—	347	88	82	6	248	250	67
2	1200	.80	2.4	402.12	.894	.923	4.615	402.12	347	92	83	6	250	245	62
	1205			406.73				406.73							
2-1	1207	.87	2.6	406.73	.932	.962	4.812	—	350	92	83	7	250	245	60
2	1212	.70	2.1	411.54	.836	.863	4.317	411.54	349	94	84	7	251	246	61
	1217			415.85				415.85							
V-13-1	1219	.85	2.5	415.85	.921	.951	4.757	—	352	93	84	7	252	247	58
2	1224	.76	2.2	420.60	.871	.899	4.498	420.60	350	95	85	8	248	250	59
	1229			425.09				425.09							
4-1	1233	.83	2.5	425.09	.856	.883	4.419	—	351	94	85	10	249	250	59
2	1238	1.0	3.0	429.50	1.00	1.032	5.16	429.50	350	94	86	12	250	245	57
	1243			434.66				434.66							
5-1	1246	.74	2.2	434.66	.860	.887	4.438	—	351	94	86	11	250	246	60
2	1251	.60	1.8	439.09	.774	.799	3.9969	439.09	351	95	86	13	251	249	61
	1256			443.08				443.08							
6-1	1258	1.2	3.6	443.08	1.09	1.13	5.652	—	349	95	87	15	251	249	62
2	1303	.92	2.7	448.73	.959	.989	4.949	448.73	347	94	87	16	250	248	62
	1308			453.679				453.679							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 3
Test Location: Toxicon Inlet (Common)
Duct Shape: Circular or Rectangular
Source Condition: Normal
Port Type: Flange

Date: 11/4/08
Client Name: ADA
Length: 18.17' Width: 17.58' or
Test Method: 17/26A
Port Length: 42"

Project Number: M084501
Plant Name: We Energies Presque Isle
Diameter:
Flue Area: 337.018 Sq. Feet
Port Size: 6"

Meter and Probe Data

Operator: MPLT
Pitot ID: 001A
Probe Liner: Teflon
Filter Number/Weight: 429 / 7.5207
Pre-Test Nozzle Leak Check: .002 @ 10 "Hg
Pre-Test Pitot Leak Check: 0 @ 7 "H_2O

Meter ID: CM17
Pitot Coefficient: 0.840
Nozzle Diameter: .271

Meter Y Value: 1.003
Probe Length: 10 ft
Train Type: Other (Goelman)
Thimble Number/Weight:
Post-Test Nozzle Leak Check: .002 @ 12 "Hg
Post-Test Pitot Leak Check: 0 @ 8 "H_2O

Traverse Data

Ports Sampled: 6
Total Points: 24

Points/Port: 4
Total Test Time: 60

Min./Point: 2.5
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.20
CO_2 %: 13.4
Initial Imp. Volume or Weight: 3702.4
Initial Silica Weight:

Static Pressure: -3
O_2 %: 5.4
Final Imp. Volume or Weight: 3853.2
Final Silica Weight:

Determined by: Method 3 or Method 3A
Imp. Volume or Weight Gain: 150.8
Silica Weight Gain:

Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/4/09 | Test Number: ~~M084501~~ 3

Client: ADA | Test Location: Tuxedo Inlet (Commercial) | Operator: MPLT | Test Tech: SMcG / AC

Plant: We Energies Pleasant Lake | Test Method: 17/26A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	X3.045 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	X1.042 Meter Rate, Cubic Feet/Min.	X5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1405	1.1	3.3	464.042	1.04	1.09	5.464	—	351	91	87	9	250	246	67
2	1410	.74	2.2	469.50	.860	.896	4.481	469.50	349	95	87	9	251	248	64
	1415			473.98				473.98							
2-1	1416	.91	2.7	473.98	.953	.994	4.970	—	354	96	88	9	245	251	63
2	1421	.61	1.8	478.95	.781	.813	4.069	478.95	356	99	88	9	245	252	61
	1426			483.01				483.01							
V-1 3-1	1428	.96	2.9	483.01	.977	1.02	5.104	—	355	97	88	11	247	249	60
2	1433	.98	2.9	488.11	.989	1.03	5.157	488.11	353	99	89	12	250	251	58
	1438			493.26				493.26							
4-1	1440	.80	2.4	493.26	.894	.931	4.659	—	354	96	91	12	251	248	59
2	1445	.70	2.1	497.91	.836	.871	4.358	497.91	353	97	91	12	247	251	57
	1450			502.26				502.26							
5-1	1452	.88	2.6	502.26	.938	.977	4.887	—	354	101	92	15	250	249	58
2	1457	.72	2.1	507.14	.848	.884	4.420	507.14	355	101	93	15	251	251	61
	1502			511.56				511.56							
6-1	1504	.92	2.8	511.56	.959	.999	4.997	—	353	102	95	16	249	250	62
2	1509	.98	2.9	516.55	.989	.103	5.157	516.55	354	103	96	16	250	251	63
	1514			521.714				521.714							

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT: We Energies - Presque Isle

UNIT NO:

LOCATION: Toxecon inlet common MP

DATE: 11/04/08

TEST NO: #1

METHOD: 26A

WEIGHED/MEASURED BY:

BALANCE ID: 510-15

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	~~[illegible]~~	729.4	779.6	
IMPINGER 2	757.2	710.2		
IMPINGER 3	752.2	738.6		
IMPINGER 4	740.8	736.4		
IMPINGER 5	811.6	790.8		
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

3841.4	3705.4	136.0
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

O_2 5.8

CO_2 13.4

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT: We Energies- Pleasant Isl.

UNIT NO:

LOCATION: Toxflow, Inlet (Common) MP

DATE: 11/04/08

TEST NO: #2

METHOD: 26A

WEIGHED/MEASURED BY:

BALANCE ID: 510-15

5.6 % O_2

13.6 % CO_2

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	789.8	736.0	53.8	
IMPINGER 2	735.2	691.8		
IMPINGER 3	721.6	710.2	11.4	
IMPINGER 4	725.0	718.8	6.2	
IMPINGER 5	807.6	775.0	32.6	
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

3779.2	3631.8	147.4
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

MERCURY SORBENT TRAP FIELD DATA SHEET

Project: _____ Date: _____
Sampling Location: _____
Source Condition: _____ Barometric Pressure:I _____
Dry Gas Meter No. _____ Y = _____ Static Pressure _____

Test Engineer: _____

TOXECON INLET (COMMON) MP TEST #3

Sample Train A

Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. (t_m) °F
	FINAL	INITIAL	
1	700.6	710.2	
2	745.0	708.0	
3	772.2	742.6	
4	744.4	730.2	
5	831.0	811.4	
Total/Average			

Sample Train B

Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. (t_m) °F
		Total	Gain
	3853.2	3702.4	150.8
Total/Average			

26A 11/04/08

15.4 ~~16.6~~ O_2

13.4 ~~2.5~~ CO_2

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 1
Date: 11/14/08
Project Number: M084501
Test Location: Toxecon Outlet
Client Name: ADA
Plant Name: We Energies-Presque Isle
Duct Shape: Circular or Rectangular
Length: 17' Width: 18' or
Diameter: ~~306.00 Sq. Feet~~
Source Condition: Normal
Test Method: 17/26A
Flue Area: 306.00 Sq. Feet
Port Type: Flange
Port Length: 7"
Port Size: 6"

Meter and Probe Data

Operator: EO
Meter ID: CM4
Meter Y Value: 1.015 ΔH = 1.548
Pitot ID: 038A
Pitot Coefficient: 0.840
Probe Length: 16'
Probe Liner: Teflon
Nozzle Diameter: 0.269
Train Type: Other (Gelman)
Filter Number/Weight: 424 / 7.4294
Thimble Number/Weight: N/A
Pre-Test Nozzle Leak Check: 0.002 @ 18 "Hg
Post-Test Nozzle Leak Check: 0.02 @ 17 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 4
Min./Point: 2.5
Total Points: 24
Total Test Time: 60
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.23
Static Pressure: 4.0
CO_2 %: 12.8
O_2 %: 6.2
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3816.6
Final Imp. Volume or Weight: 3946.6
Imp. Volume or Weight Gain: 130
Initial Silica Weight: N/A
Final Silica Weight: N/A
Silica Weight Gain: N/A
Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

32.5"
83.5"
134.5"
185.5"

M084501B

V-125

121

Platt Environmental

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/4/03 | Test Number: 1

Client: ADA | Test Location: Torcon Outlet | Operator: EO | Test Tech: Smedley/Rodos

Plant: Wx Energies-Presque Isle | Test Method: 17/26A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	2.658 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	1.005 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	~~Filter~~ Jumper Temp. °F	Impinger Outlet Well Temp °F
1-1	8:35:00	0.51	1.4	9.613	0.714	0.718	1.794	—	335	63	64	5	251	250	64
2	8:37:30	1.0	2.7	11.420	1.000	1.005	2.513	11.407	337	64	64	9	252	249	58
3	8:40:00	1.6	4.3	13.910	1.265	1.271	3.178	13.920	339	65	64	14	250	251	55
4	8:42:30	1.3	3.5	17.100	1.140	1.146	2.865	17.098	338	66	64	13	254	252	55
	8:45:00			19.960				19.963							
2-1	8:48:00	0.58	1.5	19.960	0.762	0.765	1.913	—	338	65	64	7	250	255	57
2	8:50:30	1.0	2.7	21.870	1.000	1.005	2.513	21.873	338	66	64	8	250	251	54
3	8:53:00	0.98	2.6	24.390	0.990	0.995	2.487	24.386	340	67	64	10	247	248	54
4	8:55:30	1.0	2.7	26.850	1.000	1.005	2.513	26.873	340	68	64	10	246	248	54
	8:58:00			29.390				29.386							
3-1	9:10:00	0.99	2.6	29.390	0.995	1.000	2.500	—	340	67	65	9	249	251	54
2	9:12:30	0.90	2.4	31.900	0.949	0.953	2.384	31.890	342	68	65	8	250	251	50
3	9:15:00	0.87	2.3	34.260	0.933	0.937	2.344	34.274	343	69	65	8	251	251	50
4	9:17:30	0.63	1.7	36.610	0.794	0.798	1.994	36.618	344	70	65	9	251	249	50
	9:20:00			38.619				38.612							
4-1	9:24:00	0.43	1.1	38.619	0.656	0.659	1.648	—	342	70	65	6	250	250	52
2	9:26:30	0.69	1.8	40.260	0.831	0.835	2.087	40.260	344	71	66	8	254	253	49
3	9:29:00	0.52	1.4	42.340	0.721	0.725	1.812	42.347	344	72	66	7	252	250	49
4	9:31:30	0.45	1.2	44.180	0.671	0.674	1.685	44.159	343	72	66	6	252	251	49
	9:34:00			45.847				45.844							
5-1	9:37:00	0.56	1.5	45.847	0.748	0.752	1.880	—	342	71	66	7	250	251	52
2	9:39:30	0.58	1.5	47.720	0.762	0.765	1.913	47.724	344	72	67	7	251	249	49
3	9:42:00	0.30	0.80	49.640	0.548	0.550	1.376	49.637	343	73	67	7	251	250	49
4	9:44:30	0.44	1.2	51.010	0.663	0.667	1.667	51.013	343	73	67	7	252	248	50
	9:47:00			52.679				52.677							
6-1	9:49:00	0.50	1.3	52.679	0.707	0.711	1.777	—	342	72	67	7	251	249	51
2	9:51:30	0.35	0.93	54.460	0.592	0.595	1.486	54.454	343	73	67	5	250	249	50
3	9:54:00	0.62	1.6	55.970	0.787	0.791	1.978	55.940	342	73	67	7	250	251	50
4	9:56:30	0.57	1.5	57.920	0.755	0.759	1.897	57.918	341	74	68	6	251	252	49
	9:59:00			59.817				59.815							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 2
Date: 11/4/08
Project Number: M084501
Test Location: Toxecon Outlet
Client Name: ADA
Plant Name: We Energies Presque Isle
Duct Shape: Circular or Rectangular
Length: 17' Width: 18" or
Diameter:
Source Condition: Normal
Test Method: 17/26A
Flue Area: 306.00 Sq. Feet
Port Type: Flange
Port Length: 7"
Port Size: 6"

Meter and Probe Data

Operator: EO
Meter ID: CM4
Meter Y Value: 1.015 ΔH: 1.548
Pitot ID: 038A
Pitot Coefficient: 0.840
Probe Length: 16'
Probe Liner: Teflon
Nozzle Diameter: .269
Train Type: Other (Gelman)
Filter Number/Weight: 425/ 7.2313
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: 0.001 @ 18 "Hg
Post-Test Nozzle Leak Check: 0.001 @ 18 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 4
Min./Point: 2.5
Total Points: 24
Total Test Time: 60
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.23
Static Pressure: 3.8
CO_2 %: 12.6
O_2 %: 6.0
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3674.2
Final Imp. Volume or Weight: 3819.6
Imp. Volume or Weight Gain: 145.4
Initial Silica Weight: N/A
Final Silica Weight: N/A
Silica Weight Gain: N/A
Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/4/08 | Test Number: 2

Client: ADA | Test Location: Toxecon Outlet | Operator: EO | Test Tech: SMcG/RODS

Plant: We Energies Presque Isle | Test Method: 17/26A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	2.658 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	1.005 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	11:55:00	0.84	2.2	64.100	0.917	0.921	2.303	—	343	69	68	10	245	243	58
2	11:57:30	1.3	3.5	66.380	1.140	1.146	2.865	66.403	345	75	71	11	250	247	49
3	12:00:00	1.0	2.7	69.280	1.000	1.005	2.513	69.278	346	78	71	12	251	255	50
4	12:02:30	1.1	2.9	71.790	1.049	1.054	2.635	71.791	346	78	71	12	250	252	51
	12:05:00			74.431				74.426							
2-1	12:07:00	0.55	1.5	74.431	0.742	0.745	1.863		347	78	72	9	249	252	57
2	12:09:30	0.91	2.4	76.310	0.954	0.959	2.397	76.289	347	78	72	6	248	253	58
3	12:12:00	0.99	2.6	78.670	0.995	1.000	2.500	78.686	347	78	72	10	250	252	56
4	12:14:30	0.93	2.5	81.190	0.964	0.969	2.423	81.186	349	79	72	11	251	252	56
	12:17:00			83.613				83.609							
3-1	12:21:00	0.66	1.8	83.613	0.812	0.816	2.041	—	348	78	73	8	250	248	56
2	12:23:30	0.93	2.5	85.660	0.964	0.969	2.423	85.650	348	78	73	9	251	250	55
3	12:26:00	0.89	2.4	88.070	0.943	0.948	2.370	88.073	349	79	73	10	249	250	54
4	12:28:30	0.48	1.3	90.440	0.693	0.696	1.741	90.443	349	79	73	9	251	254	55
	12:31:00			92.185				92.184							
4-1	12:33:00	0.30	0.80	92.185	0.548	0.550	1.376	—	347	78	73	5	250	252	57
2	12:35:30	0.56	1.5	93.560	0.748	0.752	1.880	93.560	347	78	73	7	252	253	56
3	12:38:00	0.57	1.5	95.430	0.755	0.759	1.897	95.440	347	79	73	7	251	254	54
4	12:40:30	0.37	0.98	97.340	0.608	0.611	1.528	97.337	348	79	73	6	250	254	54
	12:43:00			98.865				98.865							
5-1	12:45:00	0.58	1.5	98.865	0.762	0.765	1.913	—	348	78	73	7	250	251	56
2	12:47:30	0.51	1.4	100.790	0.714	0.718	1.794	100.778	347	79	74	7	248	250	53
3	12:50:00	0.50	1.3	102.570	0.707	0.711	1.777	102.572	347	79	74	7	249	250	54
4	12:52:30	0.37	0.98	104.350	0.608	0.611	1.528	104.349	347	79	74	7	249	251	54
	12:55:00			105.877				105.877							
6-1	12:57:00	0.41	1.1	105.877	0.6403	0.644	1.609	—	347	78	74	7	248	250	55
2	12:59:30	0.55	1.5	107.500	0.742	0.745	1.863	107.486	347	79	74	7	250	250	54
3	13:02:00	0.61	1.6	109.350	0.781	0.785	1.962	109.349	346	79	74	7	251	252	54
4	13:04:30	0.44	1.2	111.310	0.663	0.667	1.667	111.311	346	80	74	7	251	251	54
	13:07:00			112.981				112.978							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 3
Date: 11/4/08
Project Number: M084501
Test Location: Torecon Outlet
Client Name: ADA
Plant Name: We Energies - Presque Isle
Duct Shape: Circular or Rectangular
Length: 17' Width: 18' or
Diameter:
Source Condition: Normal
Test Method: 17/26A
Flue Area: 306.00 Sq Feet
Port Type: Flange
Port Length: 7"
Port Size: 6"

Meter and Probe Data

Operator: EB
Meter ID: CM4
Meter Y Value: 1.015 ΔH=1.548
Pitot ID: 038A
Pitot Coefficient: 0.840
Probe Length: 16'
Probe Liner: Teflon
Nozzle Diameter: .269
Train Type: other (Gelman)
Filter Number/Weight: 388 / 7.3901
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: 0.005 @ 15 "Hg
Post-Test Nozzle Leak Check: 0.005 @ 15 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3 "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 4
Min./Point: 2.5
Total Points: 24
Total Test Time: 60
Sample Plane: ~~Horizontal~~ or Vertical

Stack Parameters

Barometric Pressure: 29.23
Static Pressure: 3.8
CO_2 %: 12.9
O_2 %: 5.8
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3833.2
Final Imp. Volume or Weight: 3974.2
Imp. Volume or Weight Gain: 141.0
Initial Silica Weight: N/A
Final Silica Weight: N/A
Silica Weight Gain: N/A
Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/4/08 | Test Number: 3

Client: ADA | Test Location: Toxecon Outlet | Operator: EO | Test Tech: SMG/RODS

Plant: We Energies-Presque Isle | Test Method: 1/26A | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	2.658 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	1.005 Meter Rate, Cubic Feet/ Min.	Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	14:05:00	1.1	2.9	13.590	1.049	1.054	2.635	—	352	75	73	9	250	252	53
2	14:07:30	0.85	2.3	16.230	0.922	0.927	2.316	16.225	353	76	74	8	248	251	48
3	14:10:00	1.0	2.7	18.570	1.000	1.005	2.513	18.541	353	78	74	7	247	251	49
4	14:12:30	1.8	4.8	20.050	1.342	1.348	3.371	21.054	355	79	74	14	247	250	51
	14:15:00			24.429				24.425							
2-1	14:17:00	0.77	2.0	24.429	0.877	0.882	2.205	—	353	80	74	7	250	251	54
2	14:19:30	0.96	2.6	26.640	0.980	0.985	2.462	26.630	353	80	74	6	251	249	52
3	14:22:00	0.71	1.9	29.090	0.843	0.847	2.117	29.092	354	80	74	7	250	248	52
4	14:24:30	1.0	2.7	31.180	1.000	1.005	2.513	31.209	354	80	75	7	250	249	52
	14:27:00			33.725				33.722							
3-1	14:29:00	0.81	2.2	33.725	0.900	0.905	2.262	—	352	81	75	8	247	251	53
2	14:31:30	0.60	1.6	35.990	0.775	0.778	1.946	35.986	353	80	75	7	245	251	53
3	14:34:00	0.86	2.3	37.935	0.927	0.932	2.330	37.932	354	81	75	7	246	252	53
4	14:36:30	0.58	1.5	40.290	0.762	0.765	1.913	40.262	354	81	75	6	246	252	53
	14:39:00			42.176				42.175							
4-1	14:40:00	0.40	1.1	42.176	0.632	0.636	1.589	—	350	80	75	5	245	253	56
2	14:42:30	0.45	1.2	43.760	0.671	0.674	1.685	43.764	352	80	75	5	245	252	55
3	14:45:00	0.46	1.2	45.450	0.678	0.682	1.704	45.449	352	81	75	5	248	251	54
4	14:47:30	0.33	0.88	47.160	0.574	0.577	1.443	47.153	354	81	75	5	249	250	55
	14:50:00			48.599				48.596							
5-1	14:52:00	0.52	1.4	48.599	0.721	0.725	1.812	—	349	80	75	5	251	250	59
2	14:54:30	0.35	0.93	50.400	0.592	0.595	1.486	50.408	351	81	75	5	249	251	55
3	14:57:00	0.45	1.2	51.860	0.671	0.674	1.685	51.894	351	81	76	5	250	251	55
4	14:59:30	0.30	0.80	53.580	0.548	0.550	1.376	53.579	351	81	76	4	250	250	55
	15:02:00			54.955				54.955							
6-1	15:04:00	0.52	1.4	54.955	0.721	0.725	1.812	—	346	80	76	4	250	248	58
2	15:06:30	0.47	1.2	56.760	0.686	0.689	1.722	56.767	350	81	76	5	251	250	54
3	15:09:00	0.34	0.90	58.470	0.583	0.586	1.465	58.489	350	81	76	5	250	250	55
4	15:11:30	0.45	1.2	59.950	0.671	0.674	1.685	59.954	350	81	76	5	250	252	55
	15:14:00			61.640				61.639							

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT:

UNIT NO:

LOCATION: TOXECON outlet EmO

DATE: 11/04/08

TEST NO: #1

METHOD: 26A

WEIGHED/MEASURED BY:

BALANCE ID:

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	899.2	853.6		
IMPINGER 2	767.4	720.0		
IMPINGER 3	719.2	704.4		
IMPINGER 4	734.8	730.6		
IMPINGER 5	826.0	807.4		
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

3946.6	3816.6	130
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

O_2 6.2

CO_2 12.8

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT:

UNIT NO: TOXECON outlet EO

LOCATION:

DATE: 11/04/08

TEST NO: #2

METHOD: 26A

WEIGHED/MEASURED BY:

BALANCE ID:

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	819.2	723.0		
IMPINGER 2	761.0	731.8		
IMPINGER 3	731.4	727.0		
IMPINGER 4	743.8	742.0		
IMPINGER 5	764.2	750.6		
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

3819.6	3674.2	145.4
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

6.0 O_2
12.6 CO_2

MERCURY SORBENT TRAP FIELD DATA SHEET

Project: _____ Date: _____
Sampling Location: _____
Source Condition: _____ Barometric Pressure:I _____
Dry Gas Meter No. _____ Y = _____ Static Pressure _____

Test Engineer: _____

tokecon outlet EO test #3

Sample Train A			
Clock Time 24 hour	Meter Volume (V_m) liters FINAL	Inlet Meter Temp. (t_m) °F INITIAL	Outlet Meter Temp. (t_m) °F
1	948.2	853.0	
2	749.8	719.6	
3	708.2	703.0	
4	733.4	731.6	
5	834.6	826.0	
Total/Average			

Sample Train B			
Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. (t_m) °F
			Gain
	3974.2	3833.2	141
Total/Average			

26A 11/04/08

5.2 O_2

12.9 CO_2

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 1
Date: 11/5/08
Project Number: M084501
Test Location: Toxecon Inlet (Common)
Client Name: ADA
Plant Name: We Energies-Presque Isle
Duct Shape: Circular or Rectangular
Length: 18.17' Width: 17.58' or
Diameter: —
Source Condition: Normal
Test Method: 29
Flue Area: 337.013 Sq. Feet
Port Type: Flange
Port Length: 42"
Port Size: 6"

Meter and Probe Data

Operator: MPLT
Meter ID: CM 17
Meter Y Value: 1.003
Pitot ID: 001A
Pitot Coefficient: 0.840
Probe Length: 10'
Probe Liner: Glass
Nozzle Diameter: .271
Train Type: 4-1 Box
Filter Number/Weight: 556 / 0.3559
Thimble Number/Weight: —
Pre-Test Nozzle Leak Check: .002 @ 5 "Hg
Post-Test Nozzle Leak Check: .002 @ 15 "Hg
Pre-Test Pitot Leak Check: 0 @ 5 "H_2O
Post-Test Pitot Leak Check: 0 @ 6 "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 2
Min./Point: 10 (5/reading)
Total Points: 12
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.10
Static Pressure: -3
CO_2 %: 13.5
O_2 %: 6.0
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3022.8
Final Imp. Volume or Weight: 3261.8
Imp. Volume or Weight Gain: 239.0
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/5/08 | Test Number: 1

Client: ADA | Test Location: Toxecon Inlet (Common) | Operator: MPLT | Test Tech: JHow/AC

Plant: We Energies Presque Isle | Test Method: 29 | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	×3.128 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	×1.043 Meter Rate, Cubic Feet/Min.	×5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	820	.91	2.8	525.137	.953	.994	4.974	—	331	72	68	5	250	252	67
1	825	.90	2.8	530.11	.948	.989	4.947	530.11	333	72	68	6	251	251	64
2	830	.89	2.7	535.05	.943	.983	4.919	535.03	334	74	71	5	250	253	61
2	835	.90	2.8	539.97	.948	.989	4.947	539.97	335	76	71	6	251	252	60
	840			544.92				544.92							
2-1	844	.74	2.3	544.92	.860	.897	4.486	—	335	79	71	6	252	250	61
1	849	.86	2.6	549.40	.927	.967	4.836	549.40	337	82	71	6	251	251	59
2	854	.85	2.6	554.23	.921	.961	4.807	554.23	337	83	72	7	248	252	59
2	859	.88	2.7	559.03	.938	.978	4.892	559.03	339	85	72	8	249	249	57
	904			563.92				563.9							
3-1	906	.78	2.4	563.92	.883	.921	4.605	—	341	85	73	6	250	251	58
1	911	.74	2.3	568.52	.860	.897	4.486	568.52	341	86	74	6	251	252	56
2	916	.76	2.3	573.01	.871	.909	4.546	573.01	341	86	74	6	250	252	55
2	921	.78	2.4	577.55	.883	.921	4.605	577.55	341	87	75	6	249	251	56
	926			582.15				582.15							
4-1	928	1.1	3.4	582.15	1.04	1.09	5.469	—	342	86	76	8	247	249	57
1	933	.94	2.9	587.61	.969	1.01	5.056	587.61	342	86	77	7	249	248	57
2	938	1.0	3.1	592.66	1.00	1.04	5.215	592.66	342	87	77	8	250	250	59
2	943	1.1	3.4	597.87	1.04	1.09	5.469	597.87	343	88	78	9	250	251	58
	948			603.34				603.34							
5-1	952	.46	1.4	603.34	.678	.707	3.536	—	340	86	78	6	250	250	59
1	957	.48	1.5	606.87	.692	.722	3.613	606.87	340	86	78	6	251	252	57
2	1002	.44	1.3	610.48	.663	.691	3.459	610.48	340	87	78	6	251	251	58
2	1007	.44	1.3	613.93	.663	.691	3.459	613.93	339	87	79	5	251	249	59
	1012			617.39				617.39							
6-1	1015	1.1	3.4	617.39	1.04	1.09	5.469	—	339	87	78	12	250	248	59
1	1020	1.2	3.7	622.85	1.09	1.14	5.712	622.85	339	88	79	13	249	248	61
2	1025	1.2	3.7	628.56	1.09	1.14	5.712	628.56	339	88	79	13	248	250	62
2	1030	1.2	3.7	634.27	1.09	1.14	5.712	634.27	340	88	79	13	249	251	62
	1035			639.93				639.98							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 2
Date: 11/5/08
Project Number: M084501
Test Location: Toxecon Inlet (Common)
Client Name: ADA
Plant Name: WE Energies - Presque Isle
Duct Shape: Circular or Rectangular
Length: 19.17' Width: 17.58' or
Diameter:
Source Condition: Normal
Test Method: 29
Flue Area: 332.613
Port Type: Flange
Port Length: 42"
Port Size: 6"

Meter and Probe Data

Operator: MGT
Meter ID: CM17
Meter Y Value: 1.003
Pitot ID: 001A
Pitot Coefficient: 0.840
Probe Length: 10'
Probe Liner: Glass
Nozzle Diameter: .271
Train Type: Hot Box
Filter Number/Weight: 4261 .4323
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: .002 @ 10 "Hg
Post-Test Nozzle Leak Check: .002 @ 14 "Hg
Pre-Test Pitot Leak Check: 0 @ 7 "H_2O
Post-Test Pitot Leak Check: 0 @ 6 "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 2
Min./Point: 10 (5' reading)
Total Points: 12
Total Test Time: 120'
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.10
Static Pressure: -3
CO_2 %: 13.5
O_2 %: 5.60
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3631.8
Final Imp. Volume or Weight:
Imp. Volume or Weight Gain:
Initial Silica Weight:
Final Silica Weight: 3779.2
Silica Weight Gain: 147.4
Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 Date: 11/5/08 Test Number: 2

Client: ADA Test Location: Tuscon Inlet (Common) Operator: MPLT Test Tech: JHAN/AC

Plant: We Energies-Presque Isle Test Method: 29 Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	×3.186 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	×1.062 Meter Rate, Cubic Feet/Min.	×5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1106	1.2	3.7	642.662	1.09	1.15	5.767	—	337	80	79	10	250	249	67
1	1110	1.2	3.7	648.42	1.09	1.15	5.767	648.42	335	86	79	10	251	253	64
2	1115	1.1	3.4	654.19	1.04	1.10	5.521	654.19	334	89	79	10	249	252	60
2	1120	1.1	3.4	659.71	1.04	1.10	5.521	659.71	334	91	80	10	248	251	59
	1125			665.23				665.23							
2-1	1127	.50	1.5	665.23	.707	.750	3.754	—	333	89	80	5	251	251	60
1	1132	.50	1.5	668.98	.707	.750	3.754	668.98	334	90	81	5	251	250	58
2	1137	.47	1.4	672.73	.685	.728	3.640	672.73	334	91	81	5	250	249	57
2	1142	.49	1.5	676.37	.700	.743	3.717	676.37	334	91	81	5	251	247	56
	1147			680.08				680.08							
V-137 3-1	1149	.80	2.5	680.08	.894	.949	4.749	—	334	90	81	7	249	247	57
1	1154	.81	2.6	684.82	.900	.955	4.779	684.82	334	91	81	7	248	249	58
2	1159	.80	2.5	689.235	.894	.949	4.749	689.60	336	92	82	7	244	250	57
2	1204	.83	2.6	694.35	.911	.967	4.837	694.35	337	93	82	8	251	250	55
	1209			699.18				699.18							
4-1	1213	.81	2.6	699.18	.900	.955	4.779	—	337	90	81	7	250	250	54
1	1218	.80	2.5	703.96	.894	.949	4.749	703.96	338	92	83	7	249	251	55
2	1223	.83	2.6	708.70	.911	.967	4.837	708.70	338	93	84	7	250	250	56
2	1228	.80	2.5	713.54	.894	.949	4.749	713.54	337	94	83	8	250	252	55
	1233			718.29				718.29							
5-1	1236	.80	2.5	718.29	.894	.949	4.749	—	336	92	83	8	252	247	56
1	1241	.85	2.7	723.03	.921	1.06	4.895	723.03	336	93	84	8	253	248	58
2	1246	.88	2.8	727.92	.938	.996	4.981	727.92	336	94	84	8	251	250	58
2	1251	.90	2.8	732.90	.948	1.00	5.037	732.90	336	94	84	9	249	249	59
	1256			737.03				737.03							
6-1	1258	1.0	3.1	737.03	1.00	1.06	5.310	—	336	93	84	9	250	251	59
1	1303	.95	3.0	742.34	.974	1.03	5.175	742.34	336	93	84	9	252	251	60
2	1308	.93	2.9	747.51	.964	1.04	5.120	747.51	335	94	84	9	253	251	61
2	1313	.93	2.9	752.63	.964	1.04	5.120	752.63	336	94	84	10	254	250	62
	1318			757.750				757.750							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: 3
Date: 11/5/08
Project Number: M084501
Test Location: Toxecon Inlet (Common)
Client Name: ADA
Plant Name: We Energies - Presque Isle
Duct Shape: Circular or ~~Rectangular~~
Length: 18.17' Width: 12.58' or
Diameter:
Source Condition: Normal
Test Method: 29
Flue Area: 337.013 Sq. Feet
Port Type: Flange
Port Length: 4"
Port Size: 6"

Meter and Probe Data

Operator: MPLT
Meter ID: CM17
Meter Y Value: 1.003
Pitot ID: 001A
Pitot Coefficient: 0.84
Probe Length: 10'
Probe Liner: Glass
Nozzle Diameter: .271
Train Type: Hot Box
Filter Number/Weight: HP 460 / .4845
Thimble Number/Weight:
Pre-Test Nozzle Leak Check: .002 @ 10 "Hg
Post-Test Nozzle Leak Check: .002 @ 15 "Hg
Pre-Test Pitot Leak Check: 0 @ 5 "H_2O
Post-Test Pitot Leak Check: 0 @ 6 "H_2O

Traverse Data

Ports Sampled: 6
Points/Port: 2
Min./Point: 10 (5/reading)
Total Points: 12
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 29.1
Static Pressure: -3
CO_2 %: 13.20
O_2 %: 5.8
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3702.4
Final Imp. Volume or Weight: 3853.2
Imp. Volume or Weight Gain: 150.8
Initial Silica Weight: N/A
Final Silica Weight: N/A
Silica Weight Gain: N/A
Balance used for impingers and/or silica weights (Model and S/N): S10-15

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501 | Date: 11/5/08 | Test Number: 3

Client: AOA | Test Location: Exxon Inlet (Common) | Operator: MPLT | Test Tech: JHW/RC

Plant: We Energies-Presque Isle | Test Method: 29 | Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	X3.186 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	X1.062 Meter Rate, Cubic Feet/Min.	x 5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	1340	.96	3.0	758.160	.979	1.04	5.202	—	335	85	83	10	251	249	66
1	1345	.96	3.0	763.36	.979	1.04	5.202	763.36	335	90	84	10	252	250	64
2	1350	.97	3.0	768.56	.984	1.04	5.229	768.56	336	92	84	10	251	250	62
2	1355	.97	3.0	773.78	.984	1.04	5.229	773.78	336	93	84	10	250	251	61
	1400			779.01				779.01							
2-1	1403	.80	2.5	779.01	.894	.949	4.749	—	336	93	84	8	250	250	60
1	1408	.84	2.6	783.75	.916	.973	4.866	783.75	337	93	85	9	249	251	60
2	1413	.80	2.5	788.61	.894	.949	4.749	788.61	337	94	85	10	248	250	58
2	1418	.84	2.6	793.36	.916	.973	4.866	793.36	338	94	85	10	249	251	57
	1423			798.23				798.23							
3-1	1425	.81	2.5	798.23	.900	.955	4.779	—	339	93	85	10	249	250	60
1	1430	.78	2.4	803.00	.883	.937	4.689	803.00	340	94	85	10	250	251	60
2	1435	.76	2.4	807.68	.871	.925	4.629	807.68	340	94	85	10	251	252	59
2	1440	.74	2.3	812.30	.860	.913	4.567	812.30	341	95	86	10	250	250	58
	1445			816.86				816.86							
4-1	1447	.89	2.8	816.86	.943	1.00	5.009	—	341	93	86	11	250	250	59
1	1452	.92	2.9	821.86	.959	1.01	5.064	821.86	342	94	86	11	251	250	57
2	1457	.91	2.8	826.92	.953	1.01	5.065	826.92	342	95	86	11	252	250	56
2	1502	.94	2.9	831.98	.969	1.02	5.148	831.98	344	94	86	11	252	251	56
	1507			837.12				837.12							
5-1	1510	.41	1.3	837.12	.640	.680	3.400	—	341	98	86	7	251	252	57
1	1515	.48	1.5	840.52	.692	.735	3.678	840.52	344	93	86	7	251	251	58
2	1520	.52	1.8	844.19	.762	.809	4.044	844.19	343	94	86	7	250	251	57
2	1525	.60	1.9	848.23	.774	.822	4.113	848.23	345	95	86	7	251	249	59
	1530			852.34				852.34							
6-1	1532	1.0	3.1	852.34	1.00	1.06	5.310	—	344	93	86	12	251	250	60
1	1537	1.0	3.1	857.65	1.00	1.06	5.310	857.65	344	96	86	12	250	250	61
2	1542	1.1	3.5	862.96	1.04	1.11	5.568	862.96	343	93	86	12	249	251	62
2	1547	1.0	3.1	868.52	1.00	1.06	5.310	868.52	342	93	86	13	248	250	61
	1552			873.83				873.83							

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT: WE PIPP

UNIT NO: Toxecon Inlet

LOCATION:

DATE: 11/5/08

TEST NO: 1

METHOD: M29

WEIGHED/MEASURED BY: ELE

BALANCE ID: S10-15

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	886.0	704.4		
IMPINGER 2	762.0	728.2		
IMPINGER 3	766.0	755.8		
IMPINGER 4	817.8	834.4		
IMPINGER 5				
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

3261.8	3022.8	239.0
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

MERCURY SORBENT TRAP FIELD DATA SHEET

Project: _____ Date: _____
Sampling Location: _____
Source Condition: _____ Barometric Pressure:I _____
Dry Gas Meter No. _____ Y = _____ Static Pressure _____

Test Engineer: _____

Toxecon Inlet M29 Test 2

Sample Train A			
Clock Time 24 hour	Meter Volume (V_m) liters Final	Inlet Meter Temp. (t_m) °F Initial	Outlet Meter Temp. (t_m) °F
1	976.6	731.6	
2	785.8	735.2	
3	631.0	626.0	
4	783.8	764.8	
~~5~~			
			Gain
Total ~~Gain~~	3177.2	2857.6	319.6
Total/Average			

Sample Train B			
Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. (t_m) °F
Total/Average			

MERCURY SORBENT TRAP FIELD DATA SHEET

Project: _____ Date: 11/5/08
Sampling Location: _____
Source Condition: _____ Barometric Pressure:I _____
Dry Gas Meter No. _____ Y = _____ Static Pressure _____

Test Engineer: _____

Toxecon Inlet M29 Test 3

Sample Train A			
Clock Time 24 hour	Meter Volume (V_m) liters Final	Inlet Meter Temp. (t_m) °F Initial	Outlet Meter Temp. (t_m) °F
1	920.0	709.6	
2	786.6	722.6	
3	761.4	754.4	
4	842.0	817.8	
			Gain
Total	3310.0	3004.4	305.6
Total/Average			

Sample Train B			
Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. (t_m) °F
Total/Average			

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: #1
Date: 11/5/08
Project Number: M084501
Test Location: UNIT 8 STACK
Client Name: WE ENERGIES
Plant Name: PRESQUE ISLE
Duct Shape: Circular or Rectangular
Length: N/A Width: N/A or
Diameter: 9.5
Source Condition: NORMAL
Test Method: M29
Flue Area: 70.882
Port Type: FLANGE
Port Length: 6
Port Size: 6

Meter and Probe Data

Operator: SD
Meter ID: CM 10
Meter Y Value: .998 / Δ1.541
Pitot ID: 014A
Pitot Coefficient: .848
Probe Length: 4'
Probe Liner: GLASS
Nozzle Diameter: .234
Train Type: ANDERSON
Filter Number/Weight: HP452 / .4450
Thimble Number/Weight: N/A
Pre-Test Nozzle Leak Check: .000 @ 12 "Hg
Post-Test Nozzle Leak Check: .000 @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 4 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3.5 "H_2O

Traverse Data

Ports Sampled: 4
Points/Port: 3
Min./Point: 10
Total Points: 12
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.90
Static Pressure: -.8
CO_2 %: 12.0
O_2 %: 6.1
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 2839.8
Final Imp. Volume or Weight: 3147.8
Imp. Volume or Weight Gain: 308
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501
Client: UE ENERGIES
Plant: PRESQUE ISLE

Date: 11/5/08
Test Location: UNIT 8 STACK
Test Method: M29

Test Number: #1
Operator: SD / SMG
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	Orifice Setting (ΔH) 1.5	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	Meter Rate, Cubic Feet/ Min. .777	Theoretical Meter Volume, (V_m) ft^3, per point ×5	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	8:20	1.7	2.6	92.15	1.304	1.013	5.066		325	83	82	4	249	251	62
1-1	8:25	1.7	2.6	97.12	1.304	1.013	5.066	97.181	326	86	81	4	250	249	60
1-2	8:30	1.7	2.6	102.27	1.304	1.013	5.066	102.247	326	88	83	4	239	250	61
1-2	8:35	1.7	2.6	107.25	1.304	1.013	5.066	107.313	327	90	83	4	247	245	62
1-3	8:40	1.7	2.6	112.35	1.304	1.013	5.066	112.379	327	92	84	4	230	249	62
1-3	8:45	1.6	2.4	117.35	1.264	.982	4.914	117.445	327	93	85	4	249	250	63
	8:50			122.320				122.359							
2-1	8:54	1.6	2.4	122.320	1.264	.982	4.914		329	94	86	4	250	249	63
2-1	8:59	1.5	2.3	127.15	1.224	.951	4.758	127.273	330	94	86	4	250	251	62
2-2	9:04	1.7	2.6	131.95	1.304	1.013	5.066	132.031	331	92	87	4	250	250	63
2-2	9:09	1.7	2.6	137.01	1.304	1.013	5.066	137.097	332	95	87	4	250	250	63
2-3	9:14	1.7	2.6	142.09	1.304	1.013	5.066	142.163	332	96	88	4	250	250	62
2-3	9:19	1.7	2.6	147.19	1.304	1.013	5.066	147.229	333	96	88	4	250	251	62
	9:24			152.250				152.295							
3-1	9:27	1.7	2.6	152.250	1.304	1.013	5.066		333	96	89	4	250	250	62
3-1	9:32	1.7	2.6	157.32	1.304	1.013	5.066	157.361	334	96	88	4	250	250	61
3-2	9:37	1.7	2.6	162.35	1.304	1.013	5.066	162.427	334	96	89	4	250	250	61
3-2	9:42	1.7	2.6	167.42	1.304	1.013	5.066	167.493	335	96	89	4	250	250	61
3-3	9:47	1.7	2.6	172.48	1.304	1.013	5.066	172.559	335	96	89	4	250	250	61
3-3	9:52	1.6	2.4	177.56	1.264	.982	4.914	177.625	334	98	90	4	250	250	61
	9:57			182.520				182.539							
4-1	10:00	1.6	2.4	182.520	1.264	.982	4.914		334	96	90	4	252	250	62
4-1	10:05	1.6	2.4	187.42	1.264	.982	4.914	187.453	334	97	90	4	250	251	62
4-2	10:10	1.6	2.4	192.30	1.264	.982	4.914	192.367	334	98	90	4	250	250	62
4-2	10:15	1.7	2.6	197.18	1.304	1.013	5.066	197.281	334	98	90	4	250	249	62
4-3	10:20	1.7	2.6	202.28	1.304	1.013	5.066	202.347	334	97	90	4	250	250	62
4-3	10:25	1.7	2.6	207.38	1.304	1.013	5.066	207.413	334	98	90	4	250	249	62
	10:30			212.430				212.479							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: #2
Date: 11/5/08
Project Number: M084501
Test Location: UNIT 8 STACK
Client Name: WE ENERGIES
Plant Name: PRESQUE ISLE
Duct Shape: Circular or Rectangular
Length: N/A Width: N/A or
Diameter: 9.5
Source Condition: NORMAL
Test Method: M29
Flue Area: 0.882
Port Type: FLANGE
Port Length: 6"
Port Size: 6"

Meter and Probe Data

Operator: SD
Meter ID: CM 10
Meter Y Value: .998 / 1.541
Pitot ID: 014A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: GLASS
Nozzle Diameter: .236
Train Type: ANDERSON
Filter Number/Weight: HP 542 / 0.4672
Thimble Number/Weight: N/A
Pre-Test Nozzle Leak Check: .000 @ 10 "Hg
Post-Test Nozzle Leak Check: .000 @ 10 "Hg
Pre-Test Pitot Leak Check: ✓ @ 4.1 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3.6 "H_2O

Traverse Data

Ports Sampled: 4
Points/Port: 3
Min./Point: 10
Total Points: 12
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.9
Static Pressure: -.8
CO_2 %: 12.5
O_2 %: 6.2
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 2833.0
Final Imp. Volume or Weight: 3152.2
Imp. Volume or Weight Gain: 319.2
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number:	M084501	Date:	11/5/08	Test Number:	#2
Client:	WE ENERGIES	Test Location:	Unit 8 Stack	Operator:	SD/SMcG
Plant:	PRESQUE ISLE	Test Method:	M29	Page Number:	1 of 1

Port-Point #.	Time	(ΔP)	1.5 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	~~.782~~ Meter Rate, Cubic Feet/ Min.	×5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	11:05	1.8	2.7	15.325	1.341	1.049	5.245		333	87	87	3	250	253	55
1-1	11:10	1.8	2.7	20.42	1.341	1.049	5.245	20.570	333	91	88	3	250	253	55
1-2	11:15	1.8	2.7	25.79	1.341	1.049	5.245	25.815	332	93	87	3	250	250	56
1-2	11:20	1.7	2.6	30.95	1.304	1.019	5.098	31.060	332	95	88	3	250	249	59
1-3	11:25	1.7	2.6	35.98	1.304	1.019	5.098	36.158	331	95	88	3	250	249	60
1-3	11:30	1.7	2.6	41.08	1.304	1.019	5.098	41.256	331	96	88	3	250	250	62
	11:35			46.30				46.354							
2-1	11:37	1.7	2.6	46.30	1.304	1.019	5.098		330	93	88	3	248	250	64
2-1	11:42	1.7	2.6	51.38	1.304	1.019	5.098	51.452	330	96	89	3	250	251	64
2-2	11:47	1.7	2.6	56.39	1.304	1.019	5.098	56.450	330	96	89	3	250	249	64
2-2	11:52	1.7	2.6	61.50	1.304	1.019	5.098	61.548	330	96	89	3	250	250	63
2-3	11:57	1.7	2.6	66.59	1.304	1.019	5.098	66.646	330	96	89	3	250	250	63
2-3	12:02	1.7	2.6	71.70	1.304	1.019	5.098	71.744	330	96	89	3	250	250	63
	12:07			76.81				76.842							
3-1	12:10	1.7	2.6	76.81	1.304	1.019	5.098		331	93	90	3	247	250	64
3-1	12:15	1.8	2.7	81.92	1.341	1.049	5.245	81.940	332	96	90	3	250	249	64
3-2	12:20	1.8	2.7	87.05	1.341	1.049	5.245	87.185	332	97	90	3	250	250	64
3-2	12:25	1.8	2.7	92.35	1.341	1.049	5.245	92.430	332	97	90	3	250	250	63
3-3	12:30	1.8	2.7	97.60	1.341	1.049	5.245	97.675	332	97	90	3	250	251	63
3-3	12:35	1.8	2.7	102.89	1.341	1.049	5.245	102.920	332	97	90	3	250	251	63
	12:40			108.14				108.165							
4-1	12:43	1.8	2.7	108.14	1.341	1.049	5.245		332	95	90	3	247	251	64
4-1	12:48	1.8	2.7	113.35	1.341	1.049	5.245	113.410	332	96	90	3	249	251	64
4-2	12:53	1.8	2.7	118.59	1.341	1.049	5.245	118.655	332	97	90	3	250	249	64
4-2	12:58	1.9	2.9	123.82	1.378	1.077	5.389	123.900	332	97	90	3	250	251	64
4-3	13:03	1.9	2.9	129.21	1.378	1.077	5.389	129.289	332	98	90	3	250	249	64
4-3	13:08	1.8	2.7	134.62	1.341	1.049	5.245	134.678	332	98	91	3	250	251	64
	13:13			139.88				139.923							

Isokinetic Sampling Cover Sheet

Plant Information

Run Number: #3
Date: 11/5/08
Project Number: M084S01
Test Location: UNIT 8 STACK
Client Name: WE ENERGIES
Plant Name: PRESQUE ISLE
Duct Shape: Circular or Rectangular
Length: N/A Width: N/A or
Diameter: 9.5
Source Condition: NORMAL
Test Method: M29
Flue Area: 70.882
Port Type: FLANGE
Port Length: 6"
Port Size: 6"

Meter and Probe Data

Operator: SD
Meter ID: CM10
Meter Y Value: .998 / ΔH: 1.541
Pitot ID: 014A
Pitot Coefficient: .840
Probe Length: 4'
Probe Liner: GLASS
Nozzle Diameter: .234
Train Type: ANDERSON
Filter Number/Weight: HP 545 / 0.3613
Thimble Number/Weight: N/A
Pre-Test Nozzle Leak Check: .001 @ 10 "Hg
Post-Test Nozzle Leak Check: .000 @ 8 "Hg
Pre-Test Pitot Leak Check: ✓ @ 3.6 "H_2O
Post-Test Pitot Leak Check: ✓ @ 3.4 "H_2O

Traverse Data

Ports Sampled: 4
Points/Port: 3
Min./Point: 10
Total Points: 12
Total Test Time: 120
Sample Plane: Horizontal or Vertical

Stack Parameters

Barometric Pressure: 28.90
Static Pressure: -.8
CO_2 %: 12.5
O_2 %: 10.2
Determined by: Method 3 or Method 3A
Initial Imp. Volume or Weight: 3161.0
Final Imp. Volume or Weight: 2826.8
Imp. Volume or Weight Gain: 334.2
Initial Silica Weight:
Final Silica Weight:
Silica Weight Gain:
Balance used for impingers and/or silica weights (Model and S/N):

Comments:

Isokinetic Sampling Field Data Sheet

Project Number: M084501
Client: WE ENERGIES
Plant: PRESQUE ISLE

Date: 11/5/08
Test Location: Unit 8 Stack
Test Method: M29

Test Number: #3
Operator: SD/SMcG
Page Number: 1 of 1

Port-Point #.	Time	(ΔP)	1.5 Orifice Setting (ΔH)	Meter Volume (V_m) ft^3, Actual	Square Root, ΔP	.782 Meter Rate, Cubic Feet/ Min.	x5 Theoretical Meter Volume, (V_m) ft^3, per point	Theoretical Meter Volume, (V_m) ft^3, total	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, " Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp °F
1-1	13:40	1.7	2.6	40.23	1.304	1.019	5.098		331	89	90	4	250	250	61
1-1	13:45	1.7	2.6	45.29	1.304	1.019	5.098	45.328	331	90	89	5	250	251	62
1-2	13:50	1.7	2.6	50.39	1.304	1.019	5.098	50.426	331	91	89	5	250	250	62
1-2	13:55	1.7	2.6	55.47	1.304	1.019	5.098	55.524	331	94	89	5	250	250	62
1-3	14:00	1.6	2.4	60.58	1.264	.989	4.945	60.622	331	95	89	5	250	250	63
1-3	14:05	1.6	2.4	65.54	1.264	.989	4.945	65.567	331	96	89	6	250	250	63
	14:10			70.49				70.512							
2-1	14:13	1.7	2.6	70.49	1.304	1.019	5.098		332	95	90	6	248	251	63
2-1	14:18	1.7	2.6	75.59	1.304	1.019	5.098	75.610	332	96	90	6	250	250	63
2-2	14:23	1.7	2.6	80.67	1.304	1.019	5.098	80.708	333	97	90	6	250	250	63
2-2	14:28	1.7	2.6	85.79	1.304	1.019	5.098	85.806	333	98	91	6	250	250	63
2-3	14:33	1.7	2.6	90.92	1.304	1.019	5.098	90.904	333	98	91	6	250	250	64
2-3	14:38	1.7	2.6	96.03	1.304	1.019	5.098	96.002	334	98	91	5	250	250	64
	14:43			101.00				101.100							
3-1	14:45	1.7	2.6	101.00	1.304	1.019	5.098		334	94	91	6	250	250	63
3-1	14:50	1.7	2.6	106.13	1.304	1.019	5.098	106.198	334	98	92	6	250	250	63
3-2	14:55	1.7	2.6	111.22	1.304	1.019	5.098	111.296	335	98	91	6	250	250	63
3-2	15:00	1.7	2.6	116.33	1.304	1.019	5.098	116.394	335	99	92	6	250	250	62
3-3	15:05	1.7	2.6	121.46	1.304	1.019	5.098	121.492	336	99	92	6	250	250	62
3-3	15:10	1.7	2.6	126.58	1.304	1.019	5.098	126.590	336	99	92	6	250	250	62
	15:15			131.68				131.688							
4-1	15:17	1.7	2.6	131.68	1.304	1.019	5.098		337	96	92	6	247	250	62
4-1	15:22	1.7	2.6	136.76	1.304	1.019	5.098	136.786	337	98	92	6	250	250	62
4-2	15:27	1.7	2.6	141.85	1.304	1.019	5.098	141.884	338	99	92	6	250	250	62
4-2	15:32	1.7	2.6	146.93	1.304	1.019	5.098	146.982	339	99	92	6	250	250	62
4-3	15:37	1.7	2.6	152.03	1.304	1.019	5.098	152.080	339	99	93	6	250	250	62
4-3	15:42	1.7	2.6	157.14	1.304	1.019	5.098	157.178	339	99	93	6	250	250	62
	15:47			162.284				162.276							

PLATT ENVIRONMENTAL SERVICES INC.

IMPINGER WEIGHT SHEET

PLANT: WE PIPP

UNIT NO: 8

LOCATION: Stack

DATE: 11/5/08

TEST NO: 1

METHOD: M29

WEIGHED/MEASURED BY: ELE

BALANCE ID: S10-15

Circle One:	FINAL WEIGHT MLS / GRAMS	INITIAL WEIGHT MLS / GRAMS	IMPINGER GAIN	IMPINGER CONTENTS
IMPINGER 1	878.8	745.6		
IMPINGER 2	837.2	735.2		
IMPINGER 3	640.8	604.2		
IMPINGER 4	789.0	754.8		
IMPINGER 5				
IMPINGER 6				
IMPINGER 7				
IMPINGER 8				

3147.8	2839.8	308.0
FINAL TOTAL	INITIAL TOTAL	TOTAL GAIN

MERCURY SORBENT TRAP FIELD DATA SHEET

Project: _____ Date: _____
Sampling Location: _____
Source Condition: _____ Barometric Pressure:I _____
Dry Gas Meter No. _____ Y = _____ Static Pressure _____

Test Engineer: _____

U8 Stack M29 Test 2

Sample Train A			
Clock Time 24 hour	Meter Volume (V_m) liters Initial	Inlet Meter Temp. (t_m) °F Final	Outlet Meter Temp. (t_m) °F
1	733.8	934.4	
2	694.4	777.8	
3	596.6	612.8	
4	808.2	827.2	
Total [redacted]	2833.0	3152.2	Gain
			319.2
Total/Average			

Sample Train B			
Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. (t_m) °F
Total/Average			

MERCURY SORBENT TRAP FIELD DATA SHEET

Project: _____ Date: _____
Sampling Location: _____
Source Condition: _____ Barometric Pressure:I _____
Dry Gas Meter No. _____ Y = _____ Static Pressure _____

Test Engineer: _____

U8 Stack M29 Test 3 CO_2-12.5 O_2 6.2

Sample Train A			
Clock Time 24 hour	Meter Volume (V_m) liters Final	Inlet Meter Temp. (t_m) °F Initial	Outlet Meter Temp. (t_m) °F
1	934.6	746.6	
2	811.0	738.6	
3	620.2	605.0	
4	795.2	736.6	
			Gain
Total	3161.0	2826.8	334.2
Total/Average			

Sample Train B			
Clock Time 24 hour	Meter Volume (V_m) liters	Inlet Meter Temp. (t_m) °F	Outlet Meter Temp. (t_m) °F
Total/Average			

4/14-20-2159

Appendix W. Platt – Mercury RATA 2008

Mercury Relative Accuracy Test Audit and Diagnostic Mercury Emissions Report

---

Performed for

ADA-ES, Inc.

At the

We Energies
Presque Isle Power Plant
Unit 9 Toxecon Inlet and Toxecon Outlet (RATA's)
Unit 7 and Unit 8 Toxecon Inlets (Diagnostic)
Marquette, Michigan
November 5 and 6, 2008

Platt Environmental Services, Inc.

Platt Environmental Services, Inc.

371 Balm Court
Wood Dale, IL 60191
630-521-9400
630-521-9494 fax

Mercury Relative Accuracy Test Audit and Diagnostic Mercury Emissions Report

---

Performed for

ADA-ES, Inc.

At the

We Energies
Presque Isle Power Plant
Unit 9 Toxecon Inlet and Toxecon Outlet (RATA's)
Unit 7 and Unit 8 Toxecon Inlets (Diagnostic)
Marquette, Michigan
November 5 and 6, 2008

Prepared By

Platt Environmental Services, Inc.

Report No. M084501A

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 EXECUTIVE SUMMARY 2

3.0 TEST METHODOLOGY 2
- 3.1 Method 30B Mercury Determination (Sorbent Trap Method) 3
- 3.2 Method 4 Moisture Determination 3

4.0 TEST RESULTS SUMMARIES 4

5.0 CEM DATA 7

6.0 CONCLUSION AND CERTIFICATION 8

APPENDIX
- Test Section Diagrams 10
- Sample Train Diagrams 12
- Calculation Nomenclature and Formulas 14
- Laboratory Sample Analysis 18
- Reference Method Test Data (Computerized Sheets) 26
- Plant CEM Data 56
- Calibration Data 64
- Field Data Sheets 85

1.0 Introduction

PLATT ENVIRONMENTAL SERVICES, INC. (PES) conducted a mercury continuous emission monitoring system relative accuracy test audit (RATA) for ADA-ES, Inc. (ADA) on the Unit 9 Toxecon Inlet and the Toxecon Outlet as well as running diagnostic mercury tests on the Unit 7 and 8 Toxecon Inlet test locations at the Presque Isle Power Plant in Marquette, Michigan on November 5 and 6, 2008. This report summarizes the results of the test program and test methods used.

The test locations, test dates and test parameters are summarized below, in Table 1.

Table 1

Test Overview

Test Locations	Test Dates	Test Parameter
Unit 9 Toxecon Inlet	November 6, 2008	Mercury (Method 30B)
Toxecon Outlet	November 5 and 6, 2008	
Units 7 and 8 Toxecon Inlets	November 6, 2008	

The identification of individuals associated with the test program is summarized below, in Table 2.

Table 2

Contact Information

Location	Address	Contact
Test Facility	We Energies Presque Isle Power Plant Marquette, Michigan	Jon Konings (414) 221-2430 (phone) Jon.Konings@we-energies.com
Test Coordinator	ADA-ES, Inc. 8100 SouthPark Way, Unit B Littleton, Colorado 80120-4525	Ms. Robin Stewart Manager of Contract R&D (303) 339-8863 robins@adaes.com
Testing Company Representative	Platt Environmental Services, Inc. 371 Balm Court Wood Dale, Illinois 60191	Eric L. Ehlers Senior Project Manager (630) 521-9400 (phone) (630) 521-9494 (fax) eehlers@plattenv.com

The test program was conducted by Ms. J. Macchione, and E. Osthus and Messrs. R. Sollars, M. Platt, S. Dyra, J. Howe, S. McGough, T. Mei, A. Calix, and E. Ehlers of PES. The purpose of this test program was to determine the relative accuracy of the mercury CEM systems during specified operating conditions in units of ug/wscm and to determine mercury concentrations at the Unit 7 and 8 Toxecon Inlets.

2.0 Executive Summary

Selected results of the test program are summarized below, in Table 3. A complete summary of emission test results follows the narrative portion of this report.

Table 3

Test Results

Test Location	Test Methodology	RM Average Concentration	CEM Average Concentration	Relative Accuracy	Bias
Unit 7 Toxecon Inlet	Method 30B	5.52 μg/wscm	N/A	N/A	N/A
Unit 8 Toxecon Inlet		6.11 μg/wscm	N/A	N/A	N/A
Unit 9 Toxecon Inlet		5.76 μg/wscm	6.11 μg/wscm	8.31	1.000
Toxecon Outlet		0.46 μg/wscm	0.38 μg/wscm	0.08*	1.111**

*** Based upon <1.0 ug.wscm mean difference**

****Maximum BAF**

The test results from this test program indicate that the Unit 9 Toxecon Inlet CEM system meets the United States Environmental Protection Agency (USEPA) annual performance specification of less than 20% RA as published in 40 CFR Part 75 and the Toxecon Outlet CEM system meets the USEPA alternative annual performance specification of less than 1.0 ug/wscm mean difference for units emitting less than 5.0 ug/wscm.

The RATA tests consisted of ten (10) paired Method 30B Hg sampling runs performed on November 5 and 6, 2008. During the RATA testing, the plant CEM system periodically went through periods of calibration and blowback. These timeframes were not included in the averages for those test runs. No plant data was available for test run 1 at the Unit 9 Toxecon Inlet. The diagnostic test runs consisted of three (3) paired Method 30B Hg sampling runs performed on November 6, 2008. Each sample was extracted at three test points from one test port.

3.0 Test Methodology

Emissions testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A and USEPA Method 30B and Appendix B, Performance

Specification 12A. Schematics of the sampling trains used and copies of field data sheets for each test run are included in the Appendix.

The following methodologies were used during the test program:

3.1 Method 30B Mercury Determination (Sorbent Trap Method)

Paired trains were utilized sampling three (3) test points at each test location.

Per Method 30B sampling, each sample was collected on the paired in-situ sorbent traps. A tube of silica was used to capture remaining moisture prior to the sample reaching the gas metering system.

The sample train used for this test program was designed by APEX, Inc. and meet all requirements for Method 30B sampling. Samples were analyzed onsite utilizing an Ohio Lumex, Inc. analyzer for total gaseous mercury.

3.2 Method 4 Moisture Determination

Stack gas moisture content was determined using a Method 4 sampling train. Utilizing this technique, stack gas is drawn through a series of four impingers. The first two impingers were each charged with 100 mls of deionized water. Impinger three was left empty and impinger four was charged with clean, dried silica gel. The entire impinger train was measured before and after each test run to determine the mass of moisture condensed.

During testing, the sample train was operated in the manner specified in USEPA Method 4. All of the data specified in Method 4 (gas volume, delta H, impinger outlet well temperature, etc.) was recorded on field data sheets.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the appendix.

4.0 Test Results Summaries

Client: ADA-ES **Location:** Unit 9 Toxecon Inlet
Plant: We Energies-PIPP **Date:** 11/6/08
Project #: M084501 **Test Method:** Sorbent Hg (30B)

CEM Monitor Information

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM ug/wscm	CEM ug/wscm	(RM-CEM) Difference (di)	Difference^2 (di^2)
0	1	11/06/08	07:45	08:15	5.59	0.00	5.59	31.248
1	2	11/06/08	08:35	09:05	5.53	5.93	-0.40	0.160
1	3	11/06/08	09:22	09:52	5.66	6.05	-0.39	0.152
1	4	11/06/08	10:20	10:50	5.86	6.05	-0.19	0.036
1	5	11/06/08	11:05	11:35	5.77	6.16	-0.39	0.152
1	6	11/06/08	11:55	12:25	5.57	6.16	-0.59	0.348
1	7	11/06/08	12:40	13:10	6.10	6.12	-0.02	0.000
1	8	11/06/08	13:25	13:55	5.84	6.08	-0.24	0.058
1	9	11/06/08	14:10	14:40	5.77	6.25	-0.48	0.230
1	10	11/06/08	14:50	15:20	5.77	6.20	-0.43	0.185

n	**9**	
t(0.025)	**2.306**	
Mean Reference Method Value	**5.763**	**RM avg**
Mean CEM Value	**6.111**	**CEM avg**
Sum of Differences	**-3.130**	**di**
Mean Difference	**-0.348**	**d**
Sum of Differences Squared	**1.322**	**di^2**
Standard Deviation	**0.171**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.131**	**cc**
Relative Accuracy	**8.31**	**RA**
Bias Adjustment Factor	**1.000**	**BAF**

Client: ADA-ES **Location:** Toxecon Outlet
Plant: We Energies-PIPP **Date:** 11/5/08 and 11/6/08
Project #: M084501 **Test Method:** Sorbent Hg (30B)

CEM Monitor Information

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM ug/wscm	CEM ug/wscm	(RM-CEM) Difference (di)	Difference^2 (di^2)
1	1	11/05/08	11:10	12:40	0.48	0.35	0.13	0.017
1	2	11/05/08	13:00	14:30	0.42	0.34	0.08	0.006
0	3	11/05/08	14:45	16:15	0.66	0.48	0.18	0.032
1	4	11/05/08	16:35	18:05	0.44	0.38	0.06	0.004
1	5	11/06/08	07:30	09:00	0.43	0.36	0.07	0.005
1	6	11/06/08	09:15	10:45	0.53	0.43	0.10	0.010
1	7	11/06/08	11:00	12:30	0.38	0.31	0.07	0.005
1	8	11/06/08	12:40	14:10	0.43	0.38	0.05	0.003
1	9	11/06/08	14:20	15:50	0.55	0.45	0.10	0.010
1	10	11/06/08	16:05	17:35	0.45	0.41	0.04	0.002

n	**9**	
t(0.025)	**2.306**	
Mean Reference Method Value	**0.457**	**RM avg**
Mean CEM Value	**0.379**	**CEM avg**
Sum of Differences	**0.700**	**di**
Mean Difference	**0.078**	**d**
Sum of Differences Squared	**0.061**	**di^2**
Standard Deviation	**0.028**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.022**	**cc**
Relative Accuracy	**0.08**	**RA***
Bias Adjustment Factor	**1.111**	**BAF****

*** Based upon <1.0 ug.wscm mean difference**

****Maximum BAF**

Method 30B (Sorbent Trap) Mercury Test Results Summary
ADA-ES
We Energies-PIPP
Unit 7 Toxecon Inlet

Test No.	Date	Start Time	End Time	V_m (standard L)	ng detected	ppb	ug/dscm	ug/wscm
1A	11/6/2008	8:35	9:05	17.72	108.0000	0.73	6.10	5.40
1B	11/6/2008	8:35	9:05	17.56	121.0000	0.83	6.90	6.11
Average					114.5000	0.78	6.50	5.75
2A	11/6/2008	9:22	9:52	17.31	112.7000	0.78	6.52	5.77
2B	11/6/2008	9:22	9:52	17.44	117.5000	0.81	6.74	5.97
Average					115.1000	0.79	6.63	5.87
3A	11/6/2008	10:20	10:50	17.20	98.8000	0.69	5.75	5.09
3B	11/6/2008	10:20	10:50	17.09	92.6000	0.65	5.42	4.80
Average					95.7000	0.67	5.59	4.94
Overall Test Average					**108.4333**	**0.75**	**6.24**	**5.52**

Method 30B (Sorbent Trap) Mercury Test Results Summary
ADA-ES
We Energies-PIPP
Unit 8 Toxecon Inlet

Test No.	Date	Start Time	End Time	V_m (standard L)	ng detected	ppb	ug/dscm	ug/wscm
1A	11/6/2008	8:35	9:05	16.13	116.7000	0.87	7.24	6.50
1B	11/6/2008	8:35	9:05	16.18	105.3000	0.78	6.52	5.85
Average					111.0000	0.82	6.88	6.18
2A	11/6/2008	9:22	9:52	16.24	116.8000	0.86	7.20	6.46
2B	11/6/2008	9:22	9:52	15.81	117.4000	0.89	7.43	6.68
Average					117.1000	0.88	7.32	6.57
3A	11/6/2008	10:20	10:50	15.72	100.4000	0.77	6.39	5.74
3B	11/6/2008	10:20	10:50	15.46	93.7000	0.73	6.07	5.45
Average					97.0500	0.75	6.23	5.59
Overall Test Average					**108.3833**	**0.82**	**6.81**	**6.11**

5.0 CEM Data

CEM data was recorded by ADA personnel during each test run for the Unit 9 Toxecon Inlet and the Toxecon Outlet test locations, in order to correlate mercury emissions to the CEM data for each run in accordance with applicable regulations. The CEM data is found in the Appendix.

6.0 Conclusion and Certification

PLATT ENVIRONMENTAL SERVICES is pleased to have been of service to ADA-ES, Inc. If you have any questions regarding this test report, please do not hesitate to contact us at 630-521-9400.

CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

PLATT ENVIRONMENTAL SERVICES

_____ Project Manager

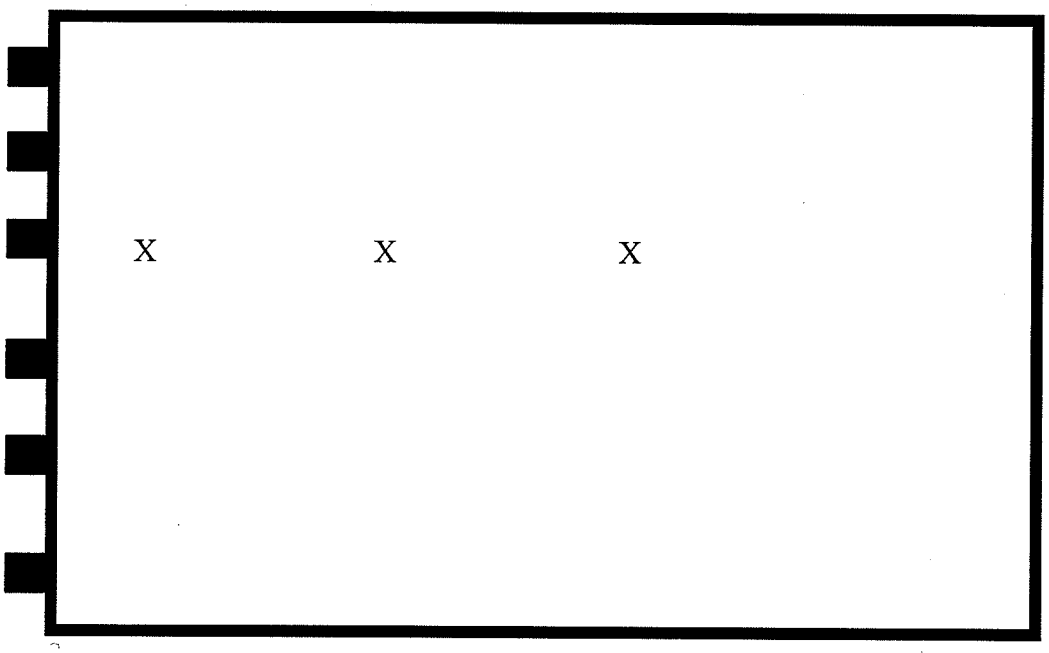
Eric L. Ehlers

_____ Quality Assurance

Scott W. Banach

Appendix

GASEOUS TRAVERSE FOR RECTANGULAR DUCTS



Job: ADA-We Energies Presque Isle Power Plant

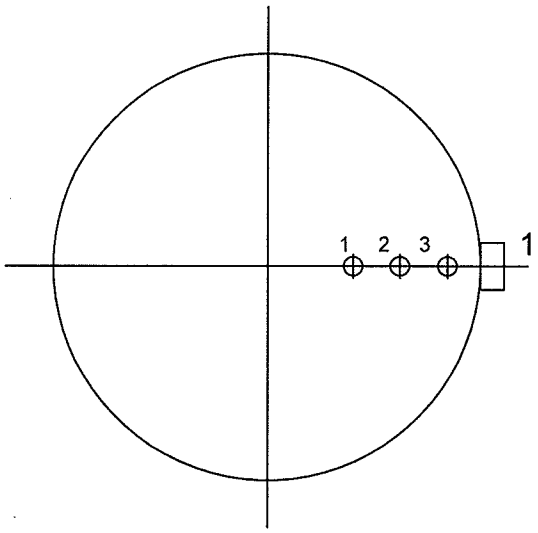
Date: November 5 and 6, 2008

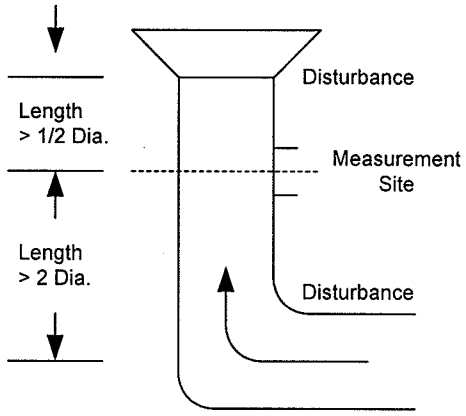
Test Location: Toxecon Outlet

Test Ports: 1

Test Points: 3

GASEOUS TRAVERSE FOR ROUND DUCTS





Job: ADA-We Energies Presque Isle

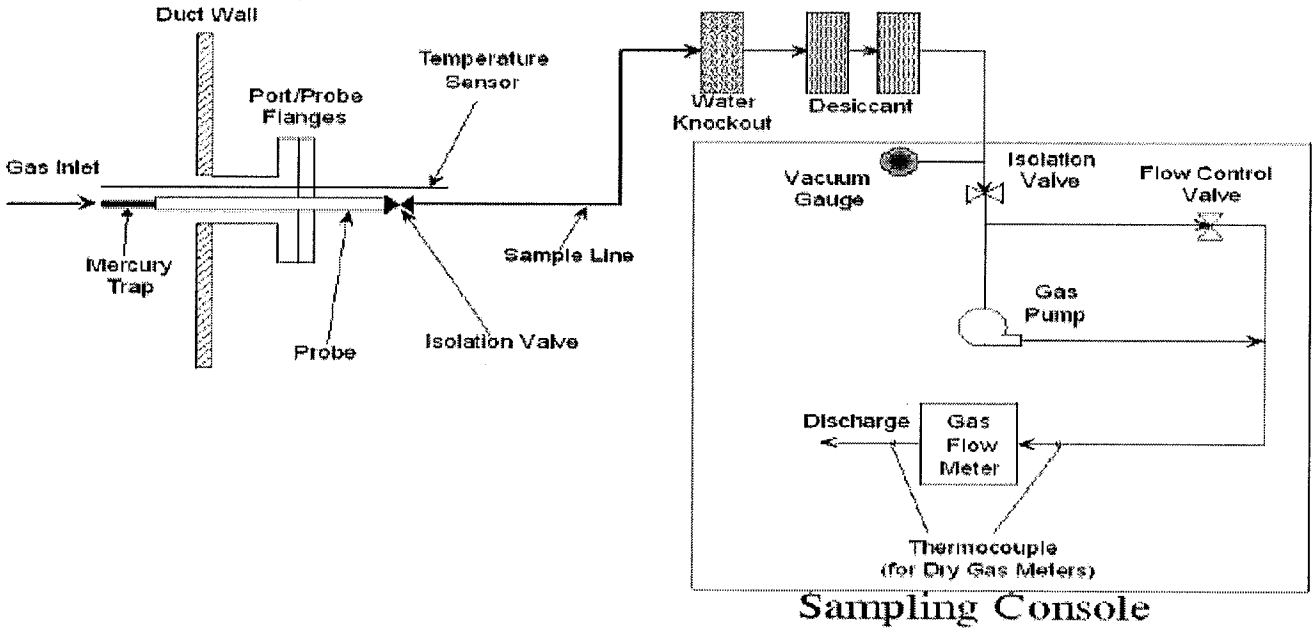
Date: November 6, 2008

Test Location: Units 7, 8, and 9 Toxecon Inlets (Identical)

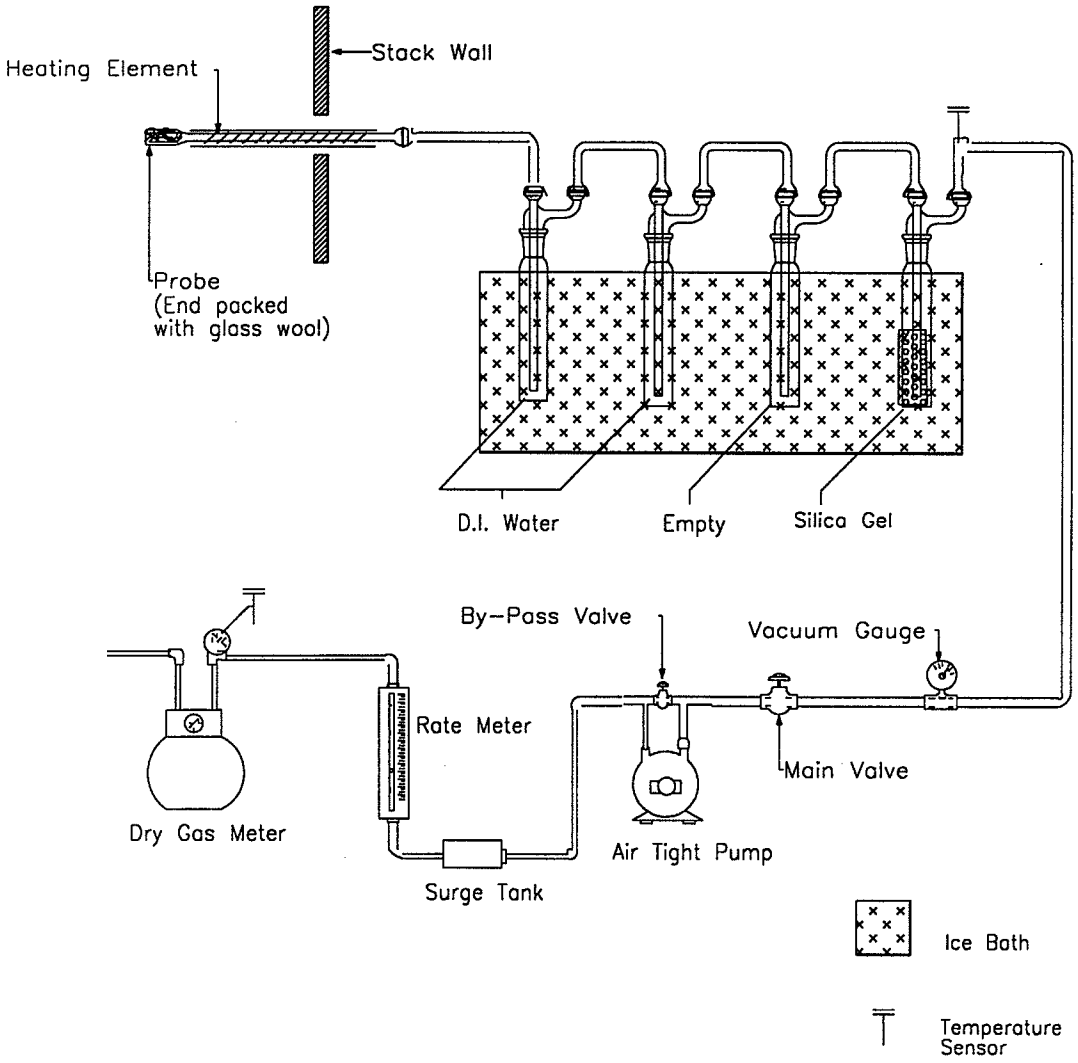
Test Ports: 1

Test Points: 3

USEPA Method 30B – Typical Mercury Sorbent Trap Sampling System



USEPA Method 4 - Moisture Sample Train Diagram



PLATT ENVIRONMENTAL SERVICES, INC.

Mercury Sample Calculations

Concentration

$$\frac{\mu g}{m^3} = \frac{\mu g \text{ of } mercury}{\text{dscf volume sampled} \times 0.02832 \frac{m^3}{ft^3}}$$

Emission Rate

$$\frac{\mu g \text{ of sample} \times \frac{1 \times 10^{-6} \text{ grams}}{\mu g}}{453.6 gr/lb} = \text{lbs of mercury}$$

$$\frac{\text{lbs of mercury}}{Vm(std)sample} \times dscfm \times 60 \frac{min}{hr} = \text{lbs of mercury/hr}$$

PLATT ENVIRONMENTAL SERVICES, INC.

MOISTURE CALCULATIONS

$$V_{wc(std)} = \frac{(V_f - V_i)\,\rho_w\,R\,T_{std}}{P_{std}M_w} = 0.04707(V_f - V_i)$$

$$V_{wsg(std)} = \frac{(W_f - W_i)\,R\,T_{std}}{P_{std}\,M_w} = 0.04715\,(W_f - W_i)$$

$$V_{m(std)} = 17.64\;V_m\,Y\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Where:

B_{ws} = Water vapor in gas stream, proportion by volume
M_w = Molecular weight of water, 18.015 lb/lb-mole
P_{bar} = Barometric pressure at the testing site, in. Hg
P_{std} = Standard absolute pressure, 29.92 in. Hg
R = Ideal gas constant, 0.048137 (in. Hg)(ft^3)/(g-mole)(°R) = [21.8348(in. Hg)(ft^3)/(lb-mole)(°R)]/453.592 g-mole/lb-mole
T_m = Absolute average dry gas meter temperature, °R
T_{std} = Standard absolute temperature, 528 °R
V_f = Final volume of condenser water, ml
V_i = Initial volume of condenser water, ml
V_m = Dry gas volume measured by dry gas meter, dcf
$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, scf
$V_{wc(std)}$ = Volume of condensed water vapor, corrected to standard conditions, scf
$V_{wsg(std)}$ = Volume of water vapor collected in silica gel, corrected to standard conditions, scf
W_f = Final weight of silica gel, g
W_i = Initial weight of silica gel, g
Y = Dry gas meter calibration factor
ΔH = Average pressure exerted on dry gas meter outlet by gas sample bag, in. H_2O
ρ_w = Density of water, 0.9982 g/ml
13.6 = Specific gravity of mercury (Hg)
17.64 = T_{std}/P_{std}
0.04707 = ft^3/ml 0.04715 = ft^3/g

PLATT ENVIRONMENTAL SERVICES, INC.

Relative Accuracy Test Audit (RATA) Calculations and Bias Adjustment Factor Calculation

Mean Difference

$$\bar{d} = \frac{1}{n}\sum_{i=1}^{n} di$$

Standard Deviation

$$Sd = \left[\frac{\sum_{i=1}^{n} d_i^2 - \frac{\left[\sum_{i=1}^{n} d_i\right]^2}{n}}{n-1}\right]^{1/2}$$

Confidence Coefficient

$$CC = t_{0.025}\frac{Sd}{\sqrt{n}}$$

Relative Accuracy

$$RA = \frac{|\bar{d}| + |CC|}{RM\,avg} \times 100$$

Bias Adjustment Factor

$$BAF = 1 + \frac{|\bar{d}|}{CEM\,avg}$$

PLATT ENVIRONMENTAL SERVICES, INC.

Coal Emission Rate Calculations

A pollutant emission rate (E), expressed as pounds of pollutant per million Btu heat input from the fuel combusted can be calculated by several methods as follows:

A. $C = C_s/7000$ where, C = pollutant concentration, lb/dscf
c_s = pollutant concentration, grains/dscf

B. If fuel flow is monitored and the fuel combusted during the test is sampled and analyzed for gross calorific value, then:

$$E = \frac{Q_{sd}C}{\text{fuel flow rate (lb/hr) GCV}} \times 10^6$$

where, E = lbs per million Btu
GCV = gross calorific value, Btu/lb
Q_{sd} = dry volumetric gas flow at standard conditions, dscf/hr

C. If an integrated gas sample is taken during the test and analyzed for $\%CO_2$ or $\%O_2$, dry basis by volume, with an approved USEPA Method 3 or 3A gas analyzer, then

$$E = C\,F_c \frac{100}{(\%CO_2)} \text{ or, } E = C\,F \frac{20.9}{(20.9 - \%O_2)} \quad \text{where,}$$

$\%CO_2$ and $\%O_2$ are expressed as percent values:

F_c = a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the fuel combusted, 1840 scf CO_2/million Btu for sub-bituminous or 1800 scf/million Btu for bituminous.
F = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted, 9820 dscf/million Btu for sub-bituminous or 9780 dscf/million Btu for bituminous.

D. If fuel sample increments are taken and composited during the test and an ultimate analysis is performed and the GCV is determined, then

$$F_c = \frac{321 \times 10^3 (\%C)}{GCV} \text{ where, } \%C = \text{carbon content by weight expressed as percent}$$

$$F = \frac{[3.64\,(\%H) + 1.53\,(\%C) + 0.57\,(\%S) + 0.14\,(\%N) - 0.46\,(\%O_2)]}{GCV} \times 10^6$$

1. H = Hydrogen, percent
2. C = Carbon, percent
3. S = Sulfur, percent
4. N = Nitrogen, percent
5. O = Oxygen, percent

Ohio Lumex Calibration and Test Results Summary
ADA-ES, Inc - We Energies Presque Isle Power Plant
Toxecon Outlet
November 5, 2008

Description	C, ng	Area	Maximum	Time
BLANK	0.0	83	2	10:34:58 AM
Std__500 HP	495	74800	7710	10:36:45 AM
Std__250 HP	258	39000	4910	10:38:24 AM
Std__50 HP	50	7280	840	10:40:08 AM
Std__100 HP	97	14000	1750	10:41:48 AM
Std__50 HP	51	7850	994	10:44:14 AM
Std__100 HP	95	13700	1460	10:46:03 AM
Std__100 HP	99	15000	1530	10:49:31 AM
Std__100 Ricca ICV	107	16300	1680	10:53:18 AM
Trap 13923 200ng Spike	201	30500	679	10:58:28 AM
Std__100 HP	94	14300	1660	11:18:49 AM
Std__100 HP	101	15400	1370	11:44:27 AM
Std__100 HP	97	14800	1750	12:53:23 PM
1A Trap 37198 Front Toxecon Outlet	79	12100	469	12:58:25 PM
1A Trap 37198 Back Toxecon Outlet	-0.1	63	3	1:00:43 PM
1B Trap 37281 Front Toxecon Outlet	77	11700	314	1:04:35 PM
1B Trap 37281 Back Toxecon Outlet	0.0	90	5	1:06:38 PM
Std__100 HP	93	14200	1610	1:26:39 PM
Std__100 HP	103	15700	1420	2:31:04 PM
Std__100 HP	95	14500	1340	2:43:30 PM
Std__100 HP	97	14800	1600	2:53:35 PM
2A Trap 28226 Front Toxecon Outlet	67	10300	383	2:56:26 PM
2A Trap 28226 Back Toxecon Outlet	-0.1	74	3	2:58:57 PM
2B Trap 28366 Front Toxecon Outlet	64	9740	360	3:01:44 PM
2B Trap 28366 Back Toxecon Outlet	-0.2	57	2	3:03:42 PM
Std__100 HP	95	14500	1620	3:06:05 PM
BLANK	0.5	156	2	3:30:32 PM
Std__50 HP	50	7630	978	3:45:15 PM
Std__100 HP	97	14700	988	3:47:15 PM
Std__500 HP	502	75800	8730	3:50:55 PM
Std__250 HP	233	35300	4820	3:53:37 PM
Std__100 Ricca ICV	91	13900	1600	3:56:12 PM
Std__100 HP	97	14700	1740	4:06:17 PM
Std__100 HP	99	15100	1390	4:22:44 PM
Std__100 HP	106	16100	1770	4:42:29 PM
3A Trap 28326 Front Toxecon Outlet	94	14300	697	4:47:40 PM
3A Trap 28326 Back Toxecon Outlet	-0.3	37	2	4:50:21 PM
3B Trap 30589 Front 100ng Spike Toxecon Outlet	201	30500	1810	4:52:59 PM
3B Trap 30589 Back 100ng Spike Toxecon Outlet	-0.2	60	3	4:55:24 PM
Std__100 HP	97	14800	1300	4:57:14 PM

Ohio Lumex Calibration and Test Results Summary
ADA-ES, Inc - We Energies Presque Isle Power Plant
Units 7 and 8 Toxecon Inlets
November 6, 2008

Description	C, ng	Area	Maximum	Time
BLANK	0.0	-47	4	7:15:13 AM
Std__500 HP	501	79300	7050	7:17:12 AM
Std__250 HP	245	38700	4960	7:18:52 AM
Std__50 HP	53	8350	844	7:20:32 AM
Std__100 HP	100	15900	1310	7:22:06 AM
Std__100 Ricca ICV	85	13500	1040	7:26:40 AM
Std__100 Ricca ICV	98	15600	1530	7:30:16 AM
Std__100 HP	95	15100	1900	7:33:17 AM
Trap 13945 200ng Spike	203	32100	906	7:38:03 AM
4A Trap 28174 Front Toxe Out	67	10600	496	7:45:33 AM
4A Trap 28174 Back Toxe Out	0.7	64	3	7:48:28 AM
4B Trap 30344 Front Toxe Out 100 ng spike	164	25900	1450	7:50:55 AM
4B Trap 30344 Back Toxe Out 100 ng spike	0.7	57	4	7:53:16 AM
Std__100 HP	104	16400	1540	7:55:10 AM
Std__100 HP	101	16000	1740	8:35:50 AM
Std__100 HP	100	15800	2060	8:55:31 AM
Std__100 HP	99	15700	1210	9:12:15 AM
5A Trap 28263 Front Toxe Out	62	9850	359	9:16:25 AM
5A Trap 28263 Back Toxe Out	0.9	95	3	9:18:18 AM
5B Trap 30319 Front Toxe Out 100 ng spike	161	25500	718	9:21:21 AM
5B Trap 30319 Back Toxe Out 100 ng spike	0.7	70	2	9:23:18 AM
Std__100 HP	98	15500	1660	10:01:00 AM
Std__100 HP	92	14600	1440	10:56:31 AM
6A Trap 28374 Front Toxe Out	81	12800	534	11:01:12 AM
6A Trap 28374 Back Toxe Out	0.4	17	4	11:03:21 AM
6B Trap 28394 Front Toxe Out	81	12800	572	11:05:39 AM
6B Trap 28394 Back Toxe Out	0.6	43	5	11:07:39 AM
Std__100 HP	84	13300	1360	11:09:12 AM
Std__100 HP	100	15800	1880	11:11:33 AM
Std__100 HP	95	15000	1290	11:25:37 AM
Std__100 HP	95	15000	1570	11:34:33 AM
Std__100 HP	92	14600	1720	11:54:08 AM
Std__100 HP	99	15700	1680	12:07:06 PM
Std__100 HP	92	14500	1600	12:21:23 PM
Std__100 HP	104	16400	1560	12:43:37 PM
7A Trap 37294 Front Toxe Out	68	10800	520	12:45:56 PM
7A Trap 37294 Back Toxe Out	0.8	79	2	12:48:28 PM
7B Trap 39575 Front Toxe Out	63	10000	560	12:50:28 PM
7B Trap 39575 Back Toxe Out	0.6	48	3	12:53:19 PM
Std__100 HP	94	14900	1600	12:55:53 PM
Std__100 HP	92	14500	1650	1:52:05 PM
Std__100 HP	97	15300	1350	2:22:31 PM
8A Trap 28313 Front Unit 9	105	16600	853	2:24:39 PM
8A Trap 28313 Back Unit 9	0.6	47	3	2:27:00 PM
8B Trap 28383 Front Unit 9	104	16400	450	2:30:51 PM
8B Trap 28383 Back Unit 9	0.8	87	2	2:33:31 PM

Ohio Lumex Calibration and Test Results Summary
ADA-ES, Inc - We Energies Presque Isle Power Plant
Toxecon Outlet
November 6, 2008

Description	C, ng	Area	Maximum	Time
Std__100 HP	101	16000	1700	2:47:31 PM
Std__100 HP	100	15800	1600	2:56:43 PM
Std__100 HP	93	14700	1740	3:50:21 PM
Std__100 HP	91	14400	1420	4:06:40 PM
9A Trap 39578 Front Toxe Out	89	14100	320	4:12:52 PM
9A Trap 39578 Back Toxe Out	0.7	69	2	4:15:31 PM
9B Trap 39607 Front Toxe Out	93	14700	804	4:23:39 PM
9B Trap 39607 Back Toxe Out	0.7	70	2	4:26:01 PM
Std__100HP	98	15600	1280	4:35:21 PM
Std__100 HP	107	17000	1330	5:44:40 PM
10A Trap 39600 Front Toxe Out	68	10800	397	5:47:01 PM
10A Trap 39600 Back Toxe Out	1.0	110	2	5:49:06 PM
10B Trap 39752 Front Toxe Out	67	10700	388	5:51:17 PM
10B Trap 39752 Back Toxe Out	0.9	88	3	5:53:03 PM
Std__100 HP	97	15300	1080	5:55:23 PM

Ohio Lumex Calibration and Test Results Summary
ADA-ES, Inc - We Energies Presque Isle Power Plant
Unit 9 Toxecon Inlet
November 6, 2008

Description	C, ng	Area	Maximum	Time
BLANK	0.0	-47	4	7:15:13 AM
Std__500 HP	501	79300	7050	7:17:12 AM
Std__250 HP	245	38700	4960	7:18:52 AM
Std__50 HP	53	8350	844	7:20:32 AM
Std__100 HP	100	15900	1310	7:22:06 AM
Std__100 Ricca ICV	98	15600	1530	7:30:16 AM
Std__100 HP	95	15100	1900	7:33:17 AM
Trap 13945 200ng Spike	203	32100	906	7:38:03 AM
Std__100 HP	104	16400	1540	7:55:10 AM
Std__100 HP	101	16000	1740	8:35:50 AM
1A Trap 37278 Front Unit 9	102	16200	235	8:41:43 AM
1A Trap 37278 Back Unit 9	1.2	150	4	8:44:36 AM
1B Trap 37358 Front Unit 9	100	15850	10	8:47:14 AM
1B Trap 37358 Back Unit 9	1.0	106	3	8:49:28 AM
Std__100 HP	100	15800	2060	8:55:31 AM
Std__100 HP	99	15700	1210	9:12:15 AM
2A Trap 39606 Front Unit 9	98	15600	636	9:25:59 AM
2A Trap 39606 Back Unit 9	0.9	98	2	9:28:19 AM
2A Partic Unit 9	0.6	55	2	9:31:12 AM
2B Trap 39602 Front Unit 9	101	16000	699	9:33:36 AM
2B Trap 39602 Back Unit 9	1.0	107	2	9:35:57 AM
Std__100 HP	98	15500	1660	10:01:00 AM
3A Trap 39550 Front Unit 9	104	16500	450	10:27:59 AM
3A Trap 39550 Back Unit 9	2.1	292	21	10:30:10 AM
3B Trap 39598 Front Unit 9	100	15900	889	10:32:20 AM
3B Trap 39598 Back Unit 9	0.9	89	6	10:34:25 AM
Std__100 HP	92	14600	1440	10:56:31 AM
Std__100 HP	100	15800	1880	11:11:33 AM
4A Trap 28309 Front Unit 9	105	16600	743	11:14:11 AM
4A Trap 28309 Back Unit 9	0.5	31	2	11:16:06 AM
4B Trap 28262 Front Unit 9	88	13900	637	11:18:29 AM
4B Trap 28262 Back unit 9	1.0	110	4	11:20:46 AM
Std__100 HP	95	15000	1290	11:25:37 AM
Std__100 HP	95	15000	1570	11:34:33 AM
Std__100 HP	92	14600	1720	11:54:08 AM
Std__100 HP	99	15700	1680	12:07:06 PM
5A Trap 30109 Front Unit 9	114	18100	756	12:10:19 PM
5A Trap 30109 Back Unit 9	0.5	38	2	12:12:26 PM
5B Trap 30368 Front 100ng Spike Unit 9	205	32500	1440	12:14:53 PM
5B Trap 30368 Back 100ng Spike Unit 9	1.1	132	4	12:16:53 PM
Std__100 HP	92	14500	1600	12:21:23 PM
Std__100 HP	104	16400	1560	12:43:37 PM
Std__100 HP	94	14900	1600	12:55:53 PM

Ohio Lumex Calibration and Test Results Summary
ADA-ES, Inc - We Energies Presque Isle Power Plant
Unit 9 Toxecon Inlet
November 6, 2008

Description	C, ng	Area	Maximum	Time
6A Trap 28180 Front Unit 9	102	16100	1000	1:04:23 PM
6A Trap 28180 Back Unit 9	0.7	58	2	1:09:45 PM
6B Trap 30302 Front 100ng Spike Unit 9	193	30600	1470	1:12:18 PM
6B Trap 30302 Back 100ng Spike Unit 9	1.2	144	3	1:15:19 PM
Std__100 HP	99	15700	1760	1:17:32 PM
Std__100 HP	91	14400	1850	1:29:14 PM
7B Trap 31116 Front 100ng Spike Unit 9	213	33700	1290	1:34:55 PM
7B Trap 31116 Back 100ng Spike Unit 9	0.9	94	3	1:38:36 PM
7A Trap 30143 Front Unit 9	98	15600	757	1:44:55 PM
7A Trap 30143 Back Unit 9	0.4	20	2	1:49:10 PM
Std__100 HP	92	14500	1650	1:52:05 PM
Std__100 HP	97	15300	1350	2:22:31 PM
8A Trap 28313 Front Unit 9	105	16600	853	2:24:39 PM
8A Trap 28313 Back Unit 9	0.6	47	3	2:27:00 PM
8B Trap 28383 Front Unit 9	104	16400	450	2:30:51 PM
8B Trap 28383 Back Unit 9	0.8	87	2	2:33:31 PM
Std__100 HP	101	16000	1700	2:47:31 PM
Std__100 HP	100	15800	1600	2:56:43 PM
9A Trap 30116 Front Unit 9	98	15500	575	3:02:03 PM
9A Trap 30116 Back Unit 9	0.4	10	2	3:03:54 PM
9B Trap 37209 Front Unit 9	101	16000	607	3:06:34 PM
9B Trap 37209 Front Unit 9	0.3	-4	2	3:08:40 PM
Std__100 Hp	93	14800	1730	3:10:42 PM
Std__100 HP	106	16800	1630	3:35:28 PM
10A Trap 28389 Front Unit 9	98	15500	545	3:40:31 PM
10A Trap 28389 Back Unit 9	0.3	-2	2	3:42:53 PM
10B Trap 28382 Front Unit 9	95	15000	599	3:45:59 PM
10B Trap 28382 Back Unit 9	1.1	122	3	3:48:01 PM
Std__100 HP	93	14700	1740	3:50:21 PM

Ohio Lumex Calibration and Test Results Summary
ADA-ES, Inc - We Energies Presque Isle Power Plant
Units 7 and 8 Toxecon Inlets
November 6, 2008

Description	C, ng	Area	Maximum	Time
BLANK	0.0	-47	4	7:15:13 AM
Std__500 HP	501	79300	7050	7:17:12 AM
Std__250 HP	245	38700	4960	7:18:52 AM
Std__50 HP	53	8350	844	7:20:32 AM
Std__100 HP	100	15900	1310	7:22:06 AM
Std__100 Ricca ICV	98	15600	1530	7:30:16 AM
Std__100 HP	95	15100	1900	7:33:17 AM
Trap 13945 200ng Spike	203	32100	906	7:38:03 AM
Std__100 HP	104	16400	1540	7:55:10 AM
Std__100 HP	101	16000	1740	8:35:50 AM
Std__100 HP	100	15800	2060	8:55:31 AM
Std__100 HP	99	15700	1210	9:12:15 AM
1A Trap 28350 Front Unit 7	107	17000	1140	9:38:16 AM
1A Trap 28350 Back Unit 7	1.0	111	3	9:40:33 AM
1B Trap 28266 Front Unit 7	121	19100	857	9:43:35 AM
1B Trap 28266 Back Unit 7	-0.1	-57	2	9:45:58 AM
1A Trap 28321 Front Unit 8	116	18300	753	9:48:57 AM
1A Trap 28321 Back Unit 8	0.7	65	2	9:51:21 AM
1B Trap 28230 Front Unit 8	105	16700	684	9:54:34 AM
1B Trap 28230 Back Unit 8	0.3	1	2	9:56:50 AM
Std__100 HP	112	17700	1610	9:58:39 AM
Std__100 HP	98	15500	1660	10:01:00 AM
2A Trap 28271 Front Unit 8	116	18300	1010	10:36:54 AM
2A Trap 28271 Back Unit 8	0.8	85	4	10:39:24 AM
2B Trap 28363 front Unit 8	117	18500	1010	10:41:47 AM
2B Trap 28363 Back Unit 8	0.4	20	5	10:43:44 AM
2A Trap 28207 Front Unit 7	112	17800	383	10:46:04 AM
2A Trap 28207 Back Unit 7	0.7	61	3	10:49:27 AM
2B Trap 28254 Front Unit 7	117	18500	264	10:52:01 AM
2B Trap 28254 Back Unit 7	0.5	39	3	10:54:25 AM
Std__100 HP	92	14600	1440	10:56:31 AM
Std__100 HP	100	15800	1880	11:11:33 AM
Std__100 HP	95	15000	1290	11:25:37 AM
Std__100 HP	95	15000	1570	11:34:33 AM
3A Trap 28362 Front Unit 8	100	15800	703	11:36:59 AM
3A Trap 28362 Back Unit 8	0.4	9	2	11:39:05 AM
3B Trap 28364 Front Unit 8	93	14700	777	11:41:15 AM
3B Trap 28364 Back Unit 8	0.7	59	2	11:43:15 AM
3A Trap 28306 Front Unit 7	98	15500	707	11:45:52 AM
3A Trap 28306 Back Unit 7	0.8	76	3	11:48:21 AM
3B Trap 28267 Front Unit 7	92	14500	665	11:50:40 AM
3B Trap 28267 Back Unit 7	0.6	54	2	11:52:25 AM
Std__100 HP	92	14600	1720	11:54:08 AM

ADA-We Energies PIPP
Toxecon Outlet
Sorbent Trap Field Recovery Summary

Test Date	Test Run	Test Time	Actual Concentration, ng	Expected Spike Concentration, ng	Sample Volume, standard liters	Recovery %
11/5/2008	3A	14:45-16:15	94.0	N/A	133.83	109.25
	3B		201.0	100	130.62	
11/5/2008	4A	16:35-18:05	67.7	N/A	138.49	101.20
	4B		164.7	100	129.90	
11/6/2008	5A	7:30-9:00	62.9	N/A	130.82	99.71
	5B		161.7	100	128.92	

ADA-We Energies PIPP
Unit 9 Toxecon Inlet
Sorbent Trap Field Recovery Summary

Test Date	Test Run	Test Time	Actual Concentration, ng	Expected Spike Concentration, ng	Sample Volume, standard liters	Recovery %
11/6/2008	5A	11:05-11:35	114.5	N/A	16.97	89.58
	5B		206.1	100	17.27	
11/6/2008	6A	11:55-12:25	102.7	N/A	15.78	91.11
	6B		194.2	100	15.84	
11/6/2008	7A	12:40-13:10	98.4	N/A	15.57	114.87
	7B		213.9	100	15.67	

Method 30B (Sorbent Trap) Mercury Test Results Summary
ADA-ES
We Energies-PIPP
Toxecon Outlet

Test No.	Date	Start Time	End Time	V_m (standard L)	ng detected	ppb	ug/dscm	ug/wscm	% difference
1A	11/5/2008	11:10	12:40	153.82	79.0000	0.06	0.51	0.46	
1B	11/5/2008	11:10	12:40	140.56	77.0000	0.07	0.55	0.49	
		Average			78.0000	0.06	0.53	**0.48**	-3.22
2A	11/5/2008	13:00	14:30	142.87	67.0000	0.06	0.47	0.42	
2B	11/5/2008	13:00	14:30	134.45	64.0000	0.06	0.48	0.42	
		Average			65.5000	0.06	0.47	**0.42**	-0.75
3A	11/5/2008	14:45	16:15	133.83	94.0000	0.08	0.70	0.62	
3B	11/5/2008	14:45	16:15	130.62	101.0000	0.09	0.77	0.69	
		Average			97.5000	0.09	0.74	**0.66**	-4.80
4A	11/5/2008	16:35	18:05	138.49	67.7000	0.06	0.49	0.43	
4B	11/5/2008	16:35	18:05	129.90	64.7000	0.06	0.50	0.44	
		Average			66.2000	0.06	0.49	**0.44**	-0.94
5A	11/6/2008	7:30	9:00	130.82	62.9000	0.06	0.48	0.43	
5B	11/6/2008	7:30	9:00	128.92	61.7000	0.06	0.48	0.43	
		Average			62.3000	0.06	0.48	**0.43**	0.23
6A	11/6/2008	9:15	10:45	138.00	81.400	0.07	0.59	0.52	
6B	11/6/2008	9:15	10:45	136.72	81.600	0.07	0.60	0.53	
		Average			81.5000	0.07	0.59	**0.53**	-0.59
7A	11/6/2008	11:00	12:30	157.07	68.8000	0.05	0.44	0.39	
7B	11/6/2008	11:00	12:30	154.70	63.6000	0.05	0.41	0.37	
		Average			66.2000	0.05	0.42	**0.38**	3.17
8A	11/6/2008	12:40	14:10	159.86	76.5000	0.06	0.48	0.43	
8B	11/6/2008	12:40	14:10	157.17	75.6000	0.06	0.48	0.43	
		Average			76.0500	0.06	0.48	**0.43**	-0.26
9A	11/6/2008	14:20	15:50	147.75	89.7000	0.07	0.61	0.54	
9B	11/6/2008	14:20	15:50	145.96	93.7000	0.08	0.64	0.57	
		Average			91.7000	0.07	0.63	**0.55**	-2.79
10A	11/6/2008	16:05	17:35	136.07	69.0000	0.06	0.51	0.45	
10B	11/6/2008	16:05	17:35	134.14	67.9000	0.06	0.51	0.45	
		Average			68.4500	0.06	0.51	**0.45**	0.09

METHOD 30B TEST RESULTS

Date:	11/5/2008	Location:	Toxecon Outlet
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	JENM
Plant:	We Energies-PIPP		

Test Number:	1A	Start Time 11:10	End Time: 12:40
Pressure, Barometric(Hg"):	29.150	Hg (ng)	79.0
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.103
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.55
Final Volume (liters)	157.453	Hg (ug/dscm)	0.51
Meter Temperature (°F)	68.14	Hg (ug/wscm)	0.46
Meter Volume (Normal liters)	143.33		
Meter Volume (Standard liters)	153.82		
Meter Calibration (Y)	1.003		

Test Number:	2A	Start Time 13:00	End Time: 14:30
Pressure, Barometric(Hg"):	29.150	Hg (ng)	67.0
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.110
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.50
Final Volume (liters)	147.396	Hg (ug/dscm)	0.47
Meter Temperature (°F)	72.29	Hg (ug/wscm)	0.42
Meter Volume (Normal liters)	133.13		
Meter Volume (Standard liters)	142.87		
Meter Calibration (Y)	1.003		

Test Number:	3A	Start Time 14:45	End Time: 16:15
Pressure, Barometric(Hg"):	28.900	Hg (ng)	94.0
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.194	Hg (ppb)	0.08
Initial Volume (liters)	0	Hg (ug/dncm)	0.75
Final Volume (liters)	139.863	Hg (ug/dscm)	0.70
Meter Temperature (°F)	74.60	Hg (ug/wscm)	0.62
Meter Volume (Normal liters)	124.70		
Meter Volume (Standard liters)	133.83		
Meter Calibration (Y)	1.003		

METHOD 30B TEST RESULTS

Date:	11/5/2008	Location:	Toxecon Outlet
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	JENM
Plant:	We Energies-PIPP		

Test Number:	1B	Start Time 11:10	End Time: 12:40
Pressure, Barometric(Hg"):	29.150	Hg (ng)	77.0
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.103
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.07
Initial Volume (liters)	0	Hg (ug/dncm)	0.59
Final Volume (liters)	145.355	Hg (ug/dscm)	0.55
Meter Temperature (°F)	69.29	Hg (ug/wscm)	0.49
Meter Volume (Normal liters)	130.98		
Meter Volume (Standard liters)	140.56		
Meter Calibration (Y)	0.995		

Test Number:	2B	Start Time 13:00	End Time: 14:30
Pressure, Barometric(Hg"):	29.150	Hg (ng)	64.0
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.110
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.51
Final Volume (liters)	140.309	Hg (ug/dscm)	0.48
Meter Temperature (°F)	74.14	Hg (ug/wscm)	0.42
Meter Volume (Normal liters)	125.29		
Meter Volume (Standard liters)	134.45		
Meter Calibration (Y)	0.995		

Test Number:	3B	Start Time 14:45	End Time: 16:15
Pressure, Barometric(Hg"):	28.900	Hg (ng)	101.0
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.194	Hg (ppb)	0.09
Initial Volume (liters)	0	Hg (ug/dncm)	0.83
Final Volume (liters)	138.047	Hg (ug/dscm)	0.77
Meter Temperature (°F)	76.30	Hg (ug/wscm)	0.69
Meter Volume (Normal liters)	121.72		
Meter Volume (Standard liters)	130.62		
Meter Calibration (Y)	0.995		

METHOD 30B TEST RESULTS

Date:	11/5/08 and 11/6/08	Location:	Toxecon Outlet
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	JENM
Plant:	We Energies-PIPP		

Test Number:	4A	Start Time 16:35	End Time: 18:05
Pressure, Barometric(Hg"):	29.150	Hg (ng)	67.7
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.53
Final Volume (liters)	143.414	Hg (ug/dscm)	0.49
Meter Temperature (°F)	74.29	Hg (ug/wscm)	0.43
Meter Volume (Normal liters)	129.05		
Meter Volume (Standard liters)	138.49		
Meter Calibration (Y)	1.003		

Test Number:	5A	Start Time 7:30	End Time: 9:00
Pressure, Barometric(Hg"):	29.150	Hg (ng)	62.9
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.109
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.52
Final Volume (liters)	132.931	Hg (ug/dscm)	0.48
Meter Temperature (°F)	64.29	Hg (ug/wscm)	0.43
Meter Volume (Normal liters)	121.90		
Meter Volume (Standard liters)	130.82		
Meter Calibration (Y)	1.003		

Test Number:	6A	Start Time 9:15	End Time: 10:45
Pressure, Barometric(Hg"):	29.150	Hg (ng)	81.4
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.07
Initial Volume (liters)	0	Hg (ug/dncm)	0.63
Final Volume (liters)	141.07	Hg (ug/dscm)	0.59
Meter Temperature (°F)	67.43	Hg (ug/wscm)	0.52
Meter Volume (Normal liters)	128.59		
Meter Volume (Standard liters)	138.00		
Meter Calibration (Y)	1.003		

METHOD 30B TEST RESULTS

Date:	11/5/08 and 11/6/08	Location:	Toxecon Outlet
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	JENM
Plant:	We Energies-PIPP		

Test Number:	4B	Start Time 16:35	End Time: 18:05
Pressure, Barometric(Hg"):	29.150	Hg (ng)	64.7
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.54
Final Volume (liters)	135.961	Hg (ug/dscm)	0.50
Meter Temperature (°F)	75.71	Hg (ug/wscm)	0.44
Meter Volume (Normal liters)	121.05		
Meter Volume (Standard liters)	129.90		
Meter Calibration (Y)	0.995		

Test Number:	5B	Start Time 7:30	End Time: 9:00
Pressure, Barometric(Hg"):	29.150	Hg (ng)	61.7
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.109
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.51
Final Volume (liters)	132.491	Hg (ug/dscm)	0.48
Meter Temperature (°F)	66.00	Hg (ug/wscm)	0.43
Meter Volume (Normal liters)	120.14		
Meter Volume (Standard liters)	128.92		
Meter Calibration (Y)	0.995		

Test Number:	6B	Start Time 9:15	End Time: 10:45
Pressure, Barometric(Hg"):	29.150	Hg (ng)	81.6
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.07
Initial Volume (liters)	0	Hg (ug/dncm)	0.64
Final Volume (liters)	141.452	Hg (ug/dscm)	0.60
Meter Temperature (°F)	69.57	Hg (ug/wscm)	0.53
Meter Volume (Normal liters)	127.40		
Meter Volume (Standard liters)	136.72		
Meter Calibration (Y)	0.995		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Toxecon Outlet
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	JENM
Plant:	We Energies-PIPP		

Test Number:	7A	Start Time 11:00	End Time: 12:30
Pressure, Barometric(Hg"):	29.150	Hg (ng)	68.8
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.05
Initial Volume (liters)	0	Hg (ug/dncm)	0.47
Final Volume (liters)	161.045	Hg (ug/dscm)	0.44
Meter Temperature (°F)	69.00	Hg (ug/wscm)	0.39
Meter Volume (Normal liters)	146.37		
Meter Volume (Standard liters)	157.07		
Meter Calibration (Y)	1.003		

Test Number:	8A	Start Time 12:40	End Time: 14:10
Pressure, Barometric(Hg"):	29.150	Hg (ng)	76.5
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.107
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.51
Final Volume (liters)	164.831	Hg (ug/dscm)	0.48
Meter Temperature (°F)	72.00	Hg (ug/wscm)	0.43
Meter Volume (Normal liters)	148.96		
Meter Volume (Standard liters)	159.86		
Meter Calibration (Y)	1.003		

Test Number:	9A	Start Time 14:20	End Time: 15:50
Pressure, Barometric(Hg"):	29.150	Hg (ng)	89.7
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.113
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.07
Initial Volume (liters)	0	Hg (ug/dncm)	0.65
Final Volume (liters)	153.041	Hg (ug/dscm)	0.61
Meter Temperature (°F)	74.43	Hg (ug/wscm)	0.54
Meter Volume (Normal liters)	137.68		
Meter Volume (Standard liters)	147.75		
Meter Calibration (Y)	1.003		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Toxecon Outlet
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	JENM
Plant:	We Energies-PIPP		

Test Number:	7B	Start Time 11:00	End Time: 12:30
Pressure, Barometric(Hg"):	29.150	Hg (ng)	63.6
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.112
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.05
Initial Volume (liters)	0	Hg (ug/dncm)	0.44
Final Volume (liters)	160.496	Hg (ug/dscm)	0.41
Meter Temperature (°F)	71.00	Hg (ug/wscm)	0.37
Meter Volume (Normal liters)	144.16		
Meter Volume (Standard liters)	154.70		
Meter Calibration (Y)	0.995		

Test Number:	8B	Start Time 12:40	End Time: 14:10
Pressure, Barometric(Hg"):	29.150	Hg (ng)	75.6
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.107
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.06
Initial Volume (liters)	0	Hg (ug/dncm)	0.52
Final Volume (liters)	164.023	Hg (ug/dscm)	0.48
Meter Temperature (°F)	74.14	Hg (ug/wscm)	0.43
Meter Volume (Normal liters)	146.46		
Meter Volume (Standard liters)	157.17		
Meter Calibration (Y)	0.995		

Test Number:	9B	Start Time 14:20	End Time: 15:50
Pressure, Barometric(Hg"):	29.150	Hg (ng)	93.7
Pressure, Static(H_2O"):	4.00	Water Vapor in Flue Gas (Bws):	0.113
Pressure, Stack(Hg"):	29.444	Hg (ppb)	0.08
Initial Volume (liters)	0	Hg (ug/dncm)	0.69
Final Volume (liters)	152.893	Hg (ug/dscm)	0.64
Meter Temperature (°F)	76.14	Hg (ug/wscm)	0.57
Meter Volume (Normal liters)	136.01		
Meter Volume (Standard liters)	145.96		
Meter Calibration (Y)	0.995		

METHOD 30B TEST RESULTS

Date:	**11/6/2008**	**Location:**	**Toxecon Outlet**
Project #:	**M084501**	**Condition:**	**Normal**
Client:	**ADA-ES**	**Data Taken By:**	**JENM**
Plant:	**We Energies-PIPP**		

Test Number:	10A	**Start Time** 16:05	**End Time:** 17:35
Pressure, Barometric(Hg"):	29.150	**Hg (ng)**	69.0
Pressure, Static(H_2O"):	4.00	**Water Vapor in Flue Gas (Bws):**	0.112
Pressure, Stack(Hg"):	29.444	**Hg (ppb)**	0.06
Initial Volume (liters)	0	**Hg (ug/dncm)**	0.54
Final Volume (liters)	140.98	**Hg (ug/dscm)**	0.51
Meter Temperature (°F)	74.57	**Hg (ug/wscm)**	0.45
Meter Volume (Normal liters)	126.79		
Meter Volume (Standard liters)	136.07		
Meter Calibration (Y)	1.003		

METHOD 30B TEST RESULTS

Date:	**11/6/2008**	**Location:**	**Toxecon Outlet**
Project #:	**M084501**	**Condition:**	**Normal**
Client:	**ADA-ES**	**Data Taken By:**	**JENM**
Plant:	**We Energies-PIPP**		

Test Number:	10B	**Start Time** 16:05	**End Time:** 17:35
Pressure, Barometric(Hg"):	29.150	**Hg (ng)**	67.9
Pressure, Static(H_2O"):	4.00	**Water Vapor in Flue Gas (Bws):**	0.112
Pressure, Stack(Hg"):	29.444	**Hg (ppb)**	0.06
Initial Volume (liters)	0	**Hg (ug/dncm)**	0.54
Final Volume (liters)	140.545	**Hg (ug/dscm)**	0.51
Meter Temperature (°F)	76.29	**Hg (ug/wscm)**	0.45
Meter Volume (Normal liters)	124.99		
Meter Volume (Standard liters)	134.14		
Meter Calibration (Y)	0.995		

METHOD 4 MOISTURE DETERMINATION

Date:	11/5/2008	**Run Number:**	**1**		
Project:	ADA	**Condition:**	normal		
Location:	Presque Isle	**Time:**	**Start-** 11:12	**End-** 12:12	
Source:	Toxecon Outlet	**Data Taken By:**	JM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	209.9		
Meter Initial Volume:	61.965	**Final Wt:**	225.2		
Meter Final Volume:	105.620	**Initial Volume:**	200.0		
Meter Temperature:	68.14	**Final Volume:**	290.0		
Meter Volume dscf:	43.326	**Water Vapor in Flue Gas (Bws):**		**0.103**	

Date:	11/5/2008	**Run Number:**	**2**		
Project:	ADA	**Condition:**	normal		
Location:	Presque Isle	**Time:**	**Start-** 13:00	**End-** 14:00	
Source:	Toxecon Outlet	**Data Taken By:**	JM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	215.0		
Meter Initial Volume:	5.712	**Final Wt:**	232.2		
Meter Final Volume:	51.290	**Initial Volume:**	200.0		
Meter Temperature:	73.85	**Final Volume:**	300.0		
Meter Volume dscf:	44.751	**Water Vapor in Flue Gas (Bws):**		**0.110**	

Date:	11/5/2008	**Run Number:**	**3**		
Project:	ADA	**Condition:**	normal		
Location:	Presque Isle	**Time:**	**Start-** 14:45	**End-** 15:45	
Source:	Toxecon Outlet	**Data Taken By:**	JM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	204.4		
Meter Initial Volume:	51.336	**Final Wt:**	218.2		
Meter Final Volume:	98.710	**Initial Volume:**	200.0		
Meter Temperature:	75.86	**Final Volume:**	310.0		
Meter Volume dscf:	46.340	**Water Vapor in Flue Gas (Bws):**		**0.112**	

Date:	11/5/2008	**Run Number:**	**4**		
Project:	ADA	**Condition:**			
Location:	Presque Isle	**Time:**	**Start-** 16:40	**End-** 17:40	
Source:	Toxecon Outlet	**Data Taken By:**	JM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	215.4		
Meter Initial Volume:	3.561	**Final Wt:**	231.4		
Meter Final Volume:	51.610	**Initial Volume:**	200.0		
Meter Temperature:	77.57	**Final Volume:**	310.0		
Meter Volume dscf:	46.851	**Water Vapor in Flue Gas (Bws):**		**0.112**	

METHOD 4 MOISTURE DETERMINATION

Date:	11/6/2008	**Run Number:**	**5**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 7:30		**End-** 8:30
Source:	Toxecon Outlet	**Data Taken By:**	JENM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	206.2		
Meter Initial Volume:	51.715	**Final Wt:**	220.2		
Meter Final Volume:	96.210	**Initial Volume:**	200.0		
Meter Temperature:	70.43	**Final Volume:**	300.0		
Meter Volume dscf:	43.969	**Water Vapor in Flue Gas (Bws):**		**0.109**	

Date:	11/6/2008	**Run Number:**	**6**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 9:15		**End-** 10:15
Source:	Toxecon Outlet	**Data Taken By:**	JENM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	212.0		
Meter Initial Volume:	96.351	**Final Wt:**	225.0		
Meter Final Volume:	143.620	**Initial Volume:**	200.0		
Meter Temperature:	78.14	**Final Volume:**	310.0		
Meter Volume dscf:	46.041	**Water Vapor in Flue Gas (Bws):**		**0.112**	

Date:	11/6/2008	**Run Number:**	**7**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 11:00		**End-** 12:00
Source:	Toxecon Outlet	**Data Taken By:**	JENM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	217.7		
Meter Initial Volume:	43.883	**Final Wt:**	230.6		
Meter Final Volume:	90.659	**Initial Volume:**	200.0		
Meter Temperature:	71.86	**Final Volume:**	310.0		
Meter Volume dscf:	46.099	**Water Vapor in Flue Gas (Bws):**		**0.112**	

Date:	11/6/2008	**Run Number:**	**8**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 12:40		**End-** 13:40
Source:	Toxecon Outlet	**Data Taken By:**	JENM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	209.6		
Meter Initial Volume:	90.720	**Final Wt:**	224.2		
Meter Final Volume:	136.831	**Initial Volume:**	200.0		
Meter Temperature:	74.00	**Final Volume:**	300.0		
Meter Volume dscf:	45.262	**Water Vapor in Flue Gas (Bws):**		**0.107**	

METHOD 4 MOISTURE DETERMINATION

Date:	11/6/2008	**Run Number:**	**9**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 14:20	**End-** 15:20	
Source:	Toxecon Outlet	**Data Taken By:**	JENM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	218.2		
Meter Initial Volume:	36.940	**Final Wt:**	231.6		
Meter Final Volume:	83.692	**Initial Volume:**	200.0		
Meter Temperature:	76.57	**Final Volume:**	310.0		
Meter Volume dscf:	45.671	**Water Vapor in Flue Gas (Bws):**		**0.113**	

Date:	11/6/2008	**Run Number:**	**10**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 16:05	**End-** 17:05	
Source:	Toxecon Outlet	**Data Taken By:**	JENM		
Pressure, Barometric(Hg"):	29.15	**Meter Calibration (Y):**	1.015		
Delta H:	1.548	**Initial Wt:**	213.0		
Meter Initial Volume:	83.702	**Final Wt:**	225.2		
Meter Final Volume:	130.359	**Initial Volume:**	200.0		
Meter Temperature:	76.50	**Final Volume:**	310.0		
Meter Volume dscf:	45.584	**Water Vapor in Flue Gas (Bws):**		**0.112**	

Method 30B (Sorbent Trap) Mercury Test Results Summary
ADA-ES
We Energies-PIPP
Unit 9 Toxecon Inlet

Test No.	Date	Start Time	End Time	V_m (standard L)	ng detected	ppb	ug/dscm	ug/wscm	% difference
1A	11/6/2008	7:45	8:15	16.27	103.2000	0.76	6.35	5.68	
1B	11/6/2008	7:45	8:15	16.42	101.0000	0.74	6.16	5.50	
		Average			102.1000	0.75	6.25	**5.59**	1.54
2A	11/6/2008	8:35	9:05	16.26	98.9000	0.73	6.09	5.43	
2B	11/6/2008	8:35	9:05	16.17	102.0000	0.76	6.31	5.63	
		Average			100.4500	0.74	6.20	**5.53**	-1.82
3A	11/6/2008	9:22	9:52	16.55	106.1000	0.77	6.42	5.78	
3B	11/6/2008	9:22	9:52	16.45	100.9000	0.74	6.14	5.53	
		Average			103.5000	0.75	6.28	**5.66**	2.21
4A	11/6/2008	10:20	10:50	15.01	105.5000	0.84	7.04	6.28	
4B	11/6/2008	10:20	10:50	14.62	89.0000	0.73	6.09	5.44	
		Average			97.2500	0.79	6.57	**5.86**	7.18
5A	11/6/2008	11:05	11:35	17.23	114.5000	0.80	6.65	5.95	
5B	11/6/2008	11:05	11:35	17.01	106.1000	0.75	6.25	5.59	
		Average			110.3000	0.77	6.45	**5.77**	3.15
6A	11/6/2008	11:55	12:25	15.78	102.700	0.78	6.51	5.82	
6B	11/6/2008	11:55	12:25	15.84	94.200	0.71	5.95	5.32	
		Average			98.4500	0.75	6.23	**5.57**	4.50
7A	11/6/2008	12:40	13:10	15.57	98.4000	0.76	6.33	5.68	
7B	11/6/2008	12:40	13:10	15.67	113.9000	0.87	7.27	6.52	
		Average			106.1500	0.81	6.80	**6.10**	-6.96
8A	11/6/2008	13:25	13:55	16.35	105.6000	0.77	6.46	5.81	
8B	11/6/2008	13:25	13:55	16.07	104.8000	0.78	6.53	5.87	
		Average			105.2000	0.78	6.49	**5.84**	-0.48
9A	11/6/2008	14:10	14:40	15.64	98.4000	0.75	6.30	5.62	
9B	11/6/2008	14:10	14:40	15.30	101.3000	0.79	6.63	5.91	
		Average			99.8500	0.77	6.46	**5.77**	-2.53
10A	11/6/2008	14:50	15:20	15.06	98.3000	0.78	6.53	5.87	
10B	11/6/2008	14:50	15:20	15.22	96.1000	0.76	6.32	5.67	
		Average			97.2000	0.77	6.43	**5.77**	1.67

METHOD 30B TEST RESULTS

Date:	11/6/2008	**Location:**	Unit 9 Toxecon Inle
Project #:	M084501	**Condition:**	Normal
Client:	ADA-ES	**Data Taken By:**	MPLT
Plant:	We Energies-PIPP		

Test Number:	1A	**Start Time** 7:45	**End Time:** 8:15
Pressure, Barometric(Hg"):	29.100	**Hg (ng)**	103.2
Pressure, Static(H_2O"):	-1.00	**Water Vapor in Flue Gas (Bws):**	0.106
Pressure, Stack(Hg"):	29.026	**Hg (ppb)**	0.76
Initial Volume (liters)	0	**Hg (ug/dncm)**	6.81
Final Volume (liters)	17.155	**Hg (ug/dscm)**	6.35
Meter Temperature (°F)	80.29	**Hg (ug/wscm)**	5.68
Meter Volume (Normal liters)	15.16		
Meter Volume (Standard liters)	16.27		
Meter Calibration (Y)	0.998		

Test Number:	2A	**Start Time** 8:35	**End Time:** 9:05
Pressure, Barometric(Hg"):	29.100	**Hg (ng)**	98.9
Pressure, Static(H_2O"):	-1.00	**Water Vapor in Flue Gas (Bws):**	0.108
Pressure, Stack(Hg"):	29.026	**Hg (ppb)**	0.73
Initial Volume (liters)	0	**Hg (ug/dncm)**	6.53
Final Volume (liters)	17.132	**Hg (ug/dscm)**	6.09
Meter Temperature (°F)	80.00	**Hg (ug/wscm)**	5.43
Meter Volume (Normal liters)	15.15		
Meter Volume (Standard liters)	16.26		
Meter Calibration (Y)	0.998		

Test Number:	3A	**Start Time** 9:22	**End Time:** 9:52
Pressure, Barometric(Hg"):	29.100	**Hg (ng)**	106.1
Pressure, Static(H_2O"):	-1.00	**Water Vapor in Flue Gas (Bws):**	0.099
Pressure, Stack(Hg"):	29.026	**Hg (ppb)**	0.77
Initial Volume (liters)	0	**Hg (ug/dncm)**	6.89
Final Volume (liters)	17.444	**Hg (ug/dscm)**	6.42
Meter Temperature (°F)	80.14	**Hg (ug/wscm)**	5.78
Meter Volume (Normal liters)	15.42		
Meter Volume (Standard liters)	16.55		
Meter Calibration (Y)	0.998		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 9 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	MPLT
Plant:	We Energies-PIPP		

Test Number:	1B	Start Time 7:45	End Time: 8:15
Pressure, Barometric(Hg"):	29.100	Hg (ng)	101.0
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.106
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.74
Initial Volume (liters)	0	Hg (ug/dncm)	6.61
Final Volume (liters)	17.371	Hg (ug/dscm)	6.16
Meter Temperature (°F)	81.00	Hg (ug/wscm)	5.50
Meter Volume (Normal liters)	15.30		
Meter Volume (Standard liters)	16.42		
Meter Calibration (Y)	0.996		

Test Number:	2B	Start Time 8:35	End Time: 9:05
Pressure, Barometric(Hg"):	29.100	Hg (ng)	102.0
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.108
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.76
Initial Volume (liters)	0	Hg (ug/dncm)	6.78
Final Volume (liters)	17.129	Hg (ug/dscm)	6.31
Meter Temperature (°F)	81.86	Hg (ug/wscm)	5.63
Meter Volume (Normal liters)	15.07		
Meter Volume (Standard liters)	16.17		
Meter Calibration (Y)	0.996		

Test Number:	3B	Start Time 9:22	End Time: 9:52
Pressure, Barometric(Hg"):	29.100	Hg (ng)	100.9
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.099
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.74
Initial Volume (liters)	0	Hg (ug/dncm)	6.59
Final Volume (liters)	17.432	Hg (ug/dscm)	6.14
Meter Temperature (°F)	82.00	Hg (ug/wscm)	5.53
Meter Volume (Normal liters)	15.33		
Meter Volume (Standard liters)	16.45		
Meter Calibration (Y)	0.996		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 9 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	MPLT
Plant:	We Energies-PIPP		

Test Number:	4A	Start Time 10:20	End Time: 10:50
Pressure, Barometric(Hg"):	29.100	Hg (ng)	105.5
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.108
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.84
Initial Volume (liters)	0	Hg (ug/dncm)	7.55
Final Volume (liters)	15.842	Hg (ug/dscm)	7.04
Meter Temperature (°F)	81.00	Hg (ug/wscm)	6.28
Meter Volume (Normal liters)	13.98		
Meter Volume (Standard liters)	15.01		
Meter Calibration (Y)	0.998		

Test Number:	5A	Start Time 11:05	End Time: 11:35
Pressure, Barometric(Hg"):	29.100	Hg (ng)	114.5
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.105
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.80
Initial Volume (liters)	0	Hg (ug/dncm)	7.14
Final Volume (liters)	18.216	Hg (ug/dscm)	6.65
Meter Temperature (°F)	81.83	Hg (ug/wscm)	5.95
Meter Volume (Normal liters)	16.06		
Meter Volume (Standard liters)	17.23		
Meter Calibration (Y)	0.998		

Test Number:	6A	Start Time 11:55	End Time: 12:25
Pressure, Barometric(Hg"):	29.100	Hg (ng)	102.7
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.106
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.78
Initial Volume (liters)	0	Hg (ug/dncm)	6.99
Final Volume (liters)	16.692	Hg (ug/dscm)	6.51
Meter Temperature (°F)	82.00	Hg (ug/wscm)	5.82
Meter Volume (Normal liters)	14.71		
Meter Volume (Standard liters)	15.78		
Meter Calibration (Y)	0.998		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 9 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	MPLT
Plant:	We Energies-PIPP		

Test Number:	4B	Start Time 10:20	End Time: 10:50
Pressure, Barometric(Hg"):	29.100	Hg (ng)	89.0
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.108
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.73
Initial Volume (liters)	0	Hg (ug/dncm)	6.54
Final Volume (liters)	15.509	Hg (ug/dscm)	6.09
Meter Temperature (°F)	82.57	Hg (ug/wscm)	5.44
Meter Volume (Normal liters)	13.62		
Meter Volume (Standard liters)	14.62		
Meter Calibration (Y)	0.996		

Test Number:	5B	Start Time 11:05	End Time: 11:35
Pressure, Barometric(Hg"):	29.100	Hg (ng)	106.1
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.105
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.75
Initial Volume (liters)	0	Hg (ug/dncm)	6.70
Final Volume (liters)	17.937	Hg (ug/dscm)	6.25
Meter Temperature (°F)	79.50	Hg (ug/wscm)	5.59
Meter Volume (Normal liters)	15.85		
Meter Volume (Standard liters)	17.01		
Meter Calibration (Y)	0.996		

Test Number:	6B	Start Time 11:55	End Time: 12:25
Pressure, Barometric(Hg"):	29.100	Hg (ng)	94.2
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.106
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.71
Initial Volume (liters)	0	Hg (ug/dncm)	6.39
Final Volume (liters)	16.85	Hg (ug/dscm)	5.95
Meter Temperature (°F)	84.00	Hg (ug/wscm)	5.32
Meter Volume (Normal liters)	14.76		
Meter Volume (Standard liters)	15.84		
Meter Calibration (Y)	0.996		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 9 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	MPLT
Plant:	We Energies-PIPP		

Test Number:	7A	Start Time 12:40	End Time: 13:10
Pressure, Barometric(Hg"):	29.100	Hg (ng)	98.4
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.103
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.76
Initial Volume (liters)	0	Hg (ug/dncm)	6.79
Final Volume (liters)	16.553	Hg (ug/dscm)	6.33
Meter Temperature (°F)	85.00	Hg (ug/wscm)	5.68
Meter Volume (Normal liters)	14.50		
Meter Volume (Standard liters)	15.57		
Meter Calibration (Y)	0.998		

Test Number:	8A	Start Time 13:25	End Time: 13:55
Pressure, Barometric(Hg"):	29.100	Hg (ng)	105.6
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.101
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.77
Initial Volume (liters)	0	Hg (ug/dncm)	6.94
Final Volume (liters)	17.363	Hg (ug/dscm)	6.46
Meter Temperature (°F)	84.14	Hg (ug/wscm)	5.81
Meter Volume (Normal liters)	15.24		
Meter Volume (Standard liters)	16.35		
Meter Calibration (Y)	0.998		

Test Number:	9A	Start Time 14:10	End Time: 14:40
Pressure, Barometric(Hg"):	29.100	Hg (ng)	98.4
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.108
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.75
Initial Volume (liters)	0	Hg (ug/dncm)	6.76
Final Volume (liters)	16.601	Hg (ug/dscm)	6.30
Meter Temperature (°F)	84.14	Hg (ug/wscm)	5.62
Meter Volume (Normal liters)	14.57		
Meter Volume (Standard liters)	15.64		
Meter Calibration (Y)	0.998		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 9 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	MPLT
Plant:	We Energies-PIPP		

Test Number:	7B	Start Time 12:40	End Time: 13:10
Pressure, Barometric(Hg"):	29.100	Hg (ng)	113.9
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.103
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.87
Initial Volume (liters)	0	Hg (ug/dncm)	7.81
Final Volume (liters)	16.741	Hg (ug/dscm)	7.27
Meter Temperature (°F)	86.29	Hg (ug/wscm)	6.52
Meter Volume (Normal liters)	14.61		
Meter Volume (Standard liters)	15.67		
Meter Calibration (Y)	0.996		

Test Number:	8B	Start Time 13:25	End Time: 13:55
Pressure, Barometric(Hg"):	29.100	Hg (ng)	104.8
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.101
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.78
Initial Volume (liters)	0	Hg (ug/dncm)	7.00
Final Volume (liters)	17.16	Hg (ug/dscm)	6.53
Meter Temperature (°F)	86.00	Hg (ug/wscm)	5.87
Meter Volume (Normal liters)	14.98		
Meter Volume (Standard liters)	16.07		
Meter Calibration (Y)	0.996		

Test Number:	9B	Start Time 14:10	End Time: 14:40
Pressure, Barometric(Hg"):	29.100	Hg (ng)	101.3
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.108
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.79
Initial Volume (liters)	0	Hg (ug/dncm)	7.11
Final Volume (liters)	16.334	Hg (ug/dscm)	6.63
Meter Temperature (°F)	86.00	Hg (ug/wscm)	5.91
Meter Volume (Normal liters)	14.26		
Meter Volume (Standard liters)	15.30		
Meter Calibration (Y)	0.996		

METHOD 30B TEST RESULTS

Date:	**11/6/2008**	**Location:**	**Unit 9 Toxecon Inle**
Project #:	**M084501**	**Condition:**	**Normal**
Client:	**ADA-ES**	**Data Taken By:**	**MPLT**
Plant:	**We Energies-PIPP**		

Test Number:	10A	**Start Time** 14:50	**End Time:** 15:20
Pressure, Barometric(Hg"):	29.100	**Hg (ng)**	98.3
Pressure, Static(H_2O"):	-1.00	**Water Vapor in Flue Gas (Bws):**	0.102
Pressure, Stack(Hg"):	29.026	**Hg (ppb)**	0.78
Initial Volume (liters)	0	**Hg (ug/dncm)**	7.01
Final Volume (liters)	15.986	**Hg (ug/dscm)**	6.53
Meter Temperature (°F)	84.00	**Hg (ug/wscm)**	5.87
Meter Volume (Normal liters)	14.03		
Meter Volume (Standard liters)	15.06		
Meter Calibration (Y)	0.998		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 9 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	MPLT
Plant:	We Energies-PIPP		

Test Number:	10B	Start Time 14:50	End Time: 15:20
Pressure, Barometric(Hg"):	29.100	Hg (ng)	96.1
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.102
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.76
Initial Volume (liters)	0	Hg (ug/dncm)	6.78
Final Volume (liters)	16.252	Hg (ug/dscm)	6.32
Meter Temperature (°F)	86.00	Hg (ug/wscm)	5.67
Meter Volume (Normal liters)	14.19		
Meter Volume (Standard liters)	15.22		
Meter Calibration (Y)	0.996		

METHOD 4 MOISTURE DETERMINATION

Date:	11/6/2008		**Run Number:**	1	
Project:	ADA		**Condition:**	Normal	
Location:	Presque Isle		**Time:**	**Start-** 7:45	**End-** 8:15
Source:	Unit 9		**Data Taken By:**	M. Platt	
Pressure, Barometric(Hg"):		29.10	**Meter Calibration (Y):**	0.996	
Delta H:		1.504	**Initial Wt:**	208.4	
Meter Initial Volume:		37.534	**Final Wt:**	215.4	
Meter Final Volume:		61.400	**Initial Volume:**	200.0	
Meter Temperature:		81.28	**Final Volume:**	250.0	
Meter Volume dscf:		22.637	**Water Vapor in Flue Gas (Bws):**		**0.106**

Date:	11/6/2008		**Run Number:**	2	
Project:	ADA		**Condition:**	Normal	
Location:	Presque Isle		**Time:**	**Start-** 8:35	**End-** 9:05
Source:	Unit 9		**Data Taken By:**	M. Platt	
Pressure, Barometric(Hg"):		29.10	**Meter Calibration (Y):**	0.996	
Delta H:		1.504	**Initial Wt:**	207.4	
Meter Initial Volume:		62.016	**Final Wt:**	214.2	
Meter Final Volume:		85.387	**Initial Volume:**	200.0	
Meter Temperature:		82.85	**Final Volume:**	250.0	
Meter Volume dscf:		22.104	**Water Vapor in Flue Gas (Bws):**		**0.108**

Date:	11/6/2008		**Run Number:**	3	
Project:	ADA		**Condition:**	Normal	
Location:	Presque Isle		**Time:**	**Start-** 9:22	**End-** 9:52
Source:	Unit 9		**Data Taken By:**	M. Platt	
Pressure, Barometric(Hg"):		29.10	**Meter Calibration (Y):**	0.996	
Delta H:		1.504	**Initial Wt:**	210.4	
Meter Initial Volume:		85.815	**Final Wt:**	214.6	
Meter Final Volume:		110.455	**Initial Volume:**	200.0	
Meter Temperature:		82.85	**Final Volume:**	250.0	
Meter Volume dscf:		23.304	**Water Vapor in Flue Gas (Bws):**		**0.099**

Date:	11/6/2008		**Run Number:**	4	
Project:	ADA		**Condition:**	Normal	
Location:	Presque Isle		**Time:**	**Start-** 10:20	**End-** 10:50
Source:	Unit 9		**Data Taken By:**	M. Platt	
Pressure, Barometric(Hg"):		29.10	**Meter Calibration (Y):**	0.996	
Delta H:		1.504	**Initial Wt:**	217.6	
Meter Initial Volume:		110.923	**Final Wt:**	224.2	
Meter Final Volume:		134.283	**Initial Volume:**	200.0	
Meter Temperature:		82.85	**Final Volume:**	250.0	
Meter Volume dscf:		22.093	**Water Vapor in Flue Gas (Bws):**		**0.108**

METHOD 4 MOISTURE DETERMINATION

Date:	11/6/2008	**Run Number:**	**5**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 11:05	**End-** 11:35	
Source:	Unit 9	**Data Taken By:**			
Pressure, Barometric(Hg"):	29.10	**Meter Calibration (Y):**	0.996		
Delta H:	1.504	**Initial Wt:**	206.2		
Meter Initial Volume:	134.649	**Final Wt:**	211.4		
Meter Final Volume:	158.145	**Initial Volume:**	200.0		
Meter Temperature:	84.57	**Final Volume:**	250.0		
Meter Volume dscf:	22.152	**Water Vapor in Flue Gas (Bws):**		**0.105**	

Date:	11/6/2008	**Run Number:**	**6**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 11:55	**End-** 12:25	
Source:	Unit 9	**Data Taken By:**	0		
Pressure, Barometric(Hg"):	29.10	**Meter Calibration (Y):**	0.996		
Delta H:	1.504	**Initial Wt:**	213.9		
Meter Initial Volume:	158.225	**Final Wt:**	218.8		
Meter Final Volume:	181.417	**Initial Volume:**	200.0		
Meter Temperature:	86.57	**Final Volume:**	250.0		
Meter Volume dscf:	21.785	**Water Vapor in Flue Gas (Bws):**		**0.106**	

Date:	11/6/2008	**Run Number:**	**7**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 12:40	**End-** 13:10	
Source:	Unit 9	**Data Taken By:**	0		
Pressure, Barometric(Hg"):	29.10	**Meter Calibration (Y):**	0.996		
Delta H:	1.504	**Initial Wt:**	215.0		
Meter Initial Volume:	181.805	**Final Wt:**	221.4		
Meter Final Volume:	206.456	**Initial Volume:**	200.0		
Meter Temperature:	87.42	**Final Volume:**	250.0		
Meter Volume dscf:	23.120	**Water Vapor in Flue Gas (Bws):**		**0.103**	

Date:	11/6/2008	**Run Number:**	**8**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 13:25	**End-** 13:55	
Source:	Unit 9	**Data Taken By:**	0		
Pressure, Barometric(Hg"):	29.10	**Meter Calibration (Y):**	0.996		
Delta H:	1.504	**Initial Wt:**	211.0		
Meter Initial Volume:	206.784	**Final Wt:**	216.4		
Meter Final Volume:	231.730	**Initial Volume:**	200.0		
Meter Temperature:	90.14	**Final Volume:**	250.0		
Meter Volume dscf:	23.281	**Water Vapor in Flue Gas (Bws):**		**0.101**	

METHOD 4 MOISTURE DETERMINATION

Date:	11/6/2008	**Run Number:**	**9**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 14:10	**End-** 14:40	
Source:	Unit 9	**Data Taken By:**	J. Howe		
Pressure, Barometric(Hg"):	29.10	**Meter Calibration (Y):**	0.996		
Delta H:	1.504	**Initial Wt:**	213.6		
Meter Initial Volume:	233.385	**Final Wt:**	219.8		
Meter Final Volume:	256.911	**Initial Volume:**	200.0		
Meter Temperature:	91.27	**Final Volume:**	250.0		
Meter Volume dscf:	21.911	**Water Vapor in Flue Gas (Bws):**		**0.108**	

Date:	11/6/2008	**Run Number:**	**10**		
Project:	ADA	**Condition:**	Normal		
Location:	Presque Isle	**Time:**	**Start-** 14:50	**End-** 15:20	
Source:	Unit 9	**Data Taken By:**	J. Howe		
Pressure, Barometric(Hg"):	29.10	**Meter Calibration (Y):**	0.996		
Delta H:	1.504	**Initial Wt:**	215.3		
Meter Initial Volume:	257.122	**Final Wt:**	221.4		
Meter Final Volume:	282.235	**Initial Volume:**	200.0		
Meter Temperature:	91.78	**Final Volume:**	250.0		
Meter Volume dscf:	23.367	**Water Vapor in Flue Gas (Bws):**		**0.102**	

Method 30B (Sorbent Trap) Mercury Test Results Summary
ADA-ES
We Energies-PIPP
Unit 7 Toxecon Inlet

Test No.	Date	Start Time	End Time	V_m (standard L)	ng detected	ppb	ug/dscm	ug/wscm
1A	11/6/2008	8:35	9:05	17.72	108.0000	0.73	6.10	5.40
1B	11/6/2008	8:35	9:05	17.56	121.0000	0.83	6.90	6.11
Average					114.5000	0.78	6.50	5.75
2A	11/6/2008	9:22	9:52	17.31	112.7000	0.78	6.52	5.77
2B	11/6/2008	9:22	9:52	17.44	117.5000	0.81	6.74	5.97
Average					115.1000	0.79	6.63	5.87
3A	11/6/2008	10:20	10:50	17.20	98.8000	0.69	5.75	5.09
3B	11/6/2008	10:20	10:50	17.09	92.6000	0.65	5.42	4.80
Average					95.7000	0.67	5.59	4.94
Overall Test Average					**108.4333**	**0.75**	**6.24**	**5.52**

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 7 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	EO
Plant:	We Energies-PIPP		

Test Number:	1A	Start Time 8:35	End Time: 9:05
Pressure, Barometric(Hg"):	29.100	Hg (ng)	108.0
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.115
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.73
Initial Volume (liters)	0	Hg (ug/dncm)	6.55
Final Volume (liters)	18.381	Hg (ug/dscm)	6.10
Meter Temperature (°F)	70.00	Hg (ug/wscm)	5.40
Meter Volume (Normal liters)	16.51		
Meter Volume (Standard liters)	17.72		
Meter Calibration (Y)	0.995		

Test Number:	2A	Start Time 9:22	End Time: 9:52
Pressure, Barometric(Hg"):	29.100	Hg (ng)	112.7
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.115
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.78
Initial Volume (liters)	0	Hg (ug/dncm)	6.99
Final Volume (liters)	17.91	Hg (ug/dscm)	6.52
Meter Temperature (°F)	68.57	Hg (ug/wscm)	5.77
Meter Volume (Normal liters)	16.13		
Meter Volume (Standard liters)	17.31		
Meter Calibration (Y)	0.995		

Test Number:	3A	Start Time 10:20	End Time: 10:50
Pressure, Barometric(Hg"):	29.100	Hg (ng)	98.8
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.115
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.69
Initial Volume (liters)	0	Hg (ug/dncm)	6.17
Final Volume (liters)	17.739	Hg (ug/dscm)	5.75
Meter Temperature (°F)	67.00	Hg (ug/wscm)	5.09
Meter Volume (Normal liters)	16.03		
Meter Volume (Standard liters)	17.20		
Meter Calibration (Y)	0.995		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 7 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	EO
Plant:	We Energies-PIPP		

Test Number:	1B	Start Time 8:35	End Time: 9:05
Pressure, Barometric(Hg"):	29.100	Hg (ng)	121.0
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.115
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.83
Initial Volume (liters)	0	Hg (ug/dncm)	7.40
Final Volume (liters)	18.192	Hg (ug/dscm)	6.90
Meter Temperature (°F)	71.57	Hg (ug/wscm)	6.11
Meter Volume (Normal liters)	16.36		
Meter Volume (Standard liters)	17.56		
Meter Calibration (Y)	0.999		

Test Number:	2B	Start Time 9:22	End Time: 9:52
Pressure, Barometric(Hg"):	29.100	Hg (ng)	117.5
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.115
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.81
Initial Volume (liters)	0	Hg (ug/dncm)	7.24
Final Volume (liters)	18.04	Hg (ug/dscm)	6.74
Meter Temperature (°F)	70.71	Hg (ug/wscm)	5.97
Meter Volume (Normal liters)	16.25		
Meter Volume (Standard liters)	17.44		
Meter Calibration (Y)	0.999		

Test Number:	3B	Start Time 10:20	End Time: 10:50
Pressure, Barometric(Hg"):	29.100	Hg (ng)	92.6
Pressure, Static(H_2O"):	-1.00	Water Vapor in Flue Gas (Bws):	0.115
Pressure, Stack(Hg"):	29.026	Hg (ppb)	0.65
Initial Volume (liters)	0	Hg (ug/dncm)	5.82
Final Volume (liters)	17.634	Hg (ug/dscm)	5.42
Meter Temperature (°F)	69.29	Hg (ug/wscm)	4.80
Meter Volume (Normal liters)	15.93		
Meter Volume (Standard liters)	17.09		
Meter Calibration (Y)	0.999		

Method 30B (Sorbent Trap) Mercury Test Results Summary
ADA-ES
We Energies-PIPP
Unit 8 Toxecon Inlet

Test No.	Date	Start Time	End Time	V_m (standard L)	ng detected	ppb	ug/dscm	ug/wscm
1A	11/6/2008	8:35	9:05	16.13	116.7000	0.87	7.24	6.50
1B	11/6/2008	8:35	9:05	16.18	105.3000	0.78	6.52	5.85
Average					111.0000	0.82	6.88	6.18
2A	11/6/2008	9:22	9:52	16.24	116.8000	0.86	7.20	6.46
2B	11/6/2008	9:22	9:52	15.81	117.4000	0.89	7.43	6.68
Average					117.1000	0.88	7.32	6.57
3A	11/6/2008	10:20	10:50	15.72	100.4000	0.77	6.39	5.74
3B	11/6/2008	10:20	10:50	15.46	93.7000	0.73	6.07	5.45
Average					97.0500	0.75	6.23	5.59
Overall Test Average					**108.3833**	**0.82**	**6.81**	**6.11**

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 8 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	SD
Plant:	We Energies-PIPP		

Test Number:	1A	Start Time 8:35	End Time: 9:05
Pressure, Barometric(Hg"):	29.100	Hg (ng)	116.7
Pressure, Static(H_2O"):	-2.00	Water Vapor in Flue Gas (Bws):	0.102
Pressure, Stack(Hg"):	28.953	Hg (ppb)	0.87
Initial Volume (liters)	0	Hg (ug/dncm)	7.77
Final Volume (liters)	16.801	Hg (ug/dscm)	7.24
Meter Temperature (°F)	76.00	Hg (ug/wscm)	6.50
Meter Volume (Normal liters)	15.03		
Meter Volume (Standard liters)	16.13		
Meter Calibration (Y)	1.002		

Test Number:	2A	Start Time 9:22	End Time: 9:52
Pressure, Barometric(Hg"):	29.100	Hg (ng)	116.8
Pressure, Static(H_2O"):	-2.00	Water Vapor in Flue Gas (Bws):	0.102
Pressure, Stack(Hg"):	28.953	Hg (ppb)	0.86
Initial Volume (liters)	0	Hg (ug/dncm)	7.72
Final Volume (liters)	16.721	Hg (ug/dscm)	7.20
Meter Temperature (°F)	69.67	Hg (ug/wscm)	6.46
Meter Volume (Normal liters)	15.14		
Meter Volume (Standard liters)	16.24		
Meter Calibration (Y)	1.002		

Test Number:	3A	Start Time 10:20	End Time: 10:50
Pressure, Barometric(Hg"):	29.100	Hg (ng)	100.4
Pressure, Static(H_2O"):	-2.00	Water Vapor in Flue Gas (Bws):	0.102
Pressure, Stack(Hg"):	28.953	Hg (ppb)	0.77
Initial Volume (liters)	0	Hg (ug/dncm)	6.86
Final Volume (liters)	16.128	Hg (ug/dscm)	6.39
Meter Temperature (°F)	68.00	Hg (ug/wscm)	5.74
Meter Volume (Normal liters)	14.65		
Meter Volume (Standard liters)	15.72		
Meter Calibration (Y)	1.002		

METHOD 30B TEST RESULTS

Date:	11/6/2008	Location:	Unit 8 Toxecon Inle
Project #:	M084501	Condition:	Normal
Client:	ADA-ES	Data Taken By:	SD
Plant:	We Energies-PIPP		

Test Number:	1B	Start Time 8:35	End Time: 9:05
Pressure, Barometric(Hg"):	29.100	Hg (ng)	105.3
Pressure, Static(H_2O"):	-2.00	Water Vapor in Flue Gas (Bws):	0.102
Pressure, Stack(Hg"):	28.953	Hg (ppb)	0.78
Initial Volume (liters)	0	Hg (ug/dncm)	6.99
Final Volume (liters)	16.934	Hg (ug/dscm)	6.52
Meter Temperature (°F)	76.50	Hg (ug/wscm)	5.85
Meter Volume (Normal liters)	15.07		
Meter Volume (Standard liters)	16.18		
Meter Calibration (Y)	0.998		

Test Number:	2B	Start Time 9:22	End Time: 9:52
Pressure, Barometric(Hg"):	29.100	Hg (ng)	117.4
Pressure, Static(H_2O"):	-2.00	Water Vapor in Flue Gas (Bws):	0.102
Pressure, Stack(Hg"):	28.953	Hg (ppb)	0.89
Initial Volume (liters)	0	Hg (ug/dncm)	7.98
Final Volume (liters)	16.461	Hg (ug/dscm)	7.43
Meter Temperature (°F)	73.67	Hg (ug/wscm)	6.68
Meter Volume (Normal liters)	14.73		
Meter Volume (Standard liters)	15.81		
Meter Calibration (Y)	0.998		

Test Number:	3B	Start Time 10:20	End Time: 10:50
Pressure, Barometric(Hg"):	29.100	Hg (ng)	93.7
Pressure, Static(H_2O"):	-2.00	Water Vapor in Flue Gas (Bws):	0.102
Pressure, Stack(Hg"):	28.953	Hg (ppb)	0.73
Initial Volume (liters)	0	Hg (ug/dncm)	6.51
Final Volume (liters)	16.027	Hg (ug/dscm)	6.07
Meter Temperature (°F)	71.17	Hg (ug/wscm)	5.45
Meter Volume (Normal liters)	14.41		
Meter Volume (Standard liters)	15.46		
Meter Calibration (Y)	0.998		

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Toxecon Outlet
Mercury CEM Data

Run 1

Date/Time	Hg Total	Date/Time	Hg Total
11/5/08 11:10	0.4249	11/5/08 11:56	0.322001
11/5/08 11:11	0.422883	11/5/08 11:57	0.318357
11/5/08 11:12	0.421431	11/5/08 11:58	0.315009
11/5/08 11:13	0.422423	11/5/08 11:59	0.318321
11/5/08 11:14	0.420975	11/5/08 12:00	0.323339
11/5/08 11:15	0.415965	11/5/08 12:01	0.320723
11/5/08 11:16	0.413339	11/5/08 12:02	0.316744
11/5/08 11:17	0.416252	11/5/08 12:03	0.316276
11/5/08 11:18	0.418026	11/5/08 12:04	0.315965
11/5/08 11:19	0.4086	11/5/08 12:05	0.313659
11/5/08 11:20	0.399553	11/5/08 12:06	0.311518
11/5/08 11:21	0.392201	11/5/08 12:07	0.317299
11/5/08 11:22	0.3848	11/5/08 12:08	0.324595
11/5/08 11:23	0.3789	11/5/08 12:09	0.324323
11/5/08 11:24	0.373431	11/5/08 12:10	0.322426
11/5/08 11:25	0.371061	11/5/08 12:11	0.325345
11/5/08 11:26	0.368737	11/5/08 12:12	0.328289
11/5/08 11:27	0.365751	11/5/08 12:13	0.332427
11/5/08 11:28	0.361976	11/5/08 12:14	0.337047
11/5/08 11:29	0.35914	11/5/08 12:15	0.335306
11/5/08 11:30	0.356908	11/5/08 12:16	0.334065
11/5/08 11:31	0.352054	11/5/08 12:17	0.340993
11/5/08 11:32	0.346733	11/5/08 12:18	0.347752
11/5/08 11:33	0.34735	11/5/08 12:19	0.354324
11/5/08 11:34	0.349394	11/5/08 12:20	0.360998
11/5/08 11:35	0.34262	11/5/08 12:21	0.358178
11/5/08 11:36	0.334677	11/5/08 12:22	0.35422
11/5/08 11:37	0.332994	11/5/08 12:23	0.353352
11/5/08 11:38	0.330896	11/5/08 12:24	0.354271
11/5/08 11:39	0.328236	11/5/08 12:25	0.358209
11/5/08 11:40	0.326285	11/5/08 12:26	0.361433
11/5/08 11:41	0.322323	11/5/08 12:27	0.364565
11/5/08 11:42	0.317641	11/5/08 12:28	0.367792
11/5/08 11:43	0.318865	11/5/08 12:29	0.372028
11/5/08 11:44	0.320781	11/5/08 12:30	0.375815
11/5/08 11:45	0.315662	11/5/08 12:31	0.37706
11/5/08 11:46	0.309523	11/5/08 12:32	0.379576
11/5/08 11:47	0.315829	11/5/08 12:33	0.381978
11/5/08 11:48	0.322532	11/5/08 12:34	0.383565
11/5/08 11:49	0.320353	11/5/08 12:35	0.385379
11/5/08 11:50	0.317026	11/5/08 12:36	0.387036
11/5/08 11:51	0.315397	11/5/08 12:37	0.387307
11/5/08 11:52	0.316131	11/5/08 12:38	0.388173
11/5/08 11:53	0.319318	11/5/08 12:39	0.386949
11/5/08 11:54	0.320665	11/5/08 12:40	0.3856
11/5/08 11:55	0.321416	**Average**	**0.35**

Run 2

Date/Time	Hg Total	Date/Time	Hg Total
11/5/08 13:00	0.361247	11/5/08 13:46	0.314167
11/5/08 13:01	0.363946	11/5/08 13:47	0.314481
11/5/08 13:02	0.367301	11/5/08 13:48	0.315486
11/5/08 13:03	0.36412	11/5/08 13:49	0.31426
11/5/08 13:04	0.360549	11/5/08 13:50	0.312744
11/5/08 13:05	0.363994	11/5/08 13:51	0.316395
11/5/08 13:06	0.365989	11/5/08 13:52	0.320546
11/5/08 13:07	0.368169	11/5/08 13:53	0.32142
11/5/08 13:08	0.371558	11/5/08 13:54	0.321623
11/5/08 13:09	0.372735	11/5/08 13:55	0.327057
11/5/08 13:10	0.373126	11/5/08 13:56	0.332616
11/5/08 13:11	0.368857	11/5/08 13:57	0.330557
11/5/08 13:12	0.365332	11/5/08 13:58	0.329187
11/5/08 13:13	0.371809	11/5/08 13:59	0.326636
11/5/08 13:14	0.377072	11/5/08 14:00	
11/5/08 13:15	0.372835	11/5/08 14:01	
11/5/08 13:16	0.36949	11/5/08 14:02	
11/5/08 13:17	0.368069	11/5/08 14:03	
11/5/08 13:18	0.36565	11/5/08 14:04	
11/5/08 13:19	0.357533	11/5/08 14:05	
11/5/08 13:20	0.350415	11/5/08 14:06	
11/5/08 13:21	0.348451	11/5/08 14:07	
11/5/08 13:22	0.345498	11/5/08 14:08	
11/5/08 13:23	0.34259	11/5/08 14:09	
11/5/08 13:24	0.340359	11/5/08 14:10	0.33021
11/5/08 13:25	0.335695	11/5/08 14:11	0.330548
11/5/08 13:26	0.330426	11/5/08 14:12	0.331646
11/5/08 13:27	0.32823	11/5/08 14:13	0.330338
11/5/08 13:28	0.327015	11/5/08 14:14	0.329569
11/5/08 13:29	0.32704	11/5/08 14:15	0.332012
11/5/08 13:30	0.325613	11/5/08 14:16	0.334228
11/5/08 13:31	0.32282	11/5/08 14:17	0.34132
11/5/08 13:32	0.321497	11/5/08 14:18	0.347617
11/5/08 13:33	0.316503	11/5/08 14:19	0.345557
11/5/08 13:34	0.310625	11/5/08 14:20	0.344113
11/5/08 13:35	0.312867	11/5/08 14:21	0.347026
11/5/08 13:36	0.315457	11/5/08 14:22	0.349628
11/5/08 13:37	0.314603	11/5/08 14:23	0.348479
11/5/08 13:38	0.313516	11/5/08 14:24	0.347563
11/5/08 13:39	0.313622	11/5/08 14:25	0.354624
11/5/08 13:40	0.314146	11/5/08 14:26	0.360369
11/5/08 13:41	0.313729	11/5/08 14:27	0.361028
11/5/08 13:42	0.313135	11/5/08 14:28	0.362094
11/5/08 13:43	0.310986	11/5/08 14:29	0.35929
11/5/08 13:44	0.309776	11/5/08 14:30	0.357723
11/5/08 13:45	0.312806	**Average**	**0.34**

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Toxecon Outlet
Mercury CEM Data

Run 3

Date/Time	Hg Total	Date/Time	Hg Total
11/5/08 14:45	0.376573	11/5/08 15:31	0.506453
11/5/08 14:46	0.378824	11/5/08 15:32	0.502742
11/5/08 14:47	0.380074	11/5/08 15:33	0.501738
11/5/08 14:48	0.379657	11/5/08 15:34	0.501015
11/5/08 14:49	0.388031	11/5/08 15:35	0.500049
11/5/08 14:50	0.396554	11/5/08 15:36	0.501307
11/5/08 14:51	0.394179	11/5/08 15:37	0.510855
11/5/08 14:52	0.393548	11/5/08 15:38	0.518647
11/5/08 14:53	0.399277	11/5/08 15:39	0.519911
11/5/08 14:54	0.403929	11/5/08 15:40	0.521432
11/5/08 14:55	0.406688	11/5/08 15:41	0.524716
11/5/08 14:56	0.408877	11/5/08 15:42	0.527885
11/5/08 14:57	0.409942	11/5/08 15:43	0.524136
11/5/08 14:58	0.411123	11/5/08 15:44	0.521947
11/5/08 14:59	0.407691	11/5/08 15:45	0.535624
11/5/08 15:00	0.406305	11/5/08 15:46	0.546646
11/5/08 15:01	0.410208	11/5/08 15:47	0.546765
11/5/08 15:02	0.411885	11/5/08 15:48	0.548724
11/5/08 15:03	0.413882	11/5/08 15:49	0.551147
11/5/08 15:04	0.4161	11/5/08 15:50	0.553775
11/5/08 15:05	0.417503	11/5/08 15:51	0.550691
11/5/08 15:06	0.420124	11/5/08 15:52	0.546517
11/5/08 15:07	0.422857	11/5/08 15:53	0.550973
11/5/08 15:08	0.425128	11/5/08 15:54	0.555399
11/5/08 15:09	0.42682	11/5/08 15:55	0.550809
11/5/08 15:10	0.427705	11/5/08 15:56	0.546002
11/5/08 15:11	0.432266	11/5/08 15:57	0.546686
11/5/08 15:12	0.437091	11/5/08 15:58	0.548829
11/5/08 15:13	0.443196	11/5/08 15:59	0.545446
11/5/08 15:14	0.451072	11/5/08 16:00	0.54084
11/5/08 15:15	0.458462	11/5/08 16:01	0.54252
11/5/08 15:16	0.463731	11/5/08 16:02	0.544311
11/5/08 15:17	0.472028	11/5/08 16:03	0.535874
11/5/08 15:18	0.481021	11/5/08 16:04	0.527004
11/5/08 15:19	0.486153	11/5/08 16:05	0.529213
11/5/08 15:20	0.491101	11/5/08 16:06	0.533148
11/5/08 15:21	0.49032	11/5/08 16:07	0.532752
11/5/08 15:22	0.490259	11/5/08 16:08	0.531037
11/5/08 15:23	0.490029	11/5/08 16:09	0.531509
11/5/08 15:24	0.488487	11/5/08 16:10	0.531852
11/5/08 15:25	0.494501	11/5/08 16:11	0.53295
11/5/08 15:26	0.500748	11/5/08 16:12	0.533665
11/5/08 15:27	0.503331	11/5/08 16:13	0.532992
11/5/08 15:28	0.507424	11/5/08 16:14	0.533815
11/5/08 15:29	0.50835	11/5/08 16:15	0.526269
11/5/08 15:30	0.50882	**Average**	**0.48**

Run 4

Date/Time	Hg Total	Date/Time	Hg Total
11/5/08 16:35	0.480982	11/5/08 17:21	0.414775
11/5/08 16:36	0.483631	11/5/08 17:22	0.414188
11/5/08 16:37	0.474135	11/5/08 17:23	0.410157
11/5/08 16:38	0.462814	11/5/08 17:24	0.404657
11/5/08 16:39	0.46369	11/5/08 17:25	0.407378
11/5/08 16:40	0.464464	11/5/08 17:26	0.409855
11/5/08 16:41	0.460944	11/5/08 17:27	0.403248
11/5/08 16:42	0.45784	11/5/08 17:28	0.39737
11/5/08 16:43	0.453804	11/5/08 17:29	0.392735
11/5/08 16:44	0.450924	11/5/08 17:30	0.388709
11/5/08 16:45	0.452699	11/5/08 17:31	0.384116
11/5/08 16:46	0.452393	11/5/08 17:32	0.377973
11/5/08 16:47	0.450857	11/5/08 17:33	0.377299
11/5/08 16:48	0.450071	11/5/08 17:34	0.376645
11/5/08 16:49	0.457119	11/5/08 17:35	0.371067
11/5/08 16:50	0.465671	11/5/08 17:36	0.366618
11/5/08 16:51	0.461034	11/5/08 17:37	0.356448
11/5/08 16:52	0.455563	11/5/08 17:38	0.346122
11/5/08 16:53	0.456209	11/5/08 17:39	0.345198
11/5/08 16:54	0.455473	11/5/08 17:40	0.34307
11/5/08 16:55	0.450298	11/5/08 17:41	0.338253
11/5/08 16:56	0.4456	11/5/08 17:42	0.333828
11/5/08 16:57	0.445176	11/5/08 17:43	0.326131
11/5/08 16:58	0.446437	11/5/08 17:44	0.319973
11/5/08 16:59	0.442398	11/5/08 17:45	0.314514
11/5/08 17:00		11/5/08 17:46	0.308125
11/5/08 17:01		11/5/08 17:47	0.304367
11/5/08 17:02		11/5/08 17:48	0.300147
11/5/08 17:03		11/5/08 17:49	0.3007
11/5/08 17:04		11/5/08 17:50	0.301918
11/5/08 17:05		11/5/08 17:51	0.292068
11/5/08 17:06		11/5/08 17:52	0.282834
11/5/08 17:07		11/5/08 17:53	0.284472
11/5/08 17:08		11/5/08 17:54	0.28539
11/5/08 17:09		11/5/08 17:55	0.287014
11/5/08 17:10	0.428287	11/5/08 17:56	0.288509
11/5/08 17:11	0.426532	11/5/08 17:57	0.284109
11/5/08 17:12	0.424701	11/5/08 17:58	0.280081
11/5/08 17:13	0.420509	11/5/08 17:59	0.279851
11/5/08 17:14	0.417799	11/5/08 18:00	0.279816
11/5/08 17:15	0.417633	11/5/08 18:01	0.283425
11/5/08 17:16	0.415183	11/5/08 18:02	0.287409
11/5/08 17:17	0.417732	11/5/08 18:03	0.283226
11/5/08 17:18	0.421749	11/5/08 18:04	0.27825
11/5/08 17:19	0.419424	11/5/08 18:05	0.28157
11/5/08 17:20	0.416474	**Average**	**0.38**

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Toxecon Outlet
Mercury CEM Data

Run 5

Date/Time	Hg Total	Date/Time	Hg Total
11/6/08 7:30	0.377608	11/6/08 8:16	0.333367
11/6/08 7:31	0.379881	11/6/08 8:17	0.332308
11/6/08 7:32	0.382341	11/6/08 8:18	0.330889
11/6/08 7:33	0.375894	11/6/08 8:19	0.326438
11/6/08 7:34	0.369839	11/6/08 8:20	0.3226
11/6/08 7:35	0.365403	11/6/08 8:21	0.323605
11/6/08 7:36	0.360298	11/6/08 8:22	0.325077
11/6/08 7:37	0.352399	11/6/08 8:23	0.328791
11/6/08 7:38	0.345547	11/6/08 8:24	0.331514
11/6/08 7:39	0.345885	11/6/08 8:25	0.33362
11/6/08 7:40	0.345661	11/6/08 8:26	0.33588
11/6/08 7:41	0.345445	11/6/08 8:27	0.338587
11/6/08 7:42	0.344702	11/6/08 8:28	0.341012
11/6/08 7:43	0.346111	11/6/08 8:29	0.340395
11/6/08 7:44		11/6/08 8:30	0.341622
11/6/08 7:45		11/6/08 8:31	0.341792
11/6/08 7:46		11/6/08 8:32	0.340478
11/6/08 7:47		11/6/08 8:33	0.339628
11/6/08 7:48		11/6/08 8:34	0.338788
11/6/08 7:49		11/6/08 8:35	0.340482
11/6/08 7:50		11/6/08 8:36	0.343353
11/6/08 7:51		11/6/08 8:37	0.350226
11/6/08 7:52		11/6/08 8:38	0.355089
11/6/08 7:53		11/6/08 8:39	0.354108
11/6/08 7:54		11/6/08 8:40	0.355543
11/6/08 7:55		11/6/08 8:41	0.356375
11/6/08 7:56		11/6/08 8:42	0.356368
11/6/08 7:57		11/6/08 8:43	0.361048
11/6/08 7:58		11/6/08 8:44	0.365418
11/6/08 7:59		11/6/08 8:45	0.364347
11/6/08 8:00		11/6/08 8:46	0.363927
11/6/08 8:01		11/6/08 8:47	0.366612
11/6/08 8:02		11/6/08 8:48	0.368155
11/6/08 8:03		11/6/08 8:49	0.372542
11/6/08 8:04		11/6/08 8:50	0.37883
11/6/08 8:05		11/6/08 8:51	0.378382
11/6/08 8:06		11/6/08 8:52	0.377683
11/6/08 8:07		11/6/08 8:53	0.380448
11/6/08 8:08		11/6/08 8:54	0.382022
11/6/08 8:09		11/6/08 8:55	0.381452
11/6/08 8:10		11/6/08 8:56	0.381739
11/6/08 8:11		11/6/08 8:57	0.389821
11/6/08 8:12		11/6/08 8:58	0.397622
11/6/08 8:13	0.331688	11/6/08 8:59	0.403902
11/6/08 8:14	0.329349	11/6/08 9:00	0.409497
11/6/08 8:15	0.330827	**Average**	**0.36**

Run 6

Date/Time	Hg Total	Date/Time	Hg Total
11/6/08 9:15	0.438157	11/6/08 10:01	0.44467
11/6/08 9:16	0.439724	11/6/08 10:02	0.445097
11/6/08 9:17	0.442906	11/6/08 10:03	0.438922
11/6/08 9:18	0.446863	11/6/08 10:04	0.432867
11/6/08 9:19	0.438649	11/6/08 10:05	0.438252
11/6/08 9:20	0.430042	11/6/08 10:06	0.441933
11/6/08 9:21	0.436862	11/6/08 10:07	0.438579
11/6/08 9:22	0.443562	11/6/08 10:08	0.437473
11/6/08 9:23	0.44075	11/6/08 10:09	0.432693
11/6/08 9:24	0.438356	11/6/08 10:10	0.426684
11/6/08 9:25	0.438518	11/6/08 10:11	0.432834
11/6/08 9:26	0.437796	11/6/08 10:12	0.439286
11/6/08 9:27	0.436406	11/6/08 10:13	0.438224
11/6/08 9:28	0.435885	11/6/08 10:14	0.437514
11/6/08 9:29	0.433905	11/6/08 10:15	0.431961
11/6/08 9:30	0.431982	11/6/08 10:16	0.424541
11/6/08 9:31	0.435762	11/6/08 10:17	0.429858
11/6/08 9:32	0.43834	11/6/08 10:18	0.437267
11/6/08 9:33	0.438498	11/6/08 10:19	0.430285
11/6/08 9:34	0.440944	11/6/08 10:20	0.422988
11/6/08 9:35	0.441749	11/6/08 10:21	0.423835
11/6/08 9:36	0.441195	11/6/08 10:22	0.424421
11/6/08 9:37	0.443421	11/6/08 10:23	0.426309
11/6/08 9:38	0.445197	11/6/08 10:24	0.428253
11/6/08 9:39	0.447132	11/6/08 10:25	0.428948
11/6/08 9:40	0.450255	11/6/08 10:26	0.428618
11/6/08 9:41	0.448119	11/6/08 10:27	0.420055
11/6/08 9:42	0.445388	11/6/08 10:28	0.413858
11/6/08 9:43	0.446326	11/6/08 10:29	0.419408
11/6/08 9:44	0.445817	11/6/08 10:30	0.423839
11/6/08 9:45	0.444613	11/6/08 10:31	0.41982
11/6/08 9:46	0.445438	11/6/08 10:32	0.415058
11/6/08 9:47	0.443235	11/6/08 10:33	0.41363
11/6/08 9:48	0.439555	11/6/08 10:34	0.413174
11/6/08 9:49	0.440908	11/6/08 10:35	0.413753
11/6/08 9:50	0.442499	11/6/08 10:36	0.414551
11/6/08 9:51	0.440942	11/6/08 10:37	0.411006
11/6/08 9:52	0.439682	11/6/08 10:38	0.405807
11/6/08 9:53	0.440513	11/6/08 10:39	0.407822
11/6/08 9:54	0.441363	11/6/08 10:40	0.411218
11/6/08 9:55	0.43829	11/6/08 10:41	0.41191
11/6/08 9:56	0.435691	11/6/08 10:42	0.411667
11/6/08 9:57	0.435108	11/6/08 10:43	0.411468
11/6/08 9:58	0.434792	11/6/08 10:44	0.411674
11/6/08 9:59	0.440506	11/6/08 10:45	0.416027
11/6/08 10:00	0.445006	**Average**	**0.43**

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Toxecon Outlet
Mercury CEM Data

Run 7

Date/Time	Hg Total	Date/Time	Hg Total
11/6/08 11:00		11/6/08 11:46	0.284683
11/6/08 11:01		11/6/08 11:47	0.282918
11/6/08 11:02		11/6/08 11:48	0.281904
11/6/08 11:03		11/6/08 11:49	0.286683
11/6/08 11:04		11/6/08 11:50	0.290585
11/6/08 11:05		11/6/08 11:51	0.289963
11/6/08 11:06		11/6/08 11:52	0.289264
11/6/08 11:07		11/6/08 11:53	0.29391
11/6/08 11:08		11/6/08 11:54	0.298833
11/6/08 11:09		11/6/08 11:55	0.297131
11/6/08 11:10	0.349963	11/6/08 11:56	0.294542
11/6/08 11:11	0.348685	11/6/08 11:57	0.295555
11/6/08 11:12	0.346853	11/6/08 11:58	0.297561
11/6/08 11:13	0.339053	11/6/08 11:59	0.304624
11/6/08 11:14	0.332093	11/6/08 12:00	0.310735
11/6/08 11:15	0.336443	11/6/08 12:01	0.311434
11/6/08 11:16	0.339725	11/6/08 12:02	0.312417
11/6/08 11:17	0.3335	11/6/08 12:03	0.317433
11/6/08 11:18	0.328594	11/6/08 12:04	0.321763
11/6/08 11:19	0.319186	11/6/08 12:05	0.316752
11/6/08 11:20	0.309496	11/6/08 12:06	0.313529
11/6/08 11:21	0.312933	11/6/08 12:07	0.311751
11/6/08 11:22	0.315734	11/6/08 12:08	0.30917
11/6/08 11:23	0.31774	11/6/08 12:09	0.313363
11/6/08 11:24	0.320264	11/6/08 12:10	0.317152
11/6/08 11:25	0.313944	11/6/08 12:11	0.316207
11/6/08 11:26	0.307424	11/6/08 12:12	0.31603
11/6/08 11:27	0.303693	11/6/08 12:13	0.320857
11/6/08 11:28	0.300791	11/6/08 12:14	0.324756
11/6/08 11:29	0.299688	11/6/08 12:15	0.313731
11/6/08 11:30	0.297951	11/6/08 12:16	0.3042
11/6/08 11:31	0.295463	11/6/08 12:17	0.305295
11/6/08 11:32	0.29253	11/6/08 12:18	0.3051
11/6/08 11:33	0.293617	11/6/08 12:19	0.308072
11/6/08 11:34	0.295659	11/6/08 12:20	0.311496
11/6/08 11:35	0.293802	11/6/08 12:21	0.312064
11/6/08 11:36	0.29149	11/6/08 12:22	0.312908
11/6/08 11:37	0.291298	11/6/08 12:23	0.311932
11/6/08 11:38	0.290744	11/6/08 12:24	0.31116
11/6/08 11:39	0.290116	11/6/08 12:25	0.306571
11/6/08 11:40	0.290228	11/6/08 12:26	0.301663
11/6/08 11:41	0.285767	11/6/08 12:27	0.306696
11/6/08 11:42	0.28017	11/6/08 12:28	0.311129
11/6/08 11:43	0.281699	11/6/08 12:29	0.312999
11/6/08 11:44	0.283879	11/6/08 12:30	0.315639
11/6/08 11:45	0.284276	**Average**	**0.31**

Run 8

Date/Time	Hg Total	Date/Time	Hg Total
11/6/08 12:40	0.328281	11/6/08 13:26	0.408458
11/6/08 12:41	0.325294	11/6/08 13:27	0.407658
11/6/08 12:42	0.323879	11/6/08 13:28	0.406223
11/6/08 12:43	0.333831	11/6/08 13:29	0.405289
11/6/08 12:44	0.341578	11/6/08 13:30	0.403533
11/6/08 12:45	0.341684	11/6/08 13:31	0.412542
11/6/08 12:46	0.342564	11/6/08 13:32	0.421962
11/6/08 12:47	0.352158	11/6/08 13:33	0.420535
11/6/08 12:48	0.362303	11/6/08 13:34	0.420396
11/6/08 12:49	0.360719	11/6/08 13:35	0.421486
11/6/08 12:50	0.358484	11/6/08 13:36	0.42139
11/6/08 12:51	0.366738	11/6/08 13:37	0.416613
11/6/08 12:52	0.375441	11/6/08 13:38	0.410862
11/6/08 12:53	0.372798	11/6/08 13:39	0.41057
11/6/08 12:54	0.369322	11/6/08 13:40	0.410561
11/6/08 12:55	0.373348	11/6/08 13:41	0.407516
11/6/08 12:56	0.377849	11/6/08 13:42	0.406476
11/6/08 12:57	0.380476	11/6/08 13:43	0.405534
11/6/08 12:58	0.382611	11/6/08 13:44	0.403026
11/6/08 12:59	0.381355	11/6/08 13:45	0.394893
11/6/08 13:00	0.38185	11/6/08 13:46	0.38648
11/6/08 13:01	0.386928	11/6/08 13:47	0.38134
11/6/08 13:02	0.390014	11/6/08 13:48	0.375956
11/6/08 13:03	0.392521	11/6/08 13:49	0.37153
11/6/08 13:04	0.395335	11/6/08 13:50	0.368676
11/6/08 13:05	0.393732	11/6/08 13:51	0.364368
11/6/08 13:06	0.39279	11/6/08 13:52	0.359389
11/6/08 13:07	0.389149	11/6/08 13:53	0.35993
11/6/08 13:08	0.38637	11/6/08 13:54	0.360215
11/6/08 13:09	0.388368	11/6/08 13:55	0.356705
11/6/08 13:10	0.389108	11/6/08 13:56	0.352498
11/6/08 13:11	0.390936	11/6/08 13:57	0.345941
11/6/08 13:12	0.393027	11/6/08 13:58	0.341047
11/6/08 13:13	0.391304	11/6/08 13:59	0.342034
11/6/08 13:14	0.390463	11/6/08 14:00	
11/6/08 13:15	0.393184	11/6/08 14:01	
11/6/08 13:16	0.394095	11/6/08 14:02	
11/6/08 13:17	0.38842	11/6/08 14:03	
11/6/08 13:18	0.384663	11/6/08 14:04	
11/6/08 13:19	0.390554	11/6/08 14:05	
11/6/08 13:20	0.395132	11/6/08 14:06	
11/6/08 13:21	0.400941	11/6/08 14:07	
11/6/08 13:22	0.407123	11/6/08 14:08	
11/6/08 13:23	0.407506	11/6/08 14:09	
11/6/08 13:24	0.407596	11/6/08 14:10	0.338126
11/6/08 13:25	0.407374	**Average**	**0.38**

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Toxecon Outlet
Mercury CEM Data

Run 9

Date/Time	Hg Total	Date/Time	Hg Total
11/6/08 14:20	0.34686	11/6/08 15:06	0.447871
11/6/08 14:21	0.341326	11/6/08 15:07	0.448325
11/6/08 14:22	0.337769	11/6/08 15:08	0.450443
11/6/08 14:23	0.341914	11/6/08 15:09	0.46027
11/6/08 14:24	0.343445	11/6/08 15:10	0.468346
11/6/08 14:25	0.346529	11/6/08 15:11	0.477204
11/6/08 14:26	0.350014	11/6/08 15:12	0.486246
11/6/08 14:27	0.346016	11/6/08 15:13	0.494752
11/6/08 14:28	0.341567	11/6/08 15:14	0.502793
11/6/08 14:29	0.351073	11/6/08 15:15	0.503844
11/6/08 14:30	0.361694	11/6/08 15:16	0.507167
11/6/08 14:31	0.361403	11/6/08 15:17	0.509245
11/6/08 14:32	0.360831	11/6/08 15:18	0.508673
11/6/08 14:33	0.365997	11/6/08 15:19	0.509331
11/6/08 14:34	0.370726	11/6/08 15:20	0.510403
11/6/08 14:35	0.370839	11/6/08 15:21	0.511756
11/6/08 14:36	0.371204	11/6/08 15:22	0.513168
11/6/08 14:37	0.374493	11/6/08 15:23	0.51598
11/6/08 14:38	0.378309	11/6/08 15:24	0.519796
11/6/08 14:39	0.386762	11/6/08 15:25	0.517823
11/6/08 14:40	0.394104	11/6/08 15:26	0.514019
11/6/08 14:41	0.394735	11/6/08 15:27	0.524126
11/6/08 14:42	0.395425	11/6/08 15:28	0.534231
11/6/08 14:43	0.401681	11/6/08 15:29	0.525586
11/6/08 14:44	0.410042	11/6/08 15:30	0.519082
11/6/08 14:45	0.405904	11/6/08 15:31	0.527714
11/6/08 14:46	0.400207	11/6/08 15:32	0.535614
11/6/08 14:47	0.400652	11/6/08 15:33	0.536646
11/6/08 14:48	0.400697	11/6/08 15:34	0.536413
11/6/08 14:49	0.404202	11/6/08 15:35	0.540287
11/6/08 14:50	0.407378	11/6/08 15:36	0.544969
11/6/08 14:51	0.407519	11/6/08 15:37	0.538532
11/6/08 14:52	0.410438	11/6/08 15:38	0.532624
11/6/08 14:53	0.416704	11/6/08 15:39	0.538936
11/6/08 14:54	0.421666	11/6/08 15:40	0.544808
11/6/08 14:55	0.424033	11/6/08 15:41	0.542674
11/6/08 14:56	0.425651	11/6/08 15:42	0.539432
11/6/08 14:57	0.426774	11/6/08 15:43	0.538427
11/6/08 14:58	0.428058	11/6/08 15:44	0.537412
11/6/08 14:59	0.431177	11/6/08 15:45	0.533716
11/6/08 15:00	0.435966	11/6/08 15:46	0.532732
11/6/08 15:01	0.428261	11/6/08 15:47	0.533417
11/6/08 15:02	0.419314	11/6/08 15:48	0.532227
11/6/08 15:03	0.428315	11/6/08 15:49	0.525186
11/6/08 15:04	0.436701	11/6/08 15:50	0.51772
11/6/08 15:05	0.442035	**Average**	**0.45**

Run 10

Date/Time	Hg Total	Date/Time	Hg Total
11/6/08 16:05	0.491856	11/6/08 16:51	0.42674
11/6/08 16:06	0.485412	11/6/08 16:52	0.427264
11/6/08 16:07	0.483577	11/6/08 16:53	0.424351
11/6/08 16:08	0.481643	11/6/08 16:54	0.421116
11/6/08 16:09	0.471475	11/6/08 16:55	0.419701
11/6/08 16:10	0.46353	11/6/08 16:56	0.418881
11/6/08 16:11	0.464406	11/6/08 16:57	0.410718
11/6/08 16:12	0.462868	11/6/08 16:58	0.401896
11/6/08 16:13	0.463458	11/6/08 16:59	0.397947
11/6/08 16:14	0.464121	11/6/08 17:00	
11/6/08 16:15	0.464764	11/6/08 17:01	
11/6/08 16:16	0.466329	11/6/08 17:02	
11/6/08 16:17	0.467301	11/6/08 17:03	
11/6/08 16:18	0.468363	11/6/08 17:04	
11/6/08 16:19	0.463505	11/6/08 17:05	
11/6/08 16:20	0.458237	11/6/08 17:06	
11/6/08 16:21	0.455984	11/6/08 17:07	
11/6/08 16:22	0.453573	11/6/08 17:08	
11/6/08 16:23	0.457776	11/6/08 17:09	
11/6/08 16:24	0.461691	11/6/08 17:10	0.341263
11/6/08 16:25	0.463297	11/6/08 17:11	0.336459
11/6/08 16:26	0.466778	11/6/08 17:12	0.332781
11/6/08 16:27	0.462608	11/6/08 17:13	0.334962
11/6/08 16:28	0.456661	11/6/08 17:14	0.335587
11/6/08 16:29	0.459923	11/6/08 17:15	0.335015
11/6/08 16:30	0.463414	11/6/08 17:16	0.333907
11/6/08 16:31	0.460224	11/6/08 17:17	0.326047
11/6/08 16:32	0.457451	11/6/08 17:18	0.318644
11/6/08 16:33	0.456034	11/6/08 17:19	0.317806
11/6/08 16:34	0.455326	11/6/08 17:20	0.317904
11/6/08 16:35	0.453674	11/6/08 17:21	0.319368
11/6/08 16:36	0.450271	11/6/08 17:22	0.319956
11/6/08 16:37	0.448492	11/6/08 17:23	0.319514
11/6/08 16:38	0.447276	11/6/08 17:24	0.319619
11/6/08 16:39	0.440996	11/6/08 17:25	0.31694
11/6/08 16:40	0.436576	11/6/08 17:26	0.313443
11/6/08 16:41	0.435514	11/6/08 17:27	0.313703
11/6/08 16:42	0.433484	11/6/08 17:28	0.315066
11/6/08 16:43	0.432256	11/6/08 17:29	0.317228
11/6/08 16:44	0.429298	11/6/08 17:30	0.318442
11/6/08 16:45	0.429387	11/6/08 17:31	0.320231
11/6/08 16:46	0.430788	11/6/08 17:32	0.32254
11/6/08 16:47	0.43003	11/6/08 17:33	0.319787
11/6/08 16:48	0.430052	11/6/08 17:34	0.316386
11/6/08 16:49	0.428981	11/6/08 17:35	0.311426
11/6/08 16:50	0.426756	**Average**	**0.41**

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Unit 9 Toxecon Inlet
Mercury CEM Data

Run 2

Date/Time	Hg Total
11/6/08 8:35	5.911361
11/6/08 8:36	5.899146
11/6/08 8:37	5.913826
11/6/08 8:38	5.918516
11/6/08 8:39	5.933767
11/6/08 8:40	5.946513
11/6/08 8:41	5.963568
11/6/08 8:42	5.985522
11/6/08 8:43	5.986665
11/6/08 8:44	5.966864
11/6/08 8:45	5.983498
11/6/08 8:46	5.973768
11/6/08 8:47	5.965491
11/6/08 8:48	5.964339
11/6/08 8:49	5.974911
11/6/08 8:50	5.978287
11/6/08 8:51	5.952996
11/6/08 8:52	5.951002
11/6/08 8:53	5.896531
11/6/08 8:54	5.867953
11/6/08 8:55	5.85186
11/6/08 8:56	5.853584
11/6/08 8:57	5.854465
11/6/08 8:58	5.843984
11/6/08 8:59	5.8372
Average	**5.93**

Run 3

Date/Time	Hg Total
11/6/08 9:22	5.844144
11/6/08 9:23	5.930831
11/6/08 9:24	5.953096
11/6/08 9:25	6.051216
11/6/08 9:26	6.058651
11/6/08 9:27	6.007617
11/6/08 9:28	5.98926
11/6/08 9:29	5.951723
11/6/08 9:30	6.006174
11/6/08 9:31	6.037348
11/6/08 9:32	6.099875
11/6/08 9:33	6.118132
11/6/08 9:34	6.074483
11/6/08 9:35	6.063671
11/6/08 9:36	6.035744
11/6/08 9:37	6.02868
11/6/08 9:38	6.026516
11/6/08 9:39	6.016125
11/6/08 9:40	6.026896
11/6/08 9:41	6.070455
11/6/08 9:42	6.103412
11/6/08 9:43	6.143574
11/6/08 9:44	6.130397
11/6/08 9:45	6.12202
11/6/08 9:46	6.101538
11/6/08 9:47	6.098703
11/6/08 9:48	6.107531
11/6/08 9:49	6.112811
11/6/08 9:50	6.121729
11/6/08 9:51	6.07769
11/6/08 9:52	6.016064
Average	**6.05**

Run 4

Date/Time	Hg Total
11/6/08 10:20	6.076888
11/6/08 10:21	6.075275
11/6/08 10:22	6.07295
11/6/08 10:23	6.069393
11/6/08 10:24	6.04806
11/6/08 10:25	6.036877
11/6/08 10:26	6.012267
11/6/08 10:27	6.00407
11/6/08 10:28	6.003288
11/6/08 10:29	6.004892
11/6/08 10:30	6.010132
11/6/08 10:31	5.986765
11/6/08 10:32	5.957806
11/6/08 10:33	5.923185
11/6/08 10:34	5.908996
11/6/08 10:35	5.949148
11/6/08 10:36	5.960291
11/6/08 10:37	6.000823
11/6/08 10:38	6.007778
11/6/08 10:39	6.025834
11/6/08 10:40	6.044973
11/6/08 10:41	6.05829
11/6/08 10:42	6.116629
11/6/08 10:43	6.135367
11/6/08 10:44	6.205801
11/6/08 10:45	6.203676
11/6/08 10:46	6.183335
11/6/08 10:47	6.175238
11/6/08 10:48	6.157643
11/6/08 10:49	6.147893
11/6/08 10:50	6.135207
Average	**6.05**

Run 5

Date/Time	Hg Total
11/6/08 11:05	6.059312
11/6/08 11:06	6.076127
11/6/08 11:07	6.071237
11/6/08 11:08	6.06808
11/6/08 11:09	6.05315
11/6/08 11:10	6.064673
11/6/08 11:11	6.088081
11/6/08 11:12	6.114755
11/6/08 11:13	6.134666
11/6/08 11:14	6.104414
11/6/08 11:15	6.091017
11/6/08 11:16	6.051006
11/6/08 11:17	6.063711
11/6/08 11:18	6.130507
11/6/08 11:19	6.175379
11/6/08 11:20	6.234048
11/6/08 11:21	6.203656
11/6/08 11:22	6.187824
11/6/08 11:23	6.142311
11/6/08 11:24	6.138353
11/6/08 11:25	6.206061
11/6/08 11:26	6.215861
11/6/08 11:27	6.26465
11/6/08 11:28	6.252796
11/6/08 11:29	6.236754
11/6/08 11:30	6.218336
11/6/08 11:31	6.208246
11/6/08 11:32	6.246503
11/6/08 11:33	6.256133
11/6/08 11:34	6.293168
11/6/08 11:35	6.278869
Average	**6.16**

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Unit 9 Toxecon Inlet
Mercury CEM Data

Run 6

Date/Time	Hg Total
11/6/08 11:55	6.148484
11/6/08 11:56	6.143845
11/6/08 11:57	6.23487
11/6/08 11:58	6.262005
11/6/08 11:59	6.33806
11/6/08 12:10	6.072559
11/6/08 12:11	6.110617
11/6/08 12:12	6.123012
11/6/08 12:13	6.156049
11/6/08 12:14	6.160829
11/6/08 12:15	6.159667
11/6/08 12:16	6.167823
11/6/08 12:17	6.174998
11/6/08 12:18	6.160769
11/6/08 12:19	6.133513
11/6/08 12:20	6.13172
11/6/08 12:21	6.137171
11/6/08 12:22	6.142993
11/6/08 12:23	6.149366
11/6/08 12:24	6.160408
11/6/08 12:25	6.167392
Average	**6.16**

Run 7

Date/Time	Hg Total
11/6/08 12:40	6.203436
11/6/08 12:41	6.195179
11/6/08 12:42	6.156891
11/6/08 12:43	6.155308
11/6/08 12:44	6.166881
11/6/08 12:45	6.174858
11/6/08 12:46	6.188355
11/6/08 12:47	6.175749
11/6/08 12:48	6.159717
11/6/08 12:49	6.139075
11/6/08 12:50	6.124184
11/6/08 12:51	6.124134
11/6/08 12:52	6.126289
11/6/08 12:53	6.129034
11/6/08 12:54	6.124796
11/6/08 12:55	6.10229
11/6/08 12:56	6.098552
11/6/08 12:57	6.083532
11/6/08 12:58	6.097029
11/6/08 12:59	6.110988
11/6/08 13:00	6.125337
11/6/08 13:01	6.133213
11/6/08 13:02	6.080295
11/6/08 13:03	6.069704
11/6/08 13:04	6.008238
11/6/08 13:05	6.014581
11/6/08 13:06	6.050665
11/6/08 13:07	6.084734
11/6/08 13:08	6.112561
11/6/08 13:09	6.087871
11/6/08 13:10	6.086037
Average	**6.12**

Run 8

Date/Time	Hg Total
11/6/08 13:25	6.114986
11/6/08 13:26	6.151831
11/6/08 13:27	6.082419
11/6/08 13:28	6.05804
11/6/08 13:29	5.963948
11/6/08 13:30	5.96951
11/6/08 13:31	5.997547
11/6/08 13:32	6.011475
11/6/08 13:33	6.036516
11/6/08 13:34	6.005242
11/6/08 13:35	5.972586
11/6/08 13:36	5.926001
11/6/08 13:37	5.908175
11/6/08 13:38	6.026365
11/6/08 13:39	6.030744
11/6/08 13:40	6.132541
11/6/08 13:41	6.135327
11/6/08 13:42	6.149516
11/6/08 13:43	6.159837
11/6/08 13:44	6.166551
11/6/08 13:45	6.120307
11/6/08 13:46	6.09762
11/6/08 13:47	6.042608
11/6/08 13:48	6.057068
11/6/08 13:49	6.108863
11/6/08 13:50	6.14656
11/6/08 13:51	6.184056
11/6/08 13:52	6.191532
11/6/08 13:53	6.196522
11/6/08 13:54	6.198987
11/6/08 13:55	6.203155
Average	**6.08**

Run 9

Date/Time	Hg Total
11/6/08 14:10	6.213396
11/6/08 14:11	6.201933
11/6/08 14:12	6.189016
11/6/08 14:13	6.18592
11/6/08 14:14	6.236022
11/6/08 14:15	6.246524
11/6/08 14:16	6.304411
11/6/08 14:17	6.302628
11/6/08 14:18	6.279641
11/6/08 14:19	6.27431
11/6/08 14:20	6.266464
11/6/08 14:21	6.254119
11/6/08 14:22	6.235732
11/6/08 14:23	6.203646
11/6/08 14:24	6.20064
11/6/08 14:25	6.217885
11/6/08 14:26	6.222855
11/6/08 14:27	6.233537
11/6/08 14:28	6.224569
11/6/08 14:29	6.217545
11/6/08 14:30	6.203195
11/6/08 14:31	6.21521
11/6/08 14:32	6.288429
11/6/08 14:33	6.311456
11/6/08 14:34	6.375075
11/6/08 14:35	6.346247
11/6/08 14:36	6.309361
11/6/08 14:37	6.259841
11/6/08 14:38	6.23997
11/6/08 14:39	6.242175
11/6/08 14:40	6.239619
Average	**6.25**

ADA-ES, Inc.
We Energies-Presque Isle Power Plant
Unit 9 Toxecon Inlet
Mercury CEM Data

Run 10

Date/Time	Hg Total
11/6/08 14:50	6.327859
11/6/08 14:51	6.327609
11/6/08 14:52	6.331416
11/6/08 14:53	6.313821
11/6/08 14:54	6.296595
11/6/08 14:55	6.270753
11/6/08 14:56	6.258909
11/6/08 14:57	6.282787
11/6/08 14:58	6.283138
11/6/08 14:59	6.302798
11/6/08 15:10	6.178615
11/6/08 15:11	6.165909
11/6/08 15:12	6.160408
11/6/08 15:13	6.143333
11/6/08 15:14	6.128012
11/6/08 15:15	6.049633
11/6/08 15:16	6.024952
11/6/08 15:17	5.968688
11/6/08 15:18	6.025023
11/6/08 15:19	6.101538
11/6/08 15:20	6.183195
Average	**6.20**

PLATT ENVIRONMENTAL SERVICES, INC.

Procedures for Calibration

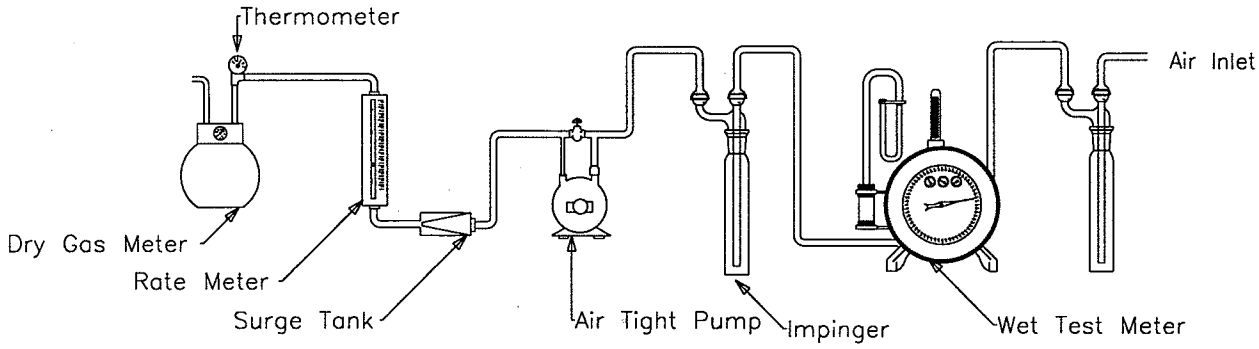
Dry Gas Meters

The test meters are calibrated according to Method 5, Section 5.3 and "Procedures for Calibrating and Using Dry Gas Volume Meters as Calibration Standards" by P.R. Westlin and R.T. Shigehara, March 10, 1978.

Temperature Sensing Devices

The potentiometer and thermocouples are calibrated utilizing a NBS traceable millivolt source.

Dry Gas Meter Calibration Sample Train Diagram



M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M2A	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002453	Totalizer Scale Factor (Final)	**0.9993**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	30-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	759.881	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	24.42	0	0	25.53									
Final	13.00	0	14.3	25.53	13.82	13.98	26.03									
Total/Avg	13.00	0	14.3	24.975	13.82	13.98	25.78	13.597	13.537	14.069	13.708	1.013	0.018	0.974	0.012	1.05
Run 2 - Initial	0.00	0	0	25.53	0	0	26.03									
Final	18.00	0	11	26.64	10.624	10.46	26.03									
Total/Avg	18.00	0	11	26.085	10.624	10.46	26.03	10.414	10.368	10.782	10.248	0.988	-0.006	0.950	-0.012	0.57
Run 3 - Initial	0.00	0	0	26.64	0	0	26.03									
Final	45.00	0	21.44	28.31	21.1	20.56	26.03									
Total/Avg	45.00	0	21.44	27.475	21.1	20.56	26.03	20.586	20.496	20.918	20.142	0.983	-0.012	0.963	0.000	0.45
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																

0.996

Average Meter Calibration Factor Y **0.995** **0.963**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

66

W-70

Platt Environmental

M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M2B	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002454	Totalizer Scale Factor (Final)	0.9993	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	30-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	737.616	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	28.31	0	0	27.2									
Final	13.00	0	12	28.31	11.846	11.93	27.2									
Total/Avg	13.00	0	12	28.31	11.846	11.93	27.2	11.188	11.139	11.333	11.301	1.015	0.015	0.997	0.023	0.87
Run 2 - Initial	0.00	0	0	28.86	0	0	27.2									
Final	18.00	0	11.4	29.42	11.056	10.87	27.2									
Total/Avg	18.00	0	11.4	29.14	11.056	10.87	27.2	10.413	10.367	10.737	10.297	0.993	-0.006	0.959	-0.015	0.57
Run 3 - Initial	0.00	0	0	29.42	0	0	27.2									
Final	45.00	0	20.3	29.97	19.911	19.5	27.75									
Total/Avg	45.00	0	20.3	29.695	19.911	19.5	27.475	18.719	18.637	19.085	18.455	0.990	-0.009	0.967	-0.007	0.41
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																
											0.996					

W-71

67

Average Meter Calibration Factor Y	0.999	0.974

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

Platt Environmental

Stack Temperature Sensor Calibration

Meter Box # : M 2 Name : M. Platt

Ambient Temperature : 80.3 °F Date : July 30, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	2	0.4
250	252	0.3
600	602	0.2
1200	1202	0.1

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M4A	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002493	Totalizer Scale Factor (Final)	**0.9993**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	29-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	740.156	mm Hg		

Calibration Data												Results					
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	26.08	0	0	24.97									
Final	13.00	0	11.2	26.64	11.185	10.99	26.08									
Total/Avg	13.00	0	11.2	26.36	11.185	10.99	25.525	10.669	10.622	10.683	10.505	0.989	-0.013	0.983	-0.020	0.81
Run 2 - Initial	0.00	0	0	26.64	0	0	26.08									
Final	18.00	0	9.8	27.2	9.973	10.1	27.2									
Total/Avg	18.00	0	9.8	26.92	9.973	10.1	26.64	9.495	9.453	9.331	9.618	1.017	0.015	1.031	0.027	0.53
Run 3 - Initial	0.00	0	0	27.2	0	0	27.2									
Final	45.00	0	20.2	28.86	20.22	20.12	27.75									
Total/Avg	45.00	0	20.2	28.03	20.22	20.12	27.475	19.180	19.096	19.161	19.107	1.001	-0.002	0.997	-0.007	0.42
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																

0.996

Average Meter Calibration Factor Y	1.002	1.004

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

W-73

69

Platt Environmental

M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M4B	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002493	Totalizer Scale Factor (Final)	**0.9993**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	29-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	740.156	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	28.86	0	0	27.75									
Final	13.00	0	11.4	29.42	11.502	11.6	27.75									
Total/Avg	13.00	0	11.4	29.14	11.502	11.6	27.75	10.871	10.823	10.774	11.006	1.017	0.019	1.022	0.024	0.85
Run 2 - Initial	0.00	0	0	29.42	0	0	27.75									
Final	18.00	0	9.6	29.97	9.734	9.47	28.31									
Total/Avg	18.00	0	9.6	29.695	9.734	9.47	28.03	9.183	9.142	9.056	8.977	0.982	-0.016	0.991	-0.006	0.50
Run 3 - Initial	0.00	0	0	29.97	0	0	28.31									
Final	45.00	0	19.3	30.53	19.1	18.8	28.31									
Total/Avg	45.00	0	19.3	30.25	19.1	18.8	28.31	17.985	17.906	18.174	17.804	0.994	-0.003	0.980	-0.018	0.40
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																

0.996

Average Meter Calibration Factor Y	0.998	0.997

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

W-74

70

Platt Environmental

Stack Temperature Sensor Calibration

Meter Box # : M 4 Name : M. PLATT

Ambient Temperature : 75.3 °F Date : July 29, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	-1	0.2
250	249	0.1
600	597	0.3
1200	1199	0.1

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M1 A	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002851	Totalizer Scale Factor (Final)	**0.9993**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	30-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	737.616	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	26.08	0	0	26.08									
Final	13.00	0	10.6	26.64	10.619	10.7	26.64									
Total/Avg	13.00	0	10.6	26.36	10.619	10.7	26.36	10.094	10.050	10.076	10.164	1.011	0.014	1.009	0.036	0.78
Run 2 - Initial	0.00	0	0	26.64	0	0	26.64									
Final	18.00	0	10.5	27.2	10.022	9.91	26.64									
Total/Avg	18.00	0	10.5	26.92	10.022	9.91	26.64	9.509	9.467	9.963	9.405	0.993	-0.004	0.944	-0.028	0.52
Run 3 - Initial	0.00	0	0	27.2	0	0	26.64									
Final	45.00	0	19.8	28.31	19.411	19.057	27.2									
Total/Avg	45.00	0	19.8	27.755	19.411	19.057	26.92	18.367	18.286	18.735	18.069	0.988	-0.009	0.964	-0.008	0.40
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																

0.996

Average Meter Calibration Factor Y	0.998	0.972

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

W-76

72

Platt Environmental

M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M1 B	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002851	Totalizer Scale Factor (Final)	**0.9993**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	30-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	737.616	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	28.31	0	0	27.2									
Final	13.00	0	12.9	28.86	12.685	12.54	27.2									
Total/Avg	13.00	0	12.9	28.585	12.685	12.54	27.2	11.969	11.917	12.172	11.879	0.997	0.001	0.976	0.004	0.91
Run 2 - Initial	0.00	0	0	28.86	0	0	27.2									
Final	18.00	0	10.5	28.86	10.321	10.05	27.2									
Total/Avg	18.00	0	10.5	28.86	10.321	10.05	27.2	9.730	9.687	9.899	9.520	0.983	-0.013	0.962	-0.010	0.53
Run 3 - Initial	0.00	0	0	28.86	0	0	27.2									
Final	45.00	0	20.7	29.42	20.124	20.1	27.2									
Total/Avg	45.00	0	20.7	29.14	20.124	20.1	27.2	18.954	18.871	19.496	19.040	1.009	0.013	0.977	0.005	0.42
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																

W-77

0.996

Average Meter Calibration Factor Y **0.996** **0.971**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

73

Platt Environmental

Stack Temperature Sensor Calibration

Meter Box # : M 1 Name : M. Platt

Ambient Temperature : 80.3 °F Date : July 30, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	1	0.2
250	251	0.1
600	599	0.1
1200	1200	0.0

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M5B	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002493	Totalizer Scale Factor (Final)	**0.9993**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	28-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	739.14	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	26.08	0	0	26.64									
Final	13.00	0	0	26.64	10.215	10.27	26.64									
Total/Avg	13.00	0	0	26.36	10.215	10.27	26.64	9.730	9.688		9.767	1.008	0.006			0.75
Run 2 - Initial	0.00	0	0	27.2	0	0	27.2									
Final	18.00	0	0	27.75	9.9	10.02	28.31									
Total/Avg	18.00	0	0	27.475	9.9	10.02	27.755	9.395	9.354		9.494	1.015	0.012			0.53
Run 3 - Initial	0.00	0	0	27.75	0	0	28.31									
Final	45.00	0	0	27.75	22.51	22.14	28.86									
Total/Avg	45.00	0	0	27.75	22.51	22.14	28.585	21.343	21.249		20.920	0.984	-0.018			0.46
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																

0.996

Average Meter Calibration Factor Y **1.003**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

W-79

75

Platt Environmental

M084501A

METER CALIBRATION

Meter Information					
Console Model	XC-260	Dry Gas Meter Number	M5B	Encoder Model	HEDS-9100-F00
Gas Meter Model	SK25	Totalizer Scale Factor (Initial)	1.0000	Totalizer Model	RED LION
Gas Meter Serial#	8002493	Totalizer Scale Factor (Final)	**0.9993**	Temp Display Model	JENCO

Calibration Conditions							
WTM ID	9605804	Calibration Technician	MPLT			Calibration Date	28-Jul-08
WTM Cal Factor	0.9993	Barometric Pressure	(Pb)	739.14	mm Hg		

	Calibration Data											Results				
	Run Time	Dry Gas Meter				Wet Test Meter		Standardized Volumes				Totalizer Gamma		Meter Gamma		Corrected Flowrate
	Elapsed	Gas Pressure	Gas Volume	Gas Temp	Totalizer Display	Gas Volume	Gas Temp	Totalizer Initial SF	Totalizer Final SF	Dry Gas Meter	Wet Test Meter	Final	Variation	DGM Display	Variation	
	(Θ)	(P_m)	(V_m)	(t_m)		(V_w)	(t_w)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{m(std)}$)	($V_{w(std)}$)	(Y)	(ΔY)	(Y)	(ΔY)	(Q_m)
	min	mm H_2O	liters	°C	liters	liters	°C	std liters	std liters	std liters	std liters					slm
Run 1 - Initial	0.00	0	0	28.31	0	0	28.86									
Final	13.00	0	0	28.31	10.266	10.27	28.86									
Total/Avg	13.00	0	0	28.31	10.266	10.27	28.86	9.716	9.673		9.695	1.002	0.007			0.75
Run 2 - Initial	0.00	0	0	28.31	0	0	28.86									
Final	18.00	0	0	28.31	10.182	10.02	29.42									
Total/Avg	18.00	0	0	28.31	10.182	10.02	29.14	9.636	9.594		9.450	0.985	-0.010			0.52
Run 3 - Initial	0.00	0	0	28.31	0	0	28.86									
Final	45.00	0	0	28.86	21.206	21.15	29.97									
Total/Avg	45.00	0	0	28.585	21.206	21.15	29.415	20.051	19.963		19.929	0.998	0.003			0.44
Run 4 - Initial																
Final																
Total/Avg																
Run 5 - Initial																
Final																
Total/Avg																

0.996

Average Meter Calibration Factor Y **0.995**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR 40 Part 60, using the Precision Wet Test Meter # 11AE6, which in turn was calibrated using the American Bell Prover # 3785, certificate # F107, which is traceable to the National Bureau of Standards (N.I.S.T.).

Signature _____ Date _____

76

W-80

Platt Environmental

Meter Box Calibration

Dry Gas Meter No.	CM6	Date:	October 27, 2008
Standard Meter No.	9605804	Calibrated By:	S. Sands
Standard Meter (Y)	0.9938	Barometric Pressure:	29.36

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			67.628	110.440	53	58	57					
Initial			58.746	101.423	53	57	57					
Difference	1	0.20	8.882	9.017	53	58	57	57	32	17	0.993	1.451
Final			73.544	116.450	53	60	57					
Initial			67.628	110.440	53	57	57					
Difference	2	0.50	5.916	6.010	53	59	57	58	14	12	0.992	1.580
Final			80.136	123.157	53	62	58					
Initial			73.544	116.450	53	60	57					
Difference	3	0.70	6.592	6.707	53	61	58	59	13	23	0.993	1.578
Final			90.046	133.223	53	64	58					
Initial			80.136	123.157	53	63	58					
Difference	4	0.90	9.910	10.066	53	64	58	61	17	33	0.997	1.539
Final			97.985	141.305	54	63	59					
Initial			90.046	133.223	54	59	59					
Difference	5	1.20	7.939	8.082	54	61	59	60	12	0	0.991	1.503
Final			58.746	101.423	52	63	56					
Initial			50.670	93.210	53	61	56					
Difference	6	2.00	8.076	8.213	53	62	56	59	10	0	0.991	1.674
									Average		**0.993**	**1.554**

Stack Temperature Sensor Calibration

Meter Box # : CM6 Name : S. Sands

Ambient Temperature : 58.3 °F Date : October 27, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	-3	0.7
250	248	0.3
600	600	0.0
1200	1207	0.4

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Meter Box Calibration

Dry Gas Meter No.	CM6	Date:	October 27, 2008
Standard Meter No.	9605804	Calibrated By:	S. Sands
Standard Meter (Y)	0.9938	Barometric Pressure:	29.36

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			67.628	110.440	53	58	57					
Initial			58.746	101.423	53	57	57					
Difference	1	0.20	8.882	9.017	53	58	57	57	32	17	0.993	1.451
Final			73.544	116.450	53	60	57					
Initial			67.628	110.440	53	57	57					
Difference	2	0.50	5.916	6.010	53	59	57	58	14	12	0.992	1.580
Final			80.136	123.157	53	62	58					
Initial			73.544	116.450	53	60	57					
Difference	3	0.70	6.592	6.707	53	61	58	59	13	23	0.993	1.578
Final			90.046	133.223	53	64	58					
Initial			80.136	123.157	53	63	58					
Difference	4	0.90	9.910	10.066	53	64	58	61	17	33	0.997	1.539
Final			97.985	141.305	54	63	59					
Initial			90.046	133.223	54	59	59					
Difference	5	1.20	7.939	8.082	54	61	59	60	12	0	0.991	1.503
Final			58.746	101.423	52	63	56					
Initial			50.670	93.210	53	61	56					
Difference	6	2.00	8.076	8.213	53	62	56	59	10	0	0.991	1.674
									Average		**0.993**	**1.554**

Stack Temperature Sensor Calibration

Meter Box # : CM6 *Name :* S. Sands

Ambient Temperature : 58.3 °F *Date :* October 27, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	-3	0.7
250	248	0.3
600	600	0.0
1200	1207	0.4

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Meter Box Calibration

Dry Gas Meter No.	CM8	Date:	October 27, 2008
Standard Meter No.	9605804	Calibrated By:	M. Platt
Standard Meter (Y)	0.9938	Barometric Pressure:	29.43

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			29.369	509.749	56	62	61					
Initial			22.644	502.933	55	63	61					
Difference	1	0.20	6.725	6.816	56	63	61	62	23	49	0.998	1.375
Final			37.000	517.477	57	64	61					
Initial			29.487	509.867	56	62	61					
Difference	2	0.50	7.513	7.610	57	63	61	62	17	2	0.997	1.414
Final			44.702	525.286	57	65	62					
Initial			37.135	517.625	57	64	61					
Difference	3	0.70	7.567	7.661	57	65	62	63	14	55	0.997	1.496
Final			50.249	530.920	57	65	62					
Initial			44.874	525.457	57	64	62					
Difference	4	0.90	5.375	5.463	57	65	62	63	9	27	0.994	1.530
Final			55.645	536.406	57	67	67					
Initial			50.399	531.077	57	66	62					
Difference	5	1.20	5.246	5.329	57	67	65	66	8	11	0.998	1.599
Final			22.535	502.823	56	68	61					
Initial			13.497	493.637	55	67	61					
Difference	6	2.00	9.038	9.186	56	68	61	64	10	59	0.996	1.612
									Average		**0.996**	**1.504**

Stack Temperature Sensor Calibration

Meter Box # : CM8 Name : M. Platt

Ambient Temperature : 61.5 °F Date : October 27, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	-2	0.4
250	249	0.1
600	601	0.1
1200	1208	0.5

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Meter Box Calibration

Dry Gas Meter No.	CM 4	Date:	October 24, 2008
Standard Meter No.	9605804	Calibrated By:	M. Platt
Standard Meter (Y)	1.0008	Barometric Pressure:	29.29

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			877.822	405.611	62	67	65					
Initial			864.361	392.300	62	68	65					
Difference	1	0.20	13.461	13.311	62	68	65	66	50	17	1.019	1.563
Final			96.162	23.887	63	70	67					
Initial			77.822	5.611	62	67	65					
Difference	2	0.50	18.340	18.276	63	69	66	67	42	54	1.011	1.532
Final			18.377	45.522	62	70	66					
Initial			12.120	39.336	62	68	65					
Difference	3	0.70	6.257	6.186	62	69	66	67	12	27	1.020	1.549
Final			36.489	63.466	62	71	67					
Initial			18.458	45.559	62	69	66					
Difference	4	0.90	18.031	17.907	62	70	67	68	31	43	1.017	1.554
Final			44.465	71.446	62	70	66					
Initial			36.489	63.466	62	67	67					
Difference	5	1.20	7.976	7.980	62	69	67	68	12	2	1.007	1.526
Final			864.202	392.143	61	71	65					
Initial			855.533	383.554	61	68	63					
Difference	6	2.00	8.669	8.589	61	70	64	67	10	16	1.015	1.563
									Average		**1.015**	**1.548**

Stack Temperature Sensor Calibration

Meter Box # : CM 4 Name : M. Platt

Ambient Temperature : 63.1 °F Date : October 24, 2008

Calibrator Model # : CL23A

Serial # : T-249465

Date Of Certification : September 22, 2006

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	0	0.0
250	250	0.0
600	599	0.1
1200	1201	0.1

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Texacon Outlet

Boiler ID: 1A

Trap ID: OL 37198

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: Jenna M

Sampling Console Ser. # Meter #5

Test Start (Date/Time :) 11/5/08 11:10

Leak Check (Pass/Fail)

Test End (Date/Time) 11/5/08 12:40

~~Leak~~ Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5	11:10	291	64	2000	0		
	11:25	328	65		29.28		
	11:40	330	67		55.85		
	11:55	331	68		81.58		
	12:10	332	70		98.52		
	12:25	335	71		132.23		
	12:40	335	72		157.453	157.453	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA 225.2

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Flexacon outlet

Boiler ID: 1B

Trap ID: OL 37281

Trap A (B) (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: Jenna M

Sampling Console Ser. #

Test Start (Date/Time :) 11/5/08 11:10

Leak Check (Pass/Fail)

Test End (Date/Time) 11/5/08 12:40

Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5	11:10	291	64	2000	0		
	11:25	328	66		29.79		
	11:40	330	68		57.83		
	11:55	331	70		85.27		
	12:10	332	71		103.36		
	12:25	335	73		134.08		
	12:40	335	73		145.355	145.355	
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon outlet

Boiler ID: 2A

Trap ID: OL 28226

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/5/08 13:00

Leak Check (Pass/Fail)

Test End (Date/Time) 11/5/08 14:30

Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5	13:00	277	71	2000	0		
	13:15	331	71		26.19		
	13:30	332	72		50.54		
	13:45	333	72		74.78		
	14:00	334	73		98.96		
	14:15	334	73		123.15		
	14:30	336	74		147.396		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: 2B

Trap ID: OL 28366

Trap A (B) (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: JM

Sampling Console Ser. #

Test Start 11/5 (Date/Time :) 13:00 Leak Check Pass/Fail

Test End 11/5 (Date/Time) 14:30 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5	13:00	277	73	2000	0		
	13:15	331	73		24.65		
	13:30	332	73		48.05		
	13:45	333	74		71.13		
	14:00	334	75		94.18		
	14:15	334	75		117.24		
	14:30	336	76		140.309		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Tracer outlet

Boiler ID: 3A

Trap ID: OL 28326

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: JM

Sampling Console Ser.#

Test Start (Date/Time :) 11/5/08 14:45

Leak Check Pass/Fail

Test End (Date/Time) 11/5/08 16:15

Leak Check (Pass)/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5	14:45	299	74	2000	0		
	15:00	335	74		29.29		
	15:15	340	74		55.81		
	15:30	342	75		78.45		
	15:45	343	75		98.91		
	16:00	343	75		119.43		
	16:15	342	75		139.863		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon outlet

Boiler ID: 38

Trap ID: OL 30589

Trap A (B) (Circle One)

Spiked At: 100 ng

QA/QC Signature

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/5/08 14:45 Leak Check Pass/Fail

Test End (Date/Time) 11/5/08 16:15 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5	14:45	299	75	2000	0		
	15:00	335	76		24.46		
	15:15	340	76		47.84		
	15:30	342	76		70.67		
	15:45	343	77		93.23		
	1600	343	77		115.67		
	1615	342	77		138.047		
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: 4A

Trap ID: OL 28174

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: CM

Sampling Console Ser. #

Test Start (Date/Time :) 11/5/08 16:35 Leak Check (Pass/Fail)

Test End (Date/Time) 11/5/08 18:05 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5/08	16:35	265	74	2000	0		
	16:50	332	74		26.95		
	17:05	338	75		50.94		
	1720	338	75		74.32		
	1735	335	74		97.71		
	1750	333	74		121.02		
	1805	333	74		143.414		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: 4B

Trap ID: OL 30344

Trap A (B) (Circle One)

Spiked At: 100 ng

QA/QC Signature

Sampled By: JM

Sampling Console Ser. # Meter Box 5

Test Start (Date/Time :) 11/5/08 16:35 Leak Check (Pass/Fail)

Test End (Date/Time) 11/5/08 1805 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/5	16:35	265	76	2000	0		
	1650	332	76		25.61		
	1705	338	76		48.01		
	1720	338	76		69.92		
	1735	335	76		91.90		
	1750	333	75		113.92		
	1805	333	75		135.961		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle Power Plant Test Location: Toxecon outlet

Boiler ID: Test 5A Trap ID: OL 28263

Trap 5A B (Circle One)

Spiked At: N/A QA/QC Signature

Sampled By: JM Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 7:30 Leak Check Pass/Fail

Test End (Date/Time) 11/6/08 900 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	7:30	317	60	2000	0		
	7:45	326	62		24.03		
	8:00	329	63		46.37		
	8:15	330	65		68.21		
	8:30	332	66		89.83		
	8:45	333	67		111.41		
	9:00	334	67		132.931		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: Test 5B

Trap ID: OL 30319

Trap A (5B) (Circle One)

Spiked At: 100 ng

QA/QC Signature

Sampled By: JM

Sampling Console Ser. # Meter 5

Test Start (Date/Time :) 11/6/08 7:30

Leak Check (Pass/Fail)

Test End (Date/Time) 11/6/08 9:00

Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	7:30	317	61	2000	0		
	7:45	326	63		24.06		
	8:00	329	65		45.75		
	8:15	330	67		67.56		
	8:30	332	68		89.19		
	8:45	333	69		110.69		
	9:00	334	69		132.491		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Tokecon Outlet

Boiler ID: Test 6A

Trap ID: OL 28374

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 9:15

Leak Check Pass/Fail

Test End (Date/Time) 11/6/08 10:45

Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	9:15	312	66	2000	0		
	9:30	332	67		25.31		
	9:45	336	67		48.89		
	10:00	336	68		72.91		
	10:15	337	68		95.07		
	10:30	337	68		118.09		
	10:45	336	68		141.070		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon outlet

Boiler ID: Test 6B

Trap ID: OL 28394

Trap A (B) (Circle One)

Spiked At:

QA/QC Signature

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 9:15 Leak Check Pass/Fail

Test End (Date/Time) 11/6/08 10:45 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	9:15	312	68	2000	0		
	9:30	332	69		25.54		
	9:45	336	69		49.31		
	10:00	336	70		73.84		
	10:15	337	70		95.43		
	10:30	337	70		118.44		
	10:45	336	71		141.452		
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: 1A

Trap ID: OL 37294

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 11:00

Leak Check (Pass/Fail)

Test End (Date/Time) 11/6/08 12:30

Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	11:00	317	68	2000	0		
	11:15	329	68		28.16		
	11:30	331	68		55.08		
	11:45	331	69		81.60		
	12:00	332	70		108.09		
	12:15	332	70		134.59		
	12:30	332	70		161.045		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon outlet

Boiler ID: 7B

Trap ID: OL 39575

Trap A (B) (Circle One)

Spiked At: N/A

QA/QC Signature Yolly

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 11:00 Leak Check (Pass/Fail)

Test End (Date/Time) 11/6/08 12:30 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	11:00	317	70	2000	0		
	11:15	329	70		27.61		
	11:30	331	70		54.83		
	11:45	331	71		81.80		
	12:00	332	72		108.73		
	12:15	332	72		134.19		
	12:30	332	72		160.496		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon outlet

Boiler ID: 8A

Trap ID: OL 39601

Trap A B (Circle One)

Spiked At:

QA/QC Signature Yolly

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 1240 ~~Leak~~ Check Pass/Fail

Test End (Date/Time) 11/6/08 1410 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1240	333	70	2000	0		
	1255	333	71		28.56		
	1310	335	71		55.91		
	1325	336	72		83.09		
	1340	336	73		110.23		
	1355	334	73		137.51		
	1410	334	74		164.831		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle Test Location: Toxecon outlet

Boiler ID: BB Trap ID: OL 39651

Trap A (B) (Circle One)

Spiked At: N/A QA/QC Signature Yoliy

Sampled By: JM Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 12:40 Leak Check Pass/Fail

Test End (Date/Time) 11/6/08 1410 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1240	333	73	2000	0		
	1255	333	73		28.36		
	1310	335	73		55.63		
	1325	336	74		82.61		
	1340	336	75		109.62		
	1355	334	75		136.79		
	1410	334	76		164.023		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: Test 9A

Trap ID: OL 39578

Trap A B (Circle One)

Spiked At: N/A

QA/QC Signature Yo/.y

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 14:20 Leak Check Pass/Fail

Test End (Date/Time) 11/6/08 15:50 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	14:20	321	74	2000	0		
	14:35	338	74		28.43		
	14:50	338	74		54.13		
	15:05	340	74		80.14		
	15:20	341	75		105.21		
	15:35	342	75		129.13		
	15:50	341	75		153.041		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon outlet

Boiler ID: Test 9B

Trap ID: OL 39607

Trap A (B) (Circle One)

Spiked At: N/A

QA/QC Signature Yu/Y

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 14:20 Leak Check (Pass/Fail)

Test End (Date/Time) 11/6/08 15:50 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1420	321	75	2000	0		
	14:35	338	76		28.32		
	14:50	338	76		54.52		
	15:05	340	76		79.43		
	15:20	341	76		104.97		
	15:35	342	77		128.74		
	15:50	341	77		152.893		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: Test 10A

Trap ID: OL 39600

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature Y.L.Y

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 16:05 Leak Check (Pass/Fail)

Test End (Date/Time) 11/6/08 1735 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1605	281	74	2000	0		
	1620	334	74		28.78		
	1635	338	74		55.19		
	1650	338	75		81.32		
	1705	336	75		107.49		
	1720	334	75		129.56		
	1735	334	75		140.980		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle

Test Location: Toxecon Outlet

Boiler ID: 10B

Trap ID: OL 39752

Trap A (B) (Circle One)

Spiked At:

QA/QC Signature Y.L.Y

Sampled By: JM

Sampling Console Ser. #

Test Start (Date/Time :) 11/6/08 1605 Leak Check (Pass/Fail)

Test End (Date/Time) 11/6/08 1735 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1605	281	76	2000	0		
	1620	334	76		28.08		
	1635	338	76		59.45		
	1650	338	76		80.90		
	1705	336	76		106.71		
	1720	334	77		130.24		
	1735	334	77		140.545		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

Keep Dry

Best Before: November 2009

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle M084501 Date: 11/5/08
Sampling Location: Texaco Outlet
Source Condition: Normal
Dry Gas Meter No. CM 4 Y = 1.015 Test Engineer: JM

Test (Run) No. 1 Barometric Pressure (P_{bar}) 29.15 in. Hg
Gas Temperature °F Static Pressure in. Hg
Orsat Analysis %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
11:12	61.965	1.548	63	48
11:22	69.47		64	48
11:32	76.92		65	48
11:42	83.69		68	48
11:52	90.91		71	50
12:02	98.26		72	50
12:12	105.620		74	50
Total Vol.				
Average			68.14 (T_m)	°R

Condensate
290 mls (V_f)
- 200 mls (V_i)
90 mls
× 0.04707 =
ft³ [$V_{wc(std)}$] + ft³ [$V_{wsg(std)}$]
$V_{m(std)}$ = ft³

Silica Gel or Train
225.2 grams (W_f)
- 209.9 grams (W_i)
15.3 grams
× 0.04715 =
= ft³ [$V_{w(std)}$]

Water Vapor, proportion by volume
Leak Check: ✓
B_{ws} = 10.3%
Moisture correction factor:
1 - B_{ws} =

Comments:

Test (Run) No. 2 Barometric Pressure (P_{bar}) in. Hg
Gas Temperature °F Static Pressure in. Hg
Orsat Analysis %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
13:00	5.712	1.548	72	48
13:10	13.34		72	48
13:20	21.01		73	48
13:30	28.64		74	48
13:40	36.20		75	49
13:50	43.78		75	49
14:00	51.290		76	49
Total Vol.				
Average			73.85 (T_m)	°R

Condensate
300 mls (V_f)
- 200 mls (V_i)
100 mls
× 0.04707 =
ft³ [$V_{wc(std)}$] + ft³ [$V_{wsg(std)}$]
$V_{m(std)}$ = ft³

Silica Gel or Train
232.2 grams (W_f)
- 215.0 grams (W_i)
17.0 grams
× 0.04715 =
= ft³ [$V_{w(std)}$]

Water Vapor, proportion by volume
Leak Check: ✓
B_{ws} = 11%
Moisture correction factor:
1 - B_{ws} =

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle M084501 Date: 11/5/08
Sampling Location: Texaco Outlet
Source Condition: Normal
Dry Gas Meter No. CM4 Y = 1.015 Test Engineer: JM

Test (Run) No. 3 Barometric Pressure (P_{bar}) 29.15 in. Hg
Gas Temperature °F Static Pressure in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
14:45	51.336	1.548	76	50
14:55	59.36		76	50
15:05	67.34		76	50
15:15	75.21		77	50
15:25	83.18		77	50
15:35	90.92		78	50
15:45	98.710		78	50
Total Vol.				
Average			75.86 (T_m)	°R

Condensate
310 mls (V_f)
- 200 mls (V_i)
110 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
$V_{m(std)}$ = _____ ft^3

Silica Gel or Train
218.2 grams (W_f)
- 204.4 grams (W_i)
13.8 grams
× 0.04715 = _____
= _____ ft^3 [$V_{w(std)}$]

Water Vapor, proportion by volume
Leak Check:
B_{ws} = 11.2%
Moisture correction factor:
1 - B_{ws} = _____

Comments:

Test (Run) No. 4 Barometric Pressure (P_{bar}) _____ in. Hg
Gas Temperature °F Static Pressure _____ in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
16:40	03.561	1.548	77	52
16 50	11.57		77	52
17 00	19.71		77	53
17 10	27.74		78	53
17 20	35.75		78	53
17 30	43.72		78	54
17.40	51.61		78	54
Total Vol.				
Average			(T_m)	°R

Condensate
310 mls (V_f)
- 200 mls (V_i)
110 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
$V_{m(std)}$ = _____ ft^3

Silica Gel or Train
231.4 grams (W_f)
- 215.4 grams (W_i)
16 grams
× 0.04715 = _____
= _____ ft^3 [$V_{w(std)}$]

Water Vapor, proportion by volume
Leak Check:
B_{ws} = 11.2%
Moisture correction factor:
1 - B_{ws} = _____

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle Power Plant Date: 11/6/08
Sampling Location: Toxecon Outlet
Source Condition: Normal
Dry Gas Meter No. CM 4 Y = 1.015 Test Engineer: JM

Test (Run) No. 5 Barometric Pressure (P_{bar}) 29.15 in. Hg
Gas Temperature °F Static Pressure in. Hg
Orsat Analysis %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
7:30	51.715	1.548	60	48
7:40	59.39		65	48
7:50	66.82		69	48
8:00	74.21		72	48
8:10	81.59		74	49
8:20	88.92		76	49
8:30	96.21		77	49
Total Vol.				
Average			(T_m)	°R

Condensate
300 mls (V_f)
- 200 mls (V_i)
100 mls
× 0.04707 = ____ ft^3 [$V_{wc(std)}$]

Silica Gel or Train
220.2 grams (W_f)
- 206.2 grams (W_i)
14 grams
× 0.04715 = ____ ft^3 [$V_{wsg(std)}$]

+ ____ ft^3 [$V_{w(std)}$]

$V_{m(std)}$ = ____ ft^3

Water Vapor, proportion by volume
B_{ws} = 9.7%

Leak Check: ✓

Moisture correction factor:
1 - B_{ws} = ____

Comments:

Test (Run) No. 6 Barometric Pressure (P_{bar}) ____ in. Hg
Gas Temperature °F Static Pressure in. Hg
Orsat Analysis %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
9:15	96.351	1.548	76	49
9:25	104.35		76	49
9:35	112.14		78	49
9:45	120.21		79	49
9:55	128.06		79	49
10:05	135.84		80	49
10:15	143.62		79	49
Total Vol.				
Average			(T_m)	°R

Condensate
310 mls (V_f)
- 200 mls (V_i)
110 mls
× 0.04707 = ____ ft^3 [$V_{wc(std)}$]

Silica Gel or Train
225 grams (W_f)
- 212 grams (W_i)
13 grams
× 0.04715 = ____ ft^3 [$V_{wsg(std)}$]

+ ____ ft^3 [$V_{w(std)}$]

$V_{m(std)}$ = ____ ft^3

Water Vapor, proportion by volume
B_{ws} = 11.2%

Leak Check: ✓

Moisture correction factor:
1 - B_{ws} = ____

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle Date: 11/6/08
Sampling Location: Toxecon outlet
Source Condition: Normal
Dry Gas Meter No. CM4 Y = 1.015 Test Engineer:

Test (Run) No. 7 Barometric Pressure (P_{bar}) 29.15 in. Hg
Gas Temperature °F Static Pressure in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
11 00	43.883	1.548	71	52
11:10	51.63		71	52
11 20	59.67		71	52
1130	67.46		72	52
11 40	75.24		72	52
11 50	83.12		73	52
12 00	90.659		73	52
Total Vol.				
Average			(T_m)	°R

Condensate
310 mls (V_f)
- 200 mls (V_i)
110 mls
× 0.04707 =
ft³ [$V_{wc(std)}$] + ft³ [$V_{wsg(std)}$]
$V_{m(std)}$ = ft³

Silica Gel or Train
830.6 grams (W_f)
- 217.7 grams (W_i)
12.9 grams
× 0.04715 =
= ft³ [$V_{w(std)}$]

Water Vapor, proportion by volume
B_{ws} = 11.2%

Leak Check:

Moisture correction factor:
1 - B_{ws} =

Comments:

Test (Run) No. 8 Barometric Pressure (P_{bar}) in. Hg
Gas Temperature °F Static Pressure in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1240	90.720	1.548	73	56
1250	98.62		73	56
1300	106.41		73	56
1310	114.13		74	57
1320	121.81		74	57
1330	129.40		75	58
1340	136.831		76	58
Total Vol.				
Average			(T_m)	°R

Condensate
300 mls (V_f)
- 200 mls (V_i)
100 mls
× 0.04707 =
ft³ [$V_{wc(std)}$] + ft³ [$V_{wsg(std)}$]
$V_{m(std)}$ = ft³

Silica Gel or Train
224.2 grams (W_f)
- 209.6 grams (W_i)
14.6 grams
× 0.04715 =
= ft³ [$V_{w(std)}$]

Water Vapor, proportion by volume
B_{ws} = 10.7%

Leak Check:

Moisture correction factor:
1 - B_{ws} =

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle Date: 11/6/08
Sampling Location: Toxecon outlet
Source Condition: Normal
Dry Gas Meter No. CM4 Y = 1.015 Test Engineer: JM

Test (Run) No. 9 Barometric Pressure (P_{bar}) 29.15 in. Hg
Gas Temperature °F Static Pressure in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1420	36.940	1.548	75	56
1430	45.21		76	56
1440	53.01		77	56
1450	60.75		77	56
1500	68.42		77	56
1510	76.03		77	56
1520	83.692		77	56
Total Vol.				
Average			(T_m)	°R

Condensate
310 mls (V_f)
- 200 mls (V_i)
110 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
231.6 grams (W_f)
- 218.2 grams (W_i)
13.4 grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3
Water Vapor, proportion by volume
Leak Check: ✓
B_{ws} = 11.3%
Moisture correction factor:
1 - B_{ws} = _____

Comments:

Test (Run) No. 10 Barometric Pressure (P_{bar}) _____ in. Hg
Gas Temperature °F Static Pressure in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1605	83.702	1.548	76	56
1615	91.61		76	56
1625	99.46		76	56
1635	107.26		77	57
1645	115.02		77	57
1655	122.77		77	57
1705	130.359		77	57
Total Vol.				
Average			(T_m)	°R

Condensate
310 mls (V_f)
- 200 mls (V_i)
110 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
225.2 grams (W_f)
- 213.0 grams (W_i)
12.2 grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3
Water Vapor, proportion by volume
Leak Check: ✓
B_{ws} = 11.2%
Moisture correction factor:
1 - B_{ws} = _____

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

Meter #1
A - .998
B - .996

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 1A Trap ID: ~~01~~ 37278

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time :) 11/6 745 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 815 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	745	340	81	500	0		
	750 755	346 350	81 80	500 500	3.75 6.42		
	800	351	80	500	9.11		
	805 810	350 351	80 80	500 500	11.91 14.49		
	815	350	80	500	17.155		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry

Best Before: November 2009

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 1B Trap ID: OL 37358

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time:) 11/6 745 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 815 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	745	340	81	500	0		
	750 755	346 350	81 81	500 500	3.34 6.21		
	800	351	81	500	9.14		
	805 810	350 351	81 81	500 500	11.98 14.63		
	815	350	81	500	17.371		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry

Best Before: November 2009

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 2A Trap ID: OL 39602

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature Yolly

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start 11/6 (Date/Time :) 835 Leak Check (Pass/Fail) Test End 11/6 (Date/Time) 905 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	835	346	80	500	0		
	840	348	80	500	3.74		
	845	350	80	500	6.38		
	850	351	80	500	9.02		
	855	352	80	500	11.38		
	900	351	80	500	14.11		
	905	351	80	500	17.132		

Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry **Best Before: November 2009**

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle Test Location: Unit 9

Boiler ID: 2B Trap ID: OL 39606

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature Yolly

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time): 11/6 835 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 9:05 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	835	346	82	500	0		
	840 845	348 350	81 82	500 500	3.72 6.22		
	850	351	82	500	8.90		
	855 900	352 351	82 82	500 500	11.21 14.23		
	905	351	82	500	17.129		

Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry **Best Before: November 2009**

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 3A Trap ID: OL 39598

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature Yu/Y

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time:) 11/6 922 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 952 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	922	346	80	500	0		
	927 932	349 351	81 80	500 500	3.68 6.65		
	937	352	80	500	9.19		
	942 947	351 350	80 80	500 500	12.56 14.80		
	952	350	80	500	17.444		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry **Best Before: November 2009**

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 3B Trap ID: OL 39550

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature Yuliy

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time :) 11/6 922 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 952 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	922	346	82	500	0		
	927 932	349 351	82 82	500 500	3.58 6.46		
	937	352	82	500	9.08		
	942 947	351 350	82 82	500 500	12.62 14.94		
	952	350	82	500	17.432		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry **Best Before: November 2009**

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 4A Trap ID: OL 28309

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time:) 11/6 1020 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 1050 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1020	345	81	500	0		
	1025	347	81	500	2.82		
	1030	349	81	500	5.55		
	1035	350	81	500	8.25		
	1040	351	81	500	10.25		
	1045	351	81	500	13.33		
	1050	351	81	500	15.842		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 4B Trap ID: OL 28262

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time): 11/6 1020 Leak Check (Pass)/Fail

Test End (Date/Time) 11/6 1050 Leak Check (Pass)/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1020	345	82	500	0		
	1025	347	82	500	2.96		
	1030	349	82	500	5.57		
	1035	350	83	500	8.15		
	1040	351	83	500	9.98		
	1045	351	83	500	12.91		
	1050	351	83	500	15.509		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 5A Trap ID: OL 30109

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature [signature]

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time): 11/6 1105 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 1135 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1105	346	80	500	0		
	1110 1115	343 345	80 79	500 500	3.162 6.323		
	1120	344	80	500	9.328		
	1125 1130	344 346	79 79	500 500	12.316 15.263		
	1135	345	80	500	18.216		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 5B Trap ID: OL 30368

Trap A (B) (Circle One)

Spiked At: 100 Ng QA/QC Signature

Sampled By: M Platt Sampling Console Ser. #

Test Start (Date/Time :) 11/6 1105 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 1135 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1105	346	82	500	0		
	1110 1115	343 345	82 81	500 500	3,637 6,810		
	1120	344	81	500	9,626 12,446		
	1125 1130	344 346	81 82	500 500	12,446 15,241		
	1135	345	82	500	17,937		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Resque Iste Test Location: Unit 9

Boiler ID: 6A Trap ID: OL28180

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: JHow Sampling Console Ser. # _____

Test Start 11/6 (Date/Time :) 11:55 Leak Check (Pass)/Fail

Test End 11/6 (Date/Time) 12:25 Leak Check (Pass)/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	11:55	347	81	500	0		
	12:00	348	81	500	2.806		
	12:05	351	81	500	5.611		
	1210	346	82	500	8.003		
	12:15	344	82	500	10.172		
	12:20	343	83	500	13.928		
	12:25	345	84	500	16.692		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 5B Trap ID: OL 30302

Trap A (B) (Circle One)

Spiked At: 100 ng QA/QC Signature

Sampled By: JHow Sampling Console Ser. #

Test Start (Date/Time :) 11/6 11:55 Leak Check (Pass)/Fail

Test End (Date/Time) 11/6 12:25 Leak Check (Pass)/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	11:55	347	83	500	0		
	12:00 12:05	348 351	83 83	500 500	2.502 5.118		
	12:10 12:15	346 344	84 84	500 500	7,779 10,436		
	12:20	343	85	500	13.071		
	12:25	345	86	500	16.850		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 7A Trap ID: OL 30143

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time :) 11/6 1240 Leak Check Pass/Fail

Test End (Date/Time) 11/6 1310 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1240	346	85	500	0		
	1245	348	85	500	3.27		
	1250	350	85	500	6.30		
	1255	353	85	500	9.00		
	1300	351	85	500	11.31		
	1305	351	85	500	13.92		
	1310	350	85	500	16.553		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 7B Trap ID: OL 31116

Trap A (B) (Circle One)

Spiked At: 100 ng QA/QC Signature

Sampled By: M. Platt Sampling Console Ser. #

Test Start (Date/Time) 11/6 1240 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 1310 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1240	346	86	500	0		
	1245 1250	348 350	86 86	500 500	3.17 6.41		
	1255	353	87	500	9.19		
	1300 1305	351 351	87 87	500 500	11.52 14.12		
	1310	350	85	500	16.741		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 8A Trap ID: OL 28313

Trap (A) B (Circle One)

Spiked At: QA/QC Signature

Sampled By: M. Platt Sampling Console Ser. #

Test Start (Date/Time :) 11/6 1325 Leak Check Pass/Fail

Test End (Date/Time) 11/6 1355 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1325	347	85	500	0		
	1330	350	84	500	2.70		
	1335	351	84	500	5.56		
	1340	350	84	500	8.62		
	1345	350	84	500	11.50		
	1350	351	84	500	14.91		
	1355	352	84	500	17.363		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 8B Trap ID: OL 28383

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature [signature]

Sampled By: M. Platt Sampling Console Ser. # _____

Test Start (Date/Time:) 11/6 1325 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 1355 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1325	347	86	500	0		
	1330	350	86	500	3.01		
	1335	351	86	500	5.95		
	1340	350	86	500	8.86		
	1345	350	86	500	11.68		
	1350	351	86	500	14.86		
	1355	352	86	500	17.160		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 9A Trap ID: QL 30116

Trap A B (Circle One)

Spiked At: QA/QC Signature

Sampled By: J. Howe Sampling Console Ser. #

Test Start (Date/Time :) 11/6 1410 Leak Check Pass/Fail Test End (Date/Time) 11/6 1440 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1410	346	84	500	0		
	1415	347	84	500	2.450		
	1420	350	84	500	5.178		
	1425	350	84	500	8.260		
	1430	350	84	500	11.107		
	1435	352	85	500	13.865		
	1440	351	84	500	16.601		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Sorbent Traps
(Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 9B Trap ID: OL 37209

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature [signature]

Sampled By: J. Howe Sampling Console Ser. # _____

Test Start (Date/Time:) 11/6 1410 Leak Check (Pass)/Fail Test End (Date/Time) 11/6 1440 Leak Check (Pass)/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1410	346	86	500	0		
	1415	347	86	500	2.763		
	1420	350	86	500	5.258		
	1425	350	86	500	8.050		
	1430	350	86	500	10.769		
	1435	352	86	500	13.565		
	1440	351	86	500	16.334		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

Keep Dry **Best Before: November 2009**

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

OHIO LUMEX

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 10A Trap ID: OL 28389

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: J. Howe Sampling Console Ser. # _____

Test Start (Date/Time:) 11/6 1450 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 1520 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1450	346	84	500	0		
	1455 1500	347 349	84 84	500 500	2.958 5.638		
	1505	350	84	500	8.273		
	1510 1515	350 350	84 84	500 500	10.764 13.379		
	1520	349	84	500	15.986		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Presque Isle ADA Test Location: Unit 9

Boiler ID: 10B Trap ID: OL 28382

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: J. Howe Sampling Console Ser. # _____

Test Start (Date/Time :) 11/6 1450 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 1520 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	1450	346	86	500	0		
	1455 1500	347 349	86 86	500 500	2.893 5.656		
	1505	350	86	500	8.362		
	1510 1515	350 350	86 86	500 500	10.839 13.457		
	1520	349	86	500	16.752		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle ADA Date: 11/6/08
Sampling Location: Unit 9
Source Condition: Normal
Dry Gas Meter No. CM8 Y = 0.996 Test Engineer: M. Platt

Test (Run) No. 1 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
745	37.534	1.5	76	67
750	41.53		78	
755	45.50		81	
800	49.44		83	
805	53.43		83	
810	57.41		84	
815	61.400		84	
Total Vol.	23.866			
Average			81.28 (T_m)	541.28

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = 2.3535
ft³ [$V_{wc(std)}$] + ft³ [$V_{wsg(std)}$]

Silica Gel or Train
215.2 grams (W_f)
- 208.4 grams (W_i)
6.8 grams
× 0.04715 = .032062
= 2.3855 ft³ [$V_{w(std)}$]

$V_{m(std)}$ = 19.028 ft³
Water Vapor, proportion by volume
Leak Check: ✓ @ 7
B_{ws} = .106
Moisture correction factor:
1 - B_{ws} =
Comments:

Test (Run) No. 2 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
835	62.016	1.5	78	67
840	66.22		81	
845	70.03		83	
850	73.55		84	
855	75.91		84	
900	81.84		85	
905	85.387		85	
Total Vol.	23.371			
Average			82.85	
			542.85 (T_m)	°R

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = 50
ft³ [$V_{wc(std)}$] + ft³ [$V_{wsg(std)}$]

Silica Gel or Train
214.2 grams (W_f)
- 207.4 grams (W_i)
6.8 grams
× 0.04715 = .032062
= ft³ [$V_{w(std)}$]

$V_{m(std)}$ = ft³
Water Vapor, proportion by volume
Leak Check: ✓ @ 6
B_{ws} = .108
Moisture correction factor:
1 - B_{ws} =
Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: ADA Presque Isle Date: 11/6/08
Sampling Location: Unit 9
Source Condition: Normal
Dry Gas Meter No. CM8 Y = 0.996 Test Engineer: M. Platt

Test (Run) No. 3 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis: %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
926	85.815	1.5	78	66
927	90.21		83	
932	94.41		83	
937	98.47		84	
942	103.08		84	
947	106.92		84	
952	110.455		84	
			82.85	
Total Vol.	24.640			
Average			(T_m)	°R

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = ____ ft^3 [$V_{wc(std)}$]

Silica Gel or Train
214.6 grams (W_f)
- 210.4 grams (W_i)
4.2 grams
× 0.04715 = ____ ft^3 [$V_{wsg(std)}$]

+ ____ ft^3 [$V_{w(std)}$]

$V_{m(std)}$ = ____ ft^3

Water Vapor, proportion by volume
B_{ws} = .100

Leak Check: ✓ @ 5

Moisture correction factor:
1 - B_{ws} = ____

Comments:

Test (Run) No. 4 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis: %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1020	110.923	1.5	78	67
1025	114.83		79	
1030	118.88		81	
1035	123.10		84	
1040	126.42		86	
1045	130.52		86	
1050	134.283		86	
			82.85	
Total Vol.	23.360			
Average			(T_m)	°R

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = ____ ft^3 [$V_{wc(std)}$]

Silica Gel or Train
224.2 grams (W_f)
- 217.6 grams (W_i)
6.6 grams
× 0.04715 = ____ ft^3 [$V_{wsg(std)}$]

+ ____ ft^3 [$V_{w(std)}$]

$V_{m(std)}$ = ____ ft^3

Water Vapor, proportion by volume
B_{ws} = .108

Leak Check: ✓ @ 6

Moisture correction factor:
1 - B_{ws} = ____

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle ADA Date: 11/6
Sampling Location: Unit 9
Source Condition: Normal
Dry Gas Meter No. CM8 Y = 0.996 Test Engineer: M. Platt

Test (Run) No. 5 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis: %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft³ or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1105	134.649	1.5	78	67
1110	138.665		82	
1115	142.713		85	
1120	146.521		86	
1125	150.463		87	
1130	154.310		87	
1135	158.145		87	
Total Vol.	23.496		84.42	
Average			(T_m)	°R

Condensate: 250 mls (V_f) − 200 mls (V_i) = 50 mls × 0.04707 = ____ ft³ [$V_{wc(std)}$]

Silica Gel or Train: 211.4 grams (W_f) − 206.2 grams (W_i) = 5.2 grams × 0.04715 = ____ ft³ [$V_{wsg(std)}$]

= ____ ft³ [$V_{w(std)}$]

$V_{m(std)}$ = ____ ft³

Water Vapor, proportion by volume

Leak Check: ✓ @ 5

B_{ws} = .105

Moisture correction factor: 1 - B_{ws} = ____

Comments:

Test (Run) No. 6 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis: %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft³ or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
11:55	158.225	1.5	80	67
12:00	162.083		84	
12:05	165.923		86	
12:10	169.867		87	
12:15	173.615		88	
12:20	177.550		87	
12:25	181.417		89	
Total Vol.	23.192		86.57	
Average			(T_m)	°R

Condensate: 250 mls (V_f) − 200 mls (V_i) = 50 mls × 0.04707 = ____ ft³ [$V_{wc(std)}$]

Silica Gel or Train: 218.8 grams (W_f) − 213.9 grams (W_i) = 4.9 grams × 0.04715 = ____ ft³ [$V_{wsg(std)}$]

= ____ ft³ [$V_{w(std)}$]

$V_{m(std)}$ = ____ ft³

Water Vapor, proportion by volume

Leak Check: ✓ @ 6

B_{ws} = .106

Moisture correction factor: 1 - B_{ws} = ____

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle ADA Date: 11/6/08
Sampling Location: Unit 9
Source Condition: Normal
Dry Gas Meter No. CM 8 Y = .996 Test Engineer: M. Platt

Test (Run) No. 7 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis: %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1240	181.805	1.5	82	67
1245	186.53		86	
1250	191.01		88	
1255	195.18		89	
1300	198.31		89	
1305	202.55		89	
1310	206.456		89	
			81.42	
Total Vol.	24.651			
Average			(T_m) °R	

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
221.4 grams (W_f)
- 215.0 grams (W_i)
6.4 grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3

Water Vapor, proportion by volume
B_{ws} = .103

Leak Check: ✓ @ 5

Moisture correction factor:
1 - B_{ws} = _____

Comments:

Test (Run) No. 8 Barometric Pressure (P_{bar}) 29.1 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg

Orsat Analysis: %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1325	206.784	1.5	82	67
1330	210.34		90	
1335	214.80		91	
1340	219.34		92	
1345	223.29		92	
1350	227.64		92	
1355	231.780		92	
			90.14	
Total Vol.	24.946			
Average			(T_m) °R	

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
216.4 grams (W_f)
- 211.0 grams (W_i)
5.4 grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3

Water Vapor, proportion by volume
B_{ws} = .101

Leak Check: ✓ @ 6

Moisture correction factor:
1 - B_{ws} = _____

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

MOISTURE FIELD DATA SHEET

Project Name/Number: Presque Isle Date: 11/6/08
Sampling Location: Unit 9
Source Condition: Normal
Dry Gas Meter No. 6148 Y = .996 Test Engineer: JHOW

Test (Run) No. 9 Barometric Pressure (P_{bar}) 29.10 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg
Orsat Analysis %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1410	233.386	1.5	84	61
1415	237.427		89	
1420	240.491		90	
1425	245.223		91	
1430	249.264		92	
1435	253.60		92	
1440	256.911		92	
			90.00	
Total Vol.	23.526			
Average			(T_m)	°R

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
219.8 grams (W_f)
- 213.6 grams (W_i)
6.2 grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3
Water Vapor, proportion by volume
B_{ws} = .108
Leak Check: ✓ @ 7
Moisture correction factor:
1 - B_{ws} = _____
Comments:

Test (Run) No. 10 Barometric Pressure (P_{bar}) 29.10 in. Hg
Gas Temperature °F Static Pressure -2 in. Hg
Orsat Analysis %CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
1450	257.122	1.5	86	63
1455	261.31		89	
1500	265.13		91	
1505	270.00		91	
1510	274.04		91	
1515	278.97		92	
1520	282.235		92	
			91.18	
Total Vol.	25.113			
Average			(T_m)	°R

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
221.4 grams (W_f)
- 215.3 grams (W_i)
6.1 grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3
Water Vapor, proportion by volume
B_{ws} = .102
Leak Check: ✓ @ 5
Moisture correction factor:
1 - B_{ws} = _____
Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Na PIPP

Test Location: RUN 1

Boiler ID: 7

Trap ID: 1A OL 28350

Trap (A) B (Circle One)

Spiked At: N/A

QA/QC Signature

Sampled By: EO

Sampling Console Ser # # 2 Y = 0.995

Test Start (Date/Time :) 11/6/08 8:35 Leak Check (Pass/Fail)

Test End (Date/Time) 11/6/08 9:05 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	8:35	348	70	500	0.00		
	8:40	349	70	500	3.35		
	8:45	349	72	500	6.42		
	8:50	351	71	500	9.48		
	8:55	352	69	500	12.31		
	9:00	352	69	500	15.34		
	9:05	353	69	500	18.381		
Total/Average				500			

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: Nc PIPP Test Location: RUN 1

Boiler ID: 7 Trap ID: OL 28266

Trap A (B) (Circle One)

Spiked At: N/A QA/QC Signature

Sampled By: EO Sampling Console Ser. # #2

Test Start (Date/Time :) 11/6/08 8:35 Leak Check Pass/Fail

Test End (Date/Time) 11/6/08 9:05 Leak Check Pass/Fail Y=0.999

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	8:35	348	72	500	0.00		
	8:40	349	72	500	3.27		
	8:45	349	72	500	6.51		
	8:50	351	72	500	9.54		
	8:55	352	71	500	12.30		
	9:00	352	71	500	15.11		
	9:05	352	71	500	18.192		
Total/Average				500			

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We PIPP Test Location: Test 2

Boiler ID: 7 Trap ID: OL 28207

Trap (A) B (Circle One)

Spiked At: N/A QA/QC Signature [signature]

Sampled By: EO Sampling Console Ser. # 2 Y= 0.995

Test Start (Date/Time :) 11/6/08 9:22 Leak Check (Pass/Fail) Test End (Date/Time) 11/6/08 9:52 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	9:22	275	69	500	6.06		
	9:27	280	68	500	3.12		
	9:32	280	68	500	6.02		
	9:37	280	69	500	9.11		
	9:42	281	68	500	11.81		
	9:47	278	69	500	14.66		
	9:52	280	69	500	17.91		
Total/Average				500			

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We PPP Test Location: Test 2

Boiler ID: 7 Trap ID: OL 28254

Trap A (B) (Circle One)

Spiked At: N/A QA/QC Signature

Sampled By: Eo Sampling Console Ser. # 2 Y=0.999

Test Start (Date/Time :) 11/6/08 9:22 Leak Check (Pass/Fail) Test End (Date/Time) 11/6/08 9:52 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	9:22	275	74	500	0.00		
	9:27	280	70	500	3.36		
	9:32	280	70	500	6.22		
	9:37	280	71	500	8.91		
	9:42	281	70	500	11.69		
	9:47	278	70	500	14.60		
	9:52	280	70	500	18.04		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We PIPP Test Location: Test 3

Boiler ID: 7 Trap ID: OL 28306

Trap (A) B (Circle One)

Spiked At: N/A QA/QC Signature: [illegible]

Sampled By: Eo Sampling Console Ser. # 2

Test Start (Date/Time :) 11/6/08 10:20 Leak Check Pass/Fail Test End (Date/Time) 11/6/08 10:50 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	10:20	308	67	500	0.00		
	10:25	311	67	500	3.02		
	10:30	313	67	500	5.94		
	10:35	314	67	500	9.08		
	10:40	316	67	500	11.95		
	10:45	316	67	500	15.01		
	10:50	315	67	500	17.739		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We PIPP Test Location: Test 3

Boiler ID: 7 Trap ID: OL 28267

Trap A (B) (Circle One)

Spiked At: N/A QA/QC Signature [signature]

Sampled By: EJ Sampling Console Ser. # 2

Test Start (Date/Time :) 11/6/08 10:20 Leak Check (Pass/Fail) Test End (Date/Time) 11/6/08 10:50 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	10:20	308	69	500	0.00		
	10:25	311	69	500	3.06		
	10:30	313	69	500	6.05		
	10:35	314	69	500	9.10		
	10:40	316	69	500	11.95		
	10:45	316	70	500	14.96		
	10:50	315	70	500	17.634		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

MOISTURE FIELD DATA SHEET

Project Name/Number: M084501 WE Energies Presque Isle ADA Date: 11/6/08
Sampling Location: Unit 7
Source Condition: Normal
Dry Gas Meter No. CM6 Y = 0.993 Test Engineer: EO

Test (Run) No. 1 Barometric Pressure (P_{bar}) 29.10 in. Hg
Gas Temperature 350 °F Static Pressure -2 in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
9:22	41.221	1.6	63	54
9:27	44.890		65	55
9:32	48.450		66	56
9:37	52.290		66	58
9:42	55.670		66	60
9:47	59.700		67	62
9:52	63.710			
Total Vol.				
Average		1.6	(T_m)	°R

Condensate
250 mls (V_f)
- 200 mls (V_i)
50 mls
× 0.04707 = 2.354

Silica Gel or Train
218.2 grams (W_f)
- 208 grams (W_i)
10.2 grams
× 0.04715 = 0.481

2.354 ft^3 [$V_{wc(std)}$] + 0.481 ft^3 [$V_{wsg(std)}$]
= 2.835 ft^3 [$V_{w(std)}$]

$V_{m(std)}$ = 21.90 ft^3

Water Vapor, proportion by volume
B_{ws} = 0.115

Leak Check:
0.001 @ 10

Moisture correction factor:
1 - B_{ws} =

Comments:

Test (Run) No. Barometric Pressure (P_{bar}) in. Hg
Gas Temperature °F Static Pressure in. Hg

Orsat Analysis
%CO_2 %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
Total Vol.				
Average			(T_m)	°R

Condensate
mls (V_f)
- mls (V_i)
mls
× 0.04707 =

Silica Gel or Train
grams (W_f)
- grams (W_i)
grams
× 0.04715 =

ft^3 [$V_{wc(std)}$] + ft^3 [$V_{wsg(std)}$]
= ft^3 [$V_{w(std)}$]

$V_{m(std)}$ = ft^3

Water Vapor, proportion by volume
B_{ws} =

Leak Check:

Moisture correction factor:
1 - B_{ws} =

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m\,(°R)}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: WE Energies Presque Isle ADA Test Location: UNIT 8

Boiler ID: 1A Trap ID: OL 28321

Trap A B (Circle One)

Spiked At: QA/QC Signature

Sampled By: SD Sampling Console Ser. # #4 1.002

Test Start (Date/Time :) 11/6 8:35 Leak Check Pass/Fail

Test End (Date/Time) 11/6 9:05 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	8:35	330	78	500	0.000		
11/6	8:40	332	76	500	2.59		
11/6	8:45	333	76	[illegible]	[illegible]		
11/6	8:50 8:55	335 336	76 76	500 [illegible]	8.07 11.02		
11/6	9:00 9:05	336 336	74 74	500 500	13.90 16.801		
Total/Average							

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

OHIO LUMEX

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: WE Energies Presque Isle ADA Test Location: UNIT 8

Boiler ID: 13 Trap ID: OL 28230

Trap A (B) (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: SD Sampling Console Ser. # #4 .998

Test Start (Date/Time :) 11/6 8:35 Leak Check (Pass/Fail) Test End (Date/Time) 11/6 9:05 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	8:35	330	78	500	0.000		
11/6	8:40	332	77	500	2.61		
11/6	[illegible]	333	76	500	5.10		
11/6	[illegible] [illegible]	335 336	76 76	500 500	8.21 11.30		
11/6	[illegible] [illegible]	336 336	76 76	500 500	14.09 16.934		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We Energies Presque Isle ADA Test Location: Unit 8

Boiler ID: 24 Trap ID: OL 28271

Trap (A) B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: SD Sampling Console Ser. # 441 1002

Test Start 11/6 (Date/Time :) 11/6 9:22 Leak Check (Pass/Fail)

Test End 11/6 (Date/Time) 9:52 Leak Check (Pass/Fail)

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	9:22	316	70	500	0.000		
11/6	9:27	321	70	500	3.12		
11/6	9:32	328	70	500	5.77		
11/6	9:37	332	70	500	8.53		
11/6	9:42	333	69	500	11.30		
11/6	9:47	333	69	500	13.94		
11/6	9:52	333	69	500	16.721		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:

Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA

Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We Energies Presque Isle ADA Test Location: UNIT 8

Boiler ID: 2B Trap ID: OL 28363

Trap A B (Circle One)

Spiked At: QA/QC Signature

Sampled By: S Dyra Sampling Console Ser. # #1 9988

Test Start (Date/Time :) 11/6 9:22 Leak Check Pass/Fail

Test End (Date/Time) 11/6 9:52 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	9:22	316	74	500	0.000		
11/6	9:27	321	74	500	3.16		
11/6	9:32	328	74	500	5.89		
11/6	9:37 9:42	[illegible] 333	[illegible] 73	500 500	8.55 11.05		
11/6	9:47 9:52	333 333	73 73	500 500	13.60 16.461		

Total/Average						

Chain of Custody

Relinquished by: Date:

Received by: Date:

Relinquished by: Date:

Received for Laboratory by: Date:

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We Energies Presque Isle ADA Test Location: Unit 8

Boiler ID: 3A Trap ID: OL 28362

Trap A B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: _____ Sampling Console Ser. # #4 1.002

Test Start (Date/Time :) 11/6 10:20 Leak Check Pass/Fail

Test End (Date/Time) 11/6 10:50 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	10:20	330	68	500	0.000		
11/6	[illegible]	332	68	500	2.63		
11/6	[illegible]	333	68	[illegible]	5.49		
11/6	[illegible] [illegible]	332 332	68 67	500 500	7.96 10.91		
11/6	[illegible] [illegible]	333 333	69 69	500 [illegible]	13.04 16.128		

Total/Average						

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

Appendix K/30B Sorbent Traps (Chain of Custody)

Plant/Source: We Energies Presque Isle ADA Test Location: UNIT 8

Boiler ID: 8B Trap ID: OL 28364

Trap A B (Circle One)

Spiked At: _____ QA/QC Signature _____

Sampled By: SD Sampling Console Ser. # #4 .998

Test Start (Date/Time :) 11/6 10:20 Leak Check Pass/Fail

Test End (Date/Time) 11/6 10:50 Leak Check Pass/Fail

Date	Time	Duct Temp (°F or °C)	Meter Temp (°F or °C)	Flow Rate (cc/min)	Dry Gas Meter Liters Initial	Dry Gas Meter Liters Final	Comments
11/6	10:20	330	71	500	0.000		
11/6	10:25	332	71	500	2.58		
11/6	10:30	333	71	500	5.24		
11/6	10:35 10:40	333 333	71 71	500 500	7.67 10.56		
11/6	10:45 10:50	333 333	72 72	500 500	13.25 16.027		
Total/Average							

Chain of Custody

Relinquished by: _____ Date: _____

Received by: _____ Date: _____

Relinquished by: _____ Date: _____

Received for Laboratory by: _____ Date: _____

For Analysis contact us:
Ohio Lumex Co., Inc. 9263 Ravenna Road Unit A-3, Twinsburg, OH 44087 USA
Phone 330-405-0837 Fax 330-405-0847 US Toll Free: 888-876-2611

Impregnated Activated Carbon – Refer to MSDS
Deactivated glass and glass wool

MOISTURE FIELD DATA SHEET

Project Name/Number: M084501 WE Energies Presque Isle ADA Date: 11/6/08
Sampling Location: UNIT 8
Source Condition: NORMAL
Dry Gas Meter No. CM6 Y = .993 Test Engineer: SD

Test (Run) No. 1 Barometric Pressure (P_{bar}) 29.10 in. Hg
Gas Temperature 338 °F Static Pressure -1.5 in. Hg

Orsat Analysis
_____ %CO_2 _____ %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
11:00	63.794	1.5	63	63
11:05	67.91	1.5	64	63
11:10	71.32	1.5	65	64
11:15	75.05	1.5	66	64
11:20	78.81	1.5	67	64
11:25	82.56	1.5	68	65
11:30	86.254			
Total Vol.	21.901			
Average			(T_m)	°R

Condensate
249 mls (V_f)
- 202 mls (V_i)
47 mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
207.2 grams (W_f)
- 201.4 grams (W_i)
5.8 grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3

Water Vapor, proportion by volume

Leak Check:

B_{ws} = .102

Moisture correction factor:
1 - B_{ws} = _____

Comments:

Test (Run) No. _____ Barometric Pressure (P_{bar}) _____ in. Hg
Gas Temperature _____ °F Static Pressure _____ in. Hg

Orsat Analysis
_____ %CO_2 _____ %O_2

Clock Time 24 hour	Meter Volume (V_m) ft^3 or L (Circle One)	Meter Gage Pressure (ΔH) in. H_2O	Meter Temp. (t_m) °F	Impgr. Outlet Temp °F
Total Vol.				
Average			(T_m)	°R

Condensate
_____ mls (V_f)
- _____ mls (V_i)
_____ mls
× 0.04707 = _____
_____ ft^3 [$V_{wc(std)}$] + _____ ft^3 [$V_{wsg(std)}$]
= _____ ft^3 [$V_{w(std)}$]

Silica Gel or Train
_____ grams (W_f)
- _____ grams (W_i)
_____ grams
× 0.04715 = _____

$V_{m(std)}$ = _____ ft^3

Water Vapor, proportion by volume

Leak Check:

B_{ws} = _____

Moisture correction factor:
1 - B_{ws} = _____

Comments:

$$V_{m(std)} = 17.64\, V_m Y \frac{P_{bar} + \frac{DH}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

Appendix X. Platt – SO_3 Testing 2009

Sulfuric Acid Mist Emissions Test Report

Performed for

ADA-ES, Inc.

At the

We Energies
Presque Isle Power Plant
Toxecon Outlet Duct
Marquette, Michigan
June 5, 2009

Platt Environmental Services, Inc.

Platt Environmental Services, Inc.

1520 Kensington Road, Suite 204
Oak Brook, IL 60523
630-521-9400
630-521-9494 fax

Sulfuric Acid Mist Emissions Test Report

Performed for

ADA-ES, Inc.

At the

We Energies
Presque Isle Power Plant
Toxecon Outlet Duct
Marquette, Michigan
June 5, 2009

Report Submittal Date
July 27, 2009

Prepared By

Platt Environmental Services

Report No. M092205P

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 EXECUTIVE SUMMARY 2

3.0 TEST METHODOLOGY 3
Consol Controlled Condensate Sulfuric Acid Mist (SO_3) Determination 3

4.0 TEST RESULT SUMMARY 4

5.0 CONCLUSION AND CERTIFICATION 5

APPENDIX
Test Section Diagram 7
Sample Train Diagram 8
Calculation Nomenclature and Formulas 9
Titration Data 12
Reference Method Test Data (Computerized Sheets) 16
Calibration Data 17
Field Data Sheets 22

1.0 Introduction

PLATT ENVIRONMENTAL SERVICES, INC. (PES) conducted a sulfuric acid mist emissions test program for ADA-ES, Inc. at the We Energies Presque Isle Power Plant in Marquette, Michigan on the Toxecon Outlet Duct on June 5, 2009. This report summarizes the results of the test program and test methods used.

The test location, test date, and test parameter are summarized below.

Test Overview

Test Location	Test Date	Test Parameter
Toxecon Outlet Duct	June 5, 2009	Sulfuric acid mist (SO_3 as H_2SO_4)

The identification of individuals associated with the test program is summarized below.

Location	Address	Contact
Test Facility	We Energies Presque Isle Power Plant Presque Isle Michigan	Mr. Jon Konings (414) 221-2430 (phone) jon.konings@we-enrgies.com
Test Coordinator	ADA-ES, Inc. 8100 SouthPark Way, Unit B Littleton, Colorado 80120-4525	Mr. Paul Johnson (303) 734-1727 (phone) (303) 734-0300 (fax) pauljohnson@adaes.com
Testing Company Representative	Platt Environmental Services, Inc. 1520 Kensington Rd. Suite 204 Oak Brook, Illinois 60523	Tim Mei (630) 521-9400 (phone) tmei@plattenv.com

The test crew consisted of Messrs. D. Runyan, A. Schavey, and T. Mei of PES. The purpose of the test program was to demonstrate the sulfuric acid mist emissions at the Toxecon Outlet Duct during specified operating conditions.

2.0 Executive Summary

Selected results of the test program are summarized below, in Table 1. A complete summary of emission test results follows the narrative portion of this report.

The results are based upon the four test runs that were performed on June 5, 2009.

Table 1

Test Results Summary

Location	Date	Pollutant	ppmvd
Toxecon Outlet Duct	6/5/09	Sulfuric Acid Mist (SO_3 as H_2SO_4)	0.49

3.0 Test Methodology

Emissions testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A. A schematic of the sampling train used and copies of field data sheets for each test run are included in the Appendix.

The following methodology was used during the test program:

Consol Controlled Condensate Sulfuric Acid Mist (SO_3) Determination

Stack gas sulfuric acid mist (SO_3) concentrations were determined in accordance with the Consol Controlled Condensate Method. An Environmental Supply Company, Inc. sampling train was used to sample stack gas, in the manner specified in the Method.

The flue gas was extracted through a quartz-lined probe fitted with a quartz wool plug to remove particulate matter. SO_3 was then collected as the sample gas passed through a hot water cooled condenser that was also loosely packed with quartz wool. The condenser assembly was maintained at a temperature of 140°F. The sample was then passed through impingers loaded with 3% H_2O_2 to capture the sulfur dioxide (SO_2) passing through the system. The impingers were placed in an ice bath to maintain the exit gas from the last impinger containing silica gel below 68°F. Maintaining the temperature increases the efficiency of the silica gel in drying the metered gas. A leak check of the entire sample train was performed at a vacuum greater than the sampling vacuum after each sampling run in order to determine if any leakage had occurred during the test run. A leakage rate not in excess of 2% of the average sampling rate is considered acceptable.

Samples were recovered as follows: the quartz wool particulate plug was removed and the probe was rinsed with an 80% IPA solution and placed in one bottle, the quartz wool plug in the condenser coil was removed and the coil was rinsed with 80% IPA, and the impingers were measured for moisture determination and the H_2O_2 solution was kept for potential analysis for SO_2 concentration.

4.0 Test Result Summary

Consol Controlled Condensate Titration Results Summary
We Energies - Presque Isle Power Plant
Toxecon Outlet Unit 7, 8, 9

June 5, 2009

Particulate Phase SO_3, 80% IPA probe rinse								
Test No.	Time	Vt-Vtb	N	Vsoln	Va	Vm(std) ft^3	C SO_3 (lbs/dscf)	ppm SO_3
1	9:20-10:20	0.09	0.0097	65	10	5.674	8.83E-08	0.42
2	11:20-12:20	0.19	0.0097	65	25	5.726	7.39E-08	0.36
3	13:43-14:43	0.09	0.0097	65	25	5.923	3.38E-08	0.16
4	15:35-16:35	0.09	0.0097	65	25	5.956	3.36E-08	0.16
							Average	**0.28**

Gaseous Phase SO_3, 80% IPA Condenser Coil								
Test No.	Time	Vt-Vtb	N	Vsoln	Va	Vm(std) ft^3	C SO_3 (lbs/dscf)	ppm SO_3
1	9:20-10:20	0.14	0.0097	65	25	5.674	5.49E-08	0.26
2	11:20-12:20	0.09	0.0097	65	25	5.726	3.50E-08	0.17
3	13:43-14:43	0.14	0.0097	65	25	5.923	5.26E-08	0.25
4	15:35-16:35	0.09	0.0097	65	25	5.956	3.36E-08	0.16
							Average	**0.21**

5.0 Conclusion and Certification

PLATT ENVIRONMENTAL SERVICES is pleased to have been of service to ADA-ES, Inc. and We Energies. If you have any questions regarding this test report, please do not hesitate to contact us at 630-521-9400.

CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

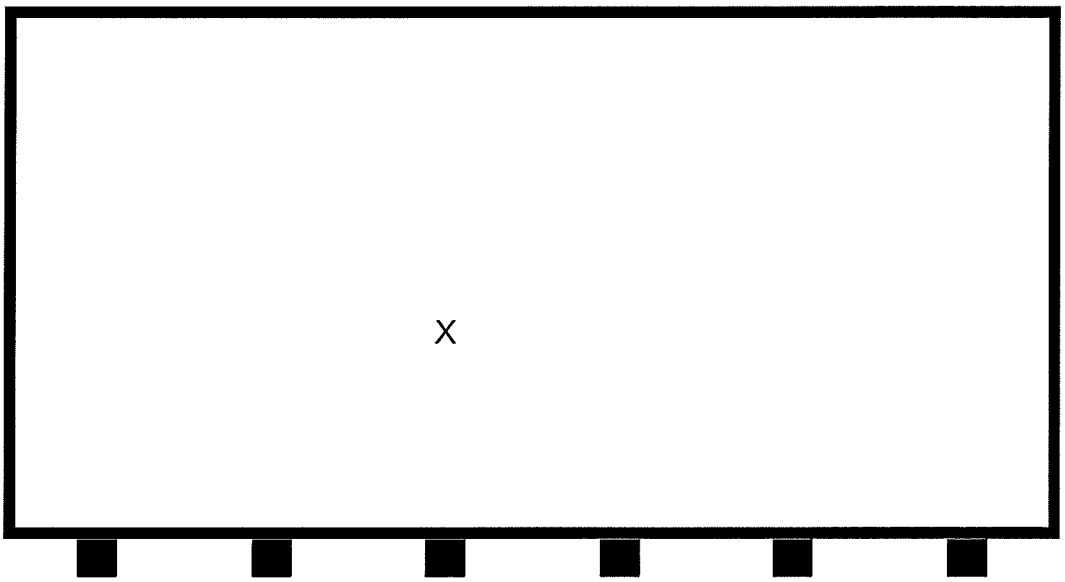
PLATT ENVIRONMENTAL SERVICES

Timothy Mei — Project Manager

Scott W. Banach — Quality Assurance

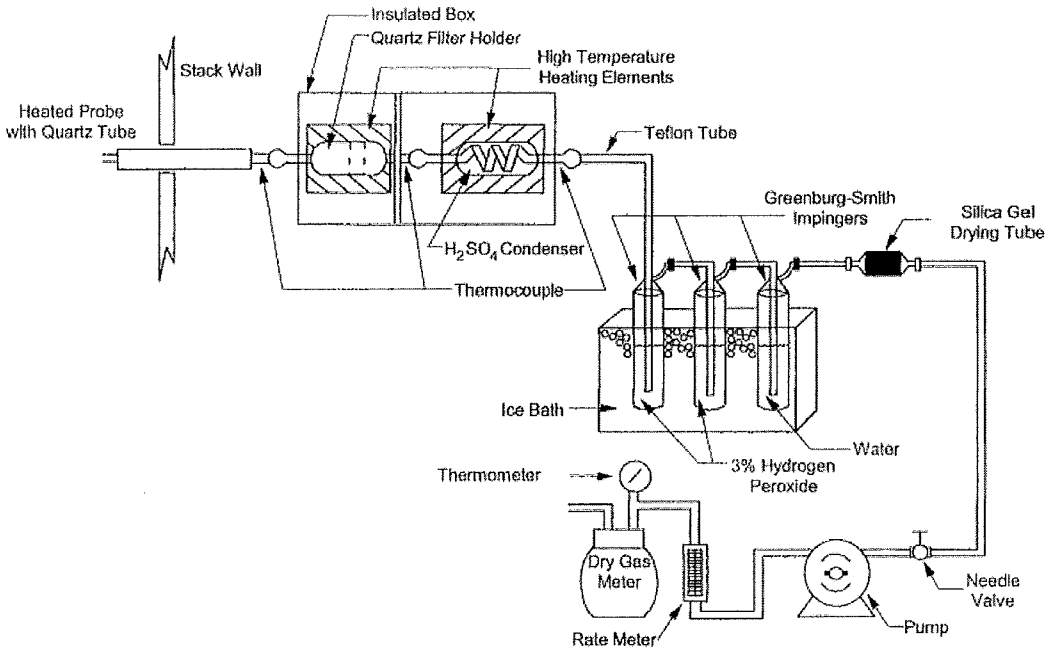
APPENDIX

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



Job:	We Energies Presque Isle Power Plant
Date:	June 5, 2009
Test Location:	TOXECON Outlet Duct
Length:	19.17 Feet
Width:	17.58 Feet
Duct Area:	337.113 Square Feet
No. of Points :	1
No. of Ports:	6 (1 used for sampling)

Consol Controlled Condensate – Sulfuric Acid Mist Sample Train Diagram



Coal Emission Rate Calculations

A pollutant emission rate (E), expressed as pounds of pollutant per million Btu heat input from the fuel combusted can be calculated by several methods as follows:

A. $C = C_s/7000$ where, C = pollutant concentration, lb/dscf
c_s = pollutant concentration, grains/dscf

B. If fuel flow is monitored and the fuel combusted during the test is sampled and analyzed for gross calorific value, then:

$$E = \frac{Q_{sd}C}{\text{fuel flow rate (lb/hr) GCV}} \times 10^6$$

where, E = lbs per million Btu
GCV = gross calorific value, Btu/lb
Q_{sd} = dry volumetric gas flow at standard conditions, dscf/hr

C. If an integrated gas sample is taken during the test and analyzed for $\%CO_2$ or $\%O_2$, dry basis by volume, with an approved USEPA Method 3 or 3A gas analyzer, then

$$E = C\,F_c \frac{100}{(\%CO_2)} \text{ or, } E = C\,F \frac{20.9}{(20.9 - \%O_2)} \quad \text{where,}$$

$\%CO_2$ and $\%O_2$ are expressed as percent values:

F_c = a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the fuel combusted, 1840 scf CO_2/million Btu for sub-bituminous or 1800 scf/million Btu for bituminous.
F = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the fuel combusted, 9820 dscf/million Btu for sub-bituminous or 9780 dscf/million Btu for bituminous.

D. If fuel sample increments are taken and composited during the test and an ultimate analysis is performed and the GCV is determined, then

$$F_c = \frac{321 \times 10^3 (\%C)}{GCV} \text{ where, } \%C = \text{carbon content by weight expressed as percent}$$

$$F = \frac{[3.64\,(\%H) + 1.53\,(\%C) + 0.57\,(\%S) + 0.14\,(\%N) - 0.46\,(\%O_2)]}{GCV} \times 10^6$$

1. H = Hydrogen, percent
2. C = Carbon, percent
3. S = Sulfur, percent
4. N = Nitrogen, percent
5. O = Oxygen, percent

PLATT ENVIRONMENTAL SERVICES, INC.

Derivation of Factors Used in Sulfuric Acid Mist Calculations

Factors for calculating from lb/dscf to parts per million:

Using 22.414 liters of gas per gram-mole at 0°C and 1 atmosphere pressure,

One pound-mole of gas is contained in 359.04765 ft^3 at 32°F and 29.92 in. Hg, or 385.31943 ft^3 at 68°F and 29.92 in. Hg

$$\text{ppm} = \frac{\text{M lb/lb–mole}}{385.31943 \text{ dscf/lb–mole} \times 10^6} = 2.5952494 \times 10^{-9} \text{ M lb/dscf}$$

Where M = pollutant molecular weight; H_2SO_4 = 98.076 lb/lb-mole

$$\text{Factor for ppm } H_2SO_4 = \frac{1}{98.076 \times 2.5952 \times 10^{-9}} = 3.9289 \times 10^6 \text{ dscf/lb}$$

$$\underline{\text{Use } 3.9289 \times 10^6}$$

Factor for converting ppm to lbs/hr

$$\text{ppm } H_2SO_4 \times 2.545 \times 10^{-7} = \frac{\text{lbs } H_2SO_4}{\text{dscf}}$$

$$\frac{\text{lbs } H_2SO_4}{\text{dscf}} \times \frac{\text{dscf}}{\text{min}} \times \frac{60\text{min}}{\text{hr}} = \frac{\text{lbs } H_2SO_4}{\text{hr}}$$

PLATT ENVIRONMENTAL SERVICES, INC.

Calculations for Sulfuric Acid Mist

$$V_{m(std)} = 17.647 \; V_m \; Y \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$$

$$C_{H_2SO_4} = 1.0811 \times 10^{-4} \frac{(V_t - V_{tb}) \; N \left(\frac{V_{soln}}{V_a} \right)}{V_{m(std)}}$$

$$\text{ppm } H_2SO_4 = 3.9289 \times 10^6 \, C_{H_2SO_4} \quad (\text{expressed as } H_2SO_4)$$

Where:

$C_{H_2SO_4}$ = Concentration of sulfuric acid (including sulfur trioxide), dry basis, corrected to standard conditions, lb/dscf

N = Normality of barium chloride titrant, meq/ml

P_{bar} = Barometric pressure at the exit of the dry gas meter, inches of mercury

P_{std} = Standard pressure, 29.92 inches of mercury

T_{std} = Standard temperature, 528 °R

17.647 = T_{std}/P_{std}

V_a = Volume of sample aliquot titrated, ml

T_m = Dry gas meter average temperature, °R

V_m = Dry gas volume measured by dry gas meter, dcf

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscf

V_{soln} = Total volume of solution in which the sulfuric acid sample is contained, ml

V_t = Volume of barium perchlorate titrant used for the sample, ml

V_{tb} = Volume of barium perchlorate titrant used for the blank, ml

Y = Dry gas meter calibration factor

ΔH = Average pressure differential across the orifice meter, inches of water

13.6 = Specific gravity of mercury

1.0811×10^{-4} = Equivalent weight of sulfuric acid, lb/g-meq

3.9289×10^6 = $\frac{\text{dscf}}{\text{lb}}$ of sulfuric acid

Barium-Thorin Titrations

Project/Project Number: M092205 WE Energies Presque Isle Analyst: Tam 6/05/09 Date:

toxecon outlet & toxecon inlet

Barium Titrant Standardization	Run No. 1	Run No. 2	Run No. 3
Volume 0.01 N H_2SO_4 titrated (ml)	20	20	
Volume $BaCl_2$ added (ml)	20.9	20.5	
Calculated $BaCl_2$ normality	.0096	.0098	

Average $BaCl_2$ normality = .0097 N
Standardization Blank (25 ml Water + 100 ml isopropanol) = .02 ml ; Must be <0.5 ml.

Sample Number	Sample Date	Sample Description	Total Volume	Sample Aliquot	Titrant Volume for Sample Final Reading - Initial Reading = V_t ml	Titrant Volume Corrected for Blank (V_t - V_{tb}) ml
*Ammonium Sulfate Controls	6/05/09	Probe Rinse outlet Test #1	65 mls	10 mls	.1 - 0 = .1 .2 - .1 = .1 Average = .1	0.09
	6/05/09	Coil Rinse outlet Test #1	65 mls	25 mls	5.2 - 5.0 = .2 5.3 - 5.2 = .1 Average = .15	0.14
	6/05/09	Probe Rinse Inlet Test #1	65 mls	25 mls	5.4 - 5.3 = .1 5.6 - 5.4 = .2 Average = .15	0.14
	6/05/09	Coil Rinse inlet Test #1	65 mls	25 mls	5.7 - 5.6 = .1 5.8 - 5.7 = .1 Average = .1	0.09
	6/05/09	H_2O_2 Imps outlet Test #1	370 mls	25 ml	10.5 - 5.7 = 4.8 15.1 - 10.5 = 4.6 Average = 4.70	4.69
	6/05/09	H_2O_2 Imps inlet Test #1	370 mls	25 ml	15.2 - 15.1 = .1 15.4 - 15.2 = .2 Average = .15	0.14
	6/05/09	H_2O_2 Reagent Blank	100 mls	20 mls	.02 - .01 = .01 .03 - .02 = .01 Average = .01	V_{tb} .01

* All titrations must be performed in replicate with agreement of 0.1% or 0.2 ml, whichever is larger.

Barium-Thorin Titrations

Project/Project Number: M092205 We Energies Presque Isle Analyst: JAM 6/05/09 Date:

Barium Titrant Standardization	Run No. 1	Run No. 2	Run No. 3
Volume 0.01 N H_2SO_4 titrated (ml)	*		
Volume $BaCl_2$ added (ml)	PAGE	1	
Calculated $BaCl_2$ normality			

Average $BaCl_2$ normality = _____ N
Standardization Blank (25 ml Water + 100 ml isopropanol) = _____ ml ; Must be <0.5 ml.

Sample Number	Sample Date	Sample Description	Total Volume	Sample Aliquot	Titrant Volume for Sample Final Reading - Initial Reading = V_t ml	Titrant Volume Corrected for Blank (V_t - V_{tb}) ml
Ammonium Sulfate Controls	6/05/09	Probe Rinse outlet Test #2	65 mls	25	.2 - 0 = .2 .4 - .2 = .2 Average = .2	0.19
	6/05/09	Coil Rinse outlet Test #2	65 mls	25	.5 - .4 = .1 .6 - .5 = .1 Average = .1	0.09
	6/05/09	Probe Rinse inlet Test #2	65 mls	25	.8 - .7 = .1 1.0 - .8 = .2 Average = .15	0.14
	6/05/09	Coil Rinse inlet Test #2	65 mls	25	1.3 - 1.2 = .1 1.5 - 1.3 = .2 Average = .15	0.14
	6/05/09	H_2O_2 Imps outlet Test #2	370 mls	25	7.2 - 1.5 = 5.7 11.3 - 7.2 = 5.5 Average = 5.6	5.59
	6/05/09	H_2O_2 Imps inlet Test #2	340 mls	25	12.4 - 12.3 = .1 12.5 - 12.4 = .1 Average = .1	0.09
		H_2O_2 Reagent Blank	PAGE	1	- = - = Average =	V_{tb} .01

* All titrations must be performed in replicate with agreement of 0.1% or 0.2 ml, whichever is larger.

Barium-Thorin Titrations

Project/Project Number: M092205 We Energies Presque Isle Analyst: JAM 6/05/09 Date:

Barium Titrant Standardization	Run No. 1	Run No. 2	Run No. 3
Volume 0.01 N H_2SO_4 titrated (ml)			
Volume $BaCl_2$ added (ml)	PAGE	1	
Calculated $BaCl_2$ normality			

Average $BaCl_2$ normality = _____ N
Standardization Blank (25 ml Water + 100 ml isopropanol) = _____ ml ; Must be <0.5 ml.

Sample Number	Sample Date	Sample Description	Total Volume	Sample Aliquot	Titrant Volume for Sample Final Reading - Initial Reading = V_t ml	Titrant Volume Corrected for Blank (V_t - V_{tb}) ml
Ammonium Sulfate Controls	6/05/09	Probe Rinse outlet Test#3	65	25	.1 - 0 = .1 .2 - .1 = .1 Average = .1	.09
	6/05/09	Probe Rinse outlet Test#3	65	25	.3 - .2 = .1 .5 - .3 = .2 Average = .15	.14
	6/05/09	Probe Rinse Inlet Test#3	65	25	1.0 - .9 = .1 1.1 - 1.0 = .1 Average = .1	.09
	6/05/09	Probe Rinse inlet Test#3	65	25	1.2 - 1.1 = .1 1.3 - 1.2 = .1 Average = .1	.09
	6/05/09	H_2O_2 Imps outlet Test#3	334	25	2.1 - 2.0 = .1 2.6 - 2.5 = .1 Average = .1	.09
	6/05/09	H_2O_2 Imps Inlet Test#3	324	25	1.7 - 1.5 = .2 1.8 - 1.7 = .1 Average = .15	.14
		H_2O_2 Reagent Blank	PAGE	1	- = - = Average =	V_{tb} .01

* All titrations must be performed in replicate with agreement of 0.1% or 0.2 ml, whichever is larger.

Barium-Thorin Titrations

Project/Project Number: M092205 We Energies Presque Isle Analyst: JAM 6/5/09 Date:

Barium Titrant Standardization	Run No. 1	Run No. 2	Run No. 3
Volume 0.01 N H_2SO_4 titrated (ml)	*		
Volume $BaCl_2$ added (ml)	PAGE	1	
Calculated $BaCl_2$ normality			

Average $BaCl_2$ normality = _____ N
Standardization Blank (25 ml Water + 100 ml isopropanol) = _____ ml ; Must be <0.5 ml.

Sample Number	Sample Date	Sample Description	Total Volume	Sample Aliquot	Titrant Volume for Sample Final Reading - Initial Reading = V_t ml	Titrant Volume Corrected for Blank (V_t - V_{tb}) ml
~~Ammonium~~ 6-9 Sulfate Controls	06/05/09	Probe Rinse Outlet Test #4	65	25	.1 - 0 = .1 .2 - .1 = .1 Average = .1	.09
	6/05/09	Con Rinse Outlet Test #4	65	25	.4 - .3 = .1 .6 - .5 = .1 Average = .1	.09
	6/05/09	H_2O_2 Pumps Outlet Test #4	270	25	14.4 - 5.3 = 9.1 23.7 - 14.4 = 9.3 Average = 9.2	9.19
					- = - = Average =	
					- = - = Average =	
					- = - = Average =	
		H_2O_2 Reagent Blank	PAGE	1	- = - = Average =	V_{tb} .01

* All titrations must be performed in replicate with agreement of 0.1% or 0.2 ml, whichever is larger.

CONSOL CONTROLLED CONDENSATE TEST RESULTS

Date:	6/5/2009	Condition:	High
Project:	We Energies Presque Isle Power Plant	Data Taken By:	DCR
Location:	Toxecon Outlet	Fuel Factor:	1840
Source:	Unit 7, 8, 9		

Test Number:	1	Time:	9:20 - 10:20
Pressure, Barometric(Hg"):	29.090		
Pressure, Static(H_2O"):	3.00		
Pressure, Stack(Hg"):	29.311		
Initial Volume (cu.ft.)	66.163		
Final Volume (cu.ft.)	72.182		
Meter Temperature (°F)	81.90		
Meter Volume (dscf)	5.674		
Meter Calibration (Y)	0.995		
Average Delta H (ΔH)	0.020		

Test Number:	2	Time:	11:20-12:20
Pressure, Barometric(Hg"):	29.090		
Pressure, Static(H_2O"):	3.00		
Pressure, Stack(Hg"):	29.311		
Initial Volume (cu.ft.)	73.262		
Final Volume (cu.ft.)	79.29		
Meter Temperature (°F)	77.77		
Meter Volume (dscf)	5.726		
Meter Calibration (Y)	0.995		
Average Delta H (ΔH)	0.020		

Test Number:	3	Time:	13:43 - 14:43
Pressure, Barometric(Hg"):	29.090		
Pressure, Static(H_2O"):	3.00		
Pressure, Stack(Hg"):	29.311		
Initial Volume (cu.ft.)	79.409		
Final Volume (cu.ft.)	85.595		
Meter Temperature (°F)	73.50		
Meter Volume (dscf)	5.923		
Meter Calibration (Y)	0.995		
Average Delta H (ΔH)	0.020		

Test Number:	4	Time:	15:35 - 16:35
Pressure, Barometric(Hg"):	29.090		
Pressure, Static(H_2O"):	3.00		
Pressure, Stack(Hg"):	29.311		
Initial Volume (cu.ft.)	86.057		
Final Volume (cu.ft.)	92.283		
Meter Temperature (°F)	74.00		
Meter Volume (dscf)	5.956		
Meter Calibration (Y)	0.995		
Average Delta H (ΔH)	0.020		

PLATT ENVIRONMENTAL SERVICES, INC.

Procedures for Calibration

Dry Gas Meters

The test meters are calibrated according to Method 5, Section 5.3 and "Procedures for Calibrating and Using Dry Gas Volume Meters as Calibration Standards" by P.R. Westlin and R.T. Shigehara, March 10, 1978.

Temperature Sensing Devices

The potentiometer and thermocouples are calibrated utilizing a NBS traceable millivolt source.

Meter Box Calibration

Dry Gas Meter No.	CM16	Date:	May 12, 2009
Standard Meter No.	14159239	Calibrated By:	DCR
Standard Meter (Y)	0.9973	Barometric Pressure:	29.87

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			81.623	26.089	50	69	66					
Initial			72.528	16.490	50	73	67					
Difference	1	0.20	9.095	9.599	50	71	67	69	36	30	0.982	1.680
Final			95.647	40.598	50	72	68					
Initial			81.623	26.089	50	69	67					
Difference	2	0.50	14.024	14.509	50	71	68	69	35	30	1.001	1.671
Final			58.601	102.047	50	69	65					
Initial			50.906	94.105	50	69	63					
Difference	3	0.70	7.695	7.942	50	69	64	67	16	30	0.999	1.686
Final			50.906	94.105	50	69	63					
Initial			43.490	86.426	50	68	62					
Difference	4	0.90	7.416	7.679	50	69	63	66	14	0	0.993	1.684
Final			72.528	16.490	50	73	66					
Initial			58.601	2.047	50	69	65					
Difference	5	1.20	13.927	14.443	50	71	66	68	23	0	0.996	1.709
Final			105.050	50.365	50	76	69					
Initial			95.647	40.598	50	72	68					
Difference	6	2.00	9.403	9.767	50	74	69	71	12		0.998	1.691
									Average		**0.995**	**1.687**

Stack Temperature Sensor Calibration

Meter Box # : CM16 *Name :* DCR

Ambient Temperature : 50 °F *Date :* May 12, 2009

Calibrator Model # : CL23A

Serial # : T-276953

Date Of Certification : November 3, 2008

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	Test Thermometer Temperature (° F)	Temperature Difference %
0	0	0.0
250	250	0.0
600	599	0.1
1200	1201	0.1

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Meter Box Calibration

Dry Gas Meter No.	CM16	Date:	July 7, 2009
Standard Meter No.	9605804	Calibrated By:	JEA
Standard Meter (Y)	0.9938	Barometric Pressure:	30.00

Run Number		Orifice Setting in H_2O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final			36.277	78.402	73	75	74					
Initial			28.822	71.007	73	75	73					
Difference	1	0.20	7.455	7.395	73	75	74	74	26	17	1.010	1.396
Final			44.779	86.847	73	75	74					
Initial			36.398	78.525	73	74	74					
Difference	2	0.50	8.381	8.322	73	75	74	74	18	59	1.008	1.440
Final			54.001	95.968	74	75	75					
Initial			45.400	87.450	74	74	74					
Difference	3	0.70	8.601	8.518	74	75	75	75	16	29	1.009	1.448
Final			63.427	105.284	74	77	75					
Initial			54.166	96.135	74	75	75					
Difference	4	0.90	9.261	9.149	74	76	75	76	15	36	1.013	1.436
Final			70.967	112.747	74	76	76					
Initial			63.627	105.497	74	76	75					
Difference	5	1.20	7.340	7.250	74	76	76	76	10	28	1.013	1.371
Final			28.667	70.861	73	76	73					
Initial			20.242	62.509	73	74	73					
Difference	6	2.00	8.425	8.352	73	75	73	74	9	52	1.006	1.541
									Average		**1.010**	**1.439**

Stack Temperature Sensor Calibration

Meter Box # : *CM16* *Name :* *JEA*

Ambient Temperature : *75* *°F* *Date :* *July 7, 2009*

Calibrator Model # : *CL23A*

Serial # : *T-276953*

Date Of Certification : *November 3, 2008*

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (° F)	***Test Thermometer Temperature (° F)***	***Temperature Difference %***
0	*0*	0.0
250	*251*	0.1
600	*600*	0.0
1200	*1203*	0.2

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

Platt Environmental Services, Inc.

H_2SO_4 VAPOR FIELD DATA SHEET
For Controlled Condensate (CCS)
(NCASI Method 8A)

Project/Project Number: WeEnergies - PIPP Date: 06/05/09

Sampling Location: Toxicon Outlet Test #1

Source Condition: Normal

Dry Gas Meter No. CM16 Y = 0.995 DH = 1.6857

Barometric Pressure: 29.09 in. Hg

Leak Check: Pre-sampling 0.00 cfm @ 8 in. Hg vacuum

Post-sampling 0.00 cfm @ 8 in. Hg vacuum

CO_2 12.7

O_2 - 5.9

Clock Time (24 hrs.)	Meter Volume (V_m) ft^3	Orifice Gauge Pressure (ΔH) in. H_2O	Temperature: Stack (°F)	Temperature: Filter > 500° Probe (°F)	Temperature: Filter > 500° Outlet (°F)	Temperature: Condenser Water (°F)	Temperature: 140° Coil Exit (°F)	Temperature: Dry Gas Meter Inlet (°F)	Temperature: Dry Gas Meter Outlet (°F)
9:20	66.163	0.02		500	500	140	140	83	81
9:25	66.673	0.02		500	500	140	140	83	82
9:30	67.201	0.02		500	500	140	140	83	82
9:35	67.720	0.02		500	500	141	140	83	82
9:40	68.290	0.02		500	500	141	140	83	82
9:45	68.810	0.02		500	500	140	140	83	82
9:50	69.350	0.02		500	500	142	140	83	82
9:55	69.860	0.02		500	500	141	140	82	82
10:00	70.330	0.02		500	500	141	140	82	81
10:05	70.810	0.02		500	500	141	140	82	81
10:10	71.290	0.02		500	500	140	140	81	81
10:15	71.750	0.02		500	500	141	140	81	81
10:20	72.182	0.02		500	500	140	140	81	81
Avg.	6.019							82.3	81.5

Operator: DCR / ASHV

DSCF - 5.67

Platt Environmental Services, Inc.

H_2SO_4 VAPOR FIELD DATA SHEET
For Controlled Condensate (CCS)
(NCASI Method 8A)

Project/Project Number: We Energies - PIPP Date: 06/05/09

Sampling Location: Toxicon - Outlet Test # 2

Source Condition: Normal

Dry Gas Meter No. CM16 Y = 0.995 ΔH: 1.687

Barometric Pressure: 29.09 in. Hg

Leak Check: Pre-sampling 0.00 cfm @ 7 in. Hg vacuum

Post-sampling 0.00 cfm @ 7 in. Hg vacuum

CO_2 12.5%
O_2 6.5%

Clock Time (24 hrs.)	Meter Volume (V_m) ft^3	Orifice Gauge Pressure (ΔH) in. H_2O	Temperature: Stack (°F)	Probe > 500° (°F)	Filter > 500° Outlet (°F)	Condenser Water (°F)	140° Coil Exit (°F)	Dry Gas Meter Inlet (°F)	Dry Gas Meter Outlet (°F)
11:20	73.262	0.02		500	500	142	140	79	78
11:25	73.740	0.02		500	500	142	140	78	78
11:30	74.280	0.02		500	500	141	140	78	78
11:35	74.810	0.02		500	500	142	140	78	78
11:40	75.300	0.02		500	500	142	140	78	78
11:45	75.810	0.02		500	500	143	140	78	78
11:50	76.350	0.02		500	500	143	140	78	78
11:55	76.840	0.02		500	500	142	140	78	78
12:00	77.310	0.02		500	500	142	140	78	78
12:05	77.870	0.02		500	500	142	140	78	77
12:10	78.290	0.02		500	500	141	140	77	77
12:15	78.810	0.02		500	500	141	140	77	77
12:20	79.290			500	500	141	140	77	77
Avg.	6.028	0.02						77.85	77.69

Operator: DCR / ASHV

DSCF - 5.43

Platt Environmental Services, Inc.

H_2SO_4 VAPOR FIELD DATA SHEET
For Controlled Condensate (CCS)
(NCASI Method 8A)

Project/Project Number: WeEnergies- PIPP Date: 06/05/09

Sampling Location: Toxicon Outlet - Test #3

Source Condition: Normal

Dry Gas Meter No. CM16 Y = 0.995 ΔH: 1.687

Barometric Pressure: 29.09 in. Hg

Leak Check: Pre-sampling 0.00 cfm @ 10 in. Hg vacuum

Post-sampling 0.00 cfm @ 10 in. Hg vacuum

CO_2 12.4 %

O_2 6.6 %

Clock Time (24 hrs.)	Meter Volume (V_m) ft^3	Orifice Gauge Pressure (ΔH) in. H_2O	Temperature: Stack (°F)	Temperature: > 500° Probe (°F)	Temperature: Filter > 500° Outlet (°F)	Temperature: Condenser Water (°F)	Temperature: 140° Coil Exit (°F)	Temperature: Dry Gas Meter Inlet (°F)	Temperature: Dry Gas Meter Outlet (°F)
13:43	79.409	0.02		500	500	143	140	74	73
13:48	79.920	0.02		500	500	144	140	74	73
13:53	80.450	0.02		500	500	142	140	74	73
13:58	80.980	0.02		500	500	142	140	74	73
14:03	81.420	0.02		500	500	143	140	74	73
14:08	81.910	0.02		500	500	143	140	74	73
14:13	82.470	0.02		500	500	144	140	74	73
14:18	82.980	0.02		500	500	144	140	74	73
14:23	83.480	0.02		500	500	144	140	74	73
14:28	83.990	0.02		500	500	143	140	74	73
14:33	84.450	0.02		500	500	143	140	74	73
14:38	85.010	0.02		500	500	143	140	74	73
14:43	85.595	0.02		500	500	141	140	74	73
Avg.	6.186	0.02						74	73

Operator: DCR / ASHV

DSCE - 5.92

Platt Environmental Services, Inc.

H_2SO_4 VAPOR FIELD DATA SHEET
For Controlled Condensate (CCS)
(NCASI Method 8A)

Project/Project Number: WeEnergies - PIPP Date: 06/05/07

Sampling Location: Toxicon - Outlet Test #4

Source Condition: Normal

Dry Gas Meter No. CM16 Y = 0.995 ΔH 1.6P7

Barometric Pressure: 29.09 in. Hg

Leak Check: Pre-sampling 0.00 cfm @ 10 in. Hg vacuum

Post-sampling 0.00 cfm @ 10 in. Hg vacuum

CO_2 12.8%
O_2 6.5%

Clock Time (24 hrs.)	Meter Volume (V_m) ft^3	Orifice Gauge Pressure (ΔH) in. H_2O	Temperature: Stack (°F)	Temperature: > 500° Probe (°F)	Temperature: Filter > 500° Outlet (°F)	Temperature: Condenser Water (°F)	Temperature: 140° Coil Exit (°F)	Temperature: Dry Gas Meter Inlet (°F)	Temperature: Dry Gas Meter Outlet (°F)
15:35	86.057	0.02		500	500	142	140	75	73
15:40	86.520	0.02		500	500	142	140	75	73
15:45	87.000	0.02		500	500	142	140	75	73
15:50	87.520	0.02		500	500	142	140	75	73
15:55	88.100	0.02		500	500	142	140	75	73
16:00	88.630	0.02		500	500	145	140	75	73
16:05	89.120	0.02		500	500	145	140	75	73
16:10	89.670	0.02		500	500	145	140	75	73
16:15	90.120	0.02		500	500	143	140	75	73
16:20	90.700	0.02		500	500	145	140	75	73
16:25	91.200	0.02		500	500	143	140	75	73
16:30	91.750	0.02		500	500	143	140	75	73
16:35	92.283	0.02		500	500	143	140	75	73
Avg.		0.02						75	73

Operator: DCR / ASHV

0SCF - 5.96

Appendix Y. GFTS Final Report

Grubb Filtration
Testing Services, Inc.

8006 Route 130 North
Post Office Box 1156
Delran, NJ 08075

TEL (856) 461-1800
FAX (856) 461-1613
www.GFTS.com

Laboratory Report No. 4649
Date: September 30, 2009

Prepared For: **ADA-ES, INC.**
8100 SouthPark Way, Unit B
Littleton, Colorado 80120

Reference: ADA-ES AGREEMENT NO. 002-2006; TASK ORDER NO. 01

Subject: We Energies Presque Isle Power Plant TOXECON Baghouse Analysis of Used Filter Bags – Final Report

Background

In 2005, in conjunction with DOE Cooperative Agreement No. DE-FC26-04NT41766, We Energies installed a TOXECON™ system designed to clean the combined flue gases of Units 7, 8, and 9 at their Presque Isle Power Plant (PIPP). TOXECON™ is a patented process in which a fabric filter system (baghouse) installed downstream of an existing particle control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. The primary purpose of the PIPP system was to control mercury emissions using powdered activated carbon (PAC) injection.

The pulse-jet baghouse for this system was supplied by Wheelabrator Air Pollution Control, and it was equipped with filter bags made of a standard, utility-grade, PPS (polyphenylene sulfide) needled felt (18 oz/yd^2, scrim-supported, singed on its external/filtration surface). Grubb Filtration Testing Services (GFTS) was subcontracted by ADA-ES to provide quality assurance (QA) testing of the fabric, which was produced by Southern Felt Co., and QA inspection of the bags, which were made by Midwesco Filter Resources, Inc.

Due to concerns that the standard PPS felt bags might not provide the optimum performance in the PIPP Toxecon baghouse, a test program was implemented to install and evaluate bags made of various alternative fabrics. The four criteria that were used in the selection of alternative test fabrics were 1) better suited for higher temperature operation; 2) higher collection efficiency; 3) lower cost; and/or 4) lower pressure drop. The project team; We Energies, ADA-ES, EPRI, and GFTS; selected five types of test bags based on the above criteria and on fabric availability. These bags were made by Midwesco, and fabric QA testing and bag QA inspection was performed on them by GFTS. Two other types of test bags, which were provided by direct arrangement with We Energies, were also included in the initial test installation. No independent QA inspection of these bags was conducted, and fabric testing was conducted on only small (and perhaps non-representative) samples. Test bags of an additional fabric type (PS050) were provided and installed in July 2008.

The following test bags were installed in Compartment 8A of the PIPP 7-9 baghouse, all prior to its initial startup on December 17, 2005, except for the PS050 bags.

Fabric (Felt) Description	Bag Supplier	Style #	Quantity
High-Perm PPS w/ PPS Scrim	Midwesco	9056	12
High-Perm PPS w/ 2.2 oz/yd^2 PTFE Scrim	Midwesco	9054	8
High-Perm PPS w/ 3.8 oz/yd^2 PTFE Scrim	Midwesco	9055	8
Dual-Density PPS (Torcon)	Midwesco	9065	10
P84	Midwesco	1342	13
PPS w/ PTFE Membrane (BHA-TEX)	GE Energy	QR033	12
Toray Composite (PPS/Glass/PTFE)	Midwesco	?	3 or 4
Dual-Density PPS	GE Energy	PS050	5

The first four bag types listed above were made using leftover material that had been purchased by EPRI for previous COHPAC bag trials. Extensive testing had been done previously on these fabrics by GFTS. The three high-perm felts had been produced by Tex Tech Industries.

High-Perm PPS Felt: This 7-denier Torcon felt, having a permeability of 137 cfm vs. 30 cfm for the standard PPS bags, was included in the test program for its lower ΔP operating potential, with the understanding that its filtration efficiency might not be adequate.

PPS Felts with PTFE Scrims: These two fabrics were included because the PTFE scrim would provide increased durability and bag life in the event that the PIPP flue gas temperature and chemistry resulted in excessive degradation of the PPS fiber. The only reason was that these specific high-perm felts were used was that they were already available, at no cost. Minimum order quantity costs and long lead times precluded the procurement of standard-perm PPS felts with PTFE scrims. Cost adders are nominally 75% for the 2.2 oz/yd^2 PTFE scrim and 125% for the 3.8 oz/yd^2 PTFE scrim compared to standard 100% PPS felt.

Dual-Density PPS Felt: This fabric was included due to its potential for providing collection efficiency equal to or better than standard PPS felt, but at a lower operating ΔP. The permeability of this fabric was only moderately higher (43 cfm) than the range specified for the standard PPS felt in this unit (25-40 cfm). This fabric had been made by Southern Felt.

P84 Felt: This fabric, made with P84 polyimide fiber and a P84 scrim, was included because of its much higher temperature rating (500°F) compared to that of PPS (375°), although its resistance to acid and moist heat hydrolysis is not as good. P84 felt is often touted as having higher collection efficiency than PPS felt. Bags made of 14 oz/yd^2, scrim-supported P84 felt cost about twice as much as the standard 18 oz/yd^2 PPS felt bags. The test bags were procured for the project by ADA-ES, and a fabric sample was tested by GFTS.

PPS Felt with PTFE Membrane: The bags made of this material were supplied gratis by GE Energy. The PTFE (BHA-TEX) membrane provides the "ultimate" filtration efficiency and promotes a light dustcake formation. The new fabric permeability is only about 5 cfm, much lower than that of standard PPS felt. No independent bag QA inspection was conducted on these bags, so their exact new dimensions are unknown. A fabric sample (not necessarily from the lot used to make the bags) was submitted for analysis by GFTS.

Toray Composite Felt: These bags were made of a 60% PPS/30% glass/10% PTFE needled felt with a PPS scrim, which was supplied gratis by Toray. We requested a sample of this fabric from Midwesco, but they never submitted one. We had previously tested swatches of this fabric for Toray, and since only one lot of this fabric had been produced, the swatches we tested and the fabric used for the test bags would have been from the same lot. However, since the swatches (presumably sampled at intervals throughout the trial run) varied considerably in weight and permeability, we cannot be certain about the properties of the fabric that was used to make the test bags. The swatches tested had an average weight of 16.7 oz/yd^2, thickness of 0.082″, permeability of 35.1 cfm, and Mullen burst of 223 psi (net). Unlike all the other fabrics (except for the PTFE membrane) this fabric was not singed, as a singe finish is not suitable for a felt containing PTFE and glass fibers. We are uncertain why this fabric was included in the test program, unless it was just because it was a truly "novel", experimental product.

Dual-Density PPS Felt (PS050): This fabric was touted by GE as having "equal filtering to standard PPS with half the pressure drop", and they furnished five bags made of it to PIPP in July 2008. No written specifications were provided by GE for this fabric, but it was described in various correspondence as a "PPS felt with a finer denier cap" and as a "16 oz/yd^2 scrim-supported PPS needle felt with a 4.0 oz/yd^2 specially-designed PPS fiber cap on a 7.0 denier fiber base, heat stabilized, with a singed finish on one side." A one-yard, full-width sample of the fabric and one of the bags were submitted by GE to GFTS for testing, inspection, and measurement. Refer to GFTS Report on. 4542 for complete results of the fabric and bag analysis.

Compared to the "dual-density" PPS felt (Style 9065) from which PIPP test bags were made in 2005, the PS050 fabric is considerably heavier (18.0 vs. 15.5 oz/yd^2) and thicker (0.098″ vs. 0.085″), but it has nearly the same permeability, Mullen burst, and shrinkage values. Both fabrics have a coarse (nominal 7 denier) PPS fiber batt on their back side, and some combination of "microdenier" (< 1.0 denier) and conventional (nominal 2-3 denier) PPS fibers on their filtration face. Although there may be some differences in the deniers of the finer fibers and perhaps in the way they are incorporated into the felts (integral blend vs. stratified/layered?), these two felts are representative of the same basic conceptual design.

This bag was nominally 1 $^1/_4$″ shorter and $^1/_8$″ to $^3/_{16}$″ larger in flat width than the standard OEM bags that were installed at PIPP in 2005. Except possibly for its dimensions, this bag was constructed identically as the BHA-Tex test bags furnished to PIPP by GE in 2005. The construction of the GE test bags has varied from that of the other test bags and the OEM bags at PIPP in that they have a 3″ high central reinforcement (at the two-piece cage junction); a double-beaded gasket made of beaded glass tape (vs. rolled PPS felt); and a bottom reinforcement whose vertical ends are not sewn closed vertically, just overlapped (as also on the central reinforcement).

Like all the other PIPP test bags, the vertical seam of this bag was sewn with glass thread. The vertical seams on the PIPP OEM bags were thermally fused.

New Fabric Physical Properties: The detailed properties obtained on all the test fabrics except for the Toray composite felt and the PS050 felt are presented in Table 1.

Used Bags Submitted

A total of 68 used bags from the PIPP 7-9 baghouse have been submitted to GFTS, and 38 of these were tested, as shown in the table below.

GFTS Sample #	Date Removed	Length of Service (Mo)	No. of Bags	
			Submitted	Tested
4236	1/6/06	<1	1	1
4269, 4274, 4275, & 4279	March 2006	<3	35	13
4394	2/26/07	14	8	8
4528	5/21/08	29	6	6
4570	10/22/08	34	1	0
4584	12/3/08	35	8	1
4624	May 2009	41	2	2
4649	8/27/09	44	7	7

#4236: A standard PPS bag was submitted directly by We Energies (not under the ADA-ES contract) for "a standard bag test". It had been removed from compartment/bank 5B after only three weeks of service at partial load conditions (filtering flue gas from only one of the three boilers). The bag was submitted primarily to obtain baseline data prior to the initiation of activated carbon injection, but there was also mention of some unspecified moisture issues that had been observed during the inspection. Due to its appearance and its brief service at low flow conditions, it was only examined, measured and tested for Mullen burst strength. Results were presented in GFTS Report No. 4236.

March 2006: A total of 35 bags (many more than originally intended) were submitted following the PAC auto-ignition episode in the baghouse hoppers.. Some bags were submitted from all ten compartments, but it was subsequently decided to test only the bags from compartments 3, 4, 8, and 9, to examine one bag each from the other six compartments, and to discard the rest. These thirteen bags were examined, measured, and tested for Mullen burst strength, and six of them spot-checked for permeability (as-received and vacuumed). These bags included two of the test bags from compartment 8A, one P84 bag as requested and one BHA-TEX bag by mistake. It was determined that, except where actually melted at the bottom from the radiant heat, these bags had been unaffected by the "burning ember" episode. Test results were reported verbally, but no written report was prepared. Data obtained on these bags are included therein.

#4394: A full set of test bags (7) and one standard PPS control bag from compartment 8A were submitted for analysis after fourteen months of service. These bags were completely tested; photos were taken of vacuumed weight squares (internal surface of top, middle and bottom); and sections of some of them were submitted to EERC for SEM studies. Summary test results were reported verbally, but no written report was prepared. Data obtained on these bags are included herein.

#4528: A full set of the remaining test bags (4) and two standard PPS control bags from Compartment 8A were submitted for analysis after 29 months of service (except only 15 months on one control bag). These bags were completely tested, and photos were taken as described above (no SEM studies). Summary test results were reported verbally, but no written report was prepared. Data obtained on these bags are included herein.

#4570: One standard PPS bag from compartment 8A was submitted, but it was never tested.

#4584: A set of the remaining original test bags (4), three standard PPS control bags, and one PS050 test bag from compartment 8A were submitted. It was believed at that time that these would be the final used bags to be submitted under the DOE contract. Testing of these bags was delayed by GFTS, and it was subsequently cancelled when removal of the actual final set of test bags was scheduled in August 2009. However, one of these bags was the last of the Toray composite felt test bags (#4584-M15) so it was tested along with the final set of used bags.

#4624: Two standard PPS felt begs from compartment #1 were submitted after 41 months of service for "typical bag analysis" to determine "how the bags are holding up and if they need to be considering replacement soon." It was reported verbally to We Energies on June 20, 2009, and in GFTS Report No. 4624 dated August 10, 2009, that based on our test results, "These bags should easily last another year, or possibly two, and their replacement at this time would seem unnecessary." Data obtained on these bags are included herein.

#4649: The final set of test bags to be analyzed under the DOE contract was removed from compartment 8A after 44 months of service (except 13 months on the PS050 test bag and 15 months on one standard PPS felt bag). One of these bags (P30) is an original PPS bag pulled from bundle B in compartment 8 since there was some discoloration (black) of the bags in that region of the compartment. The results of our testing on these bags are presented herein.

Please refer to ADA-ES' final version of the Test Bag Layout sheet for Compartment 8A for detailed information and locations of all bags removed from that compartment since startup. (We do not yet have that document.)

Summary and Conclusions

All of the 100% PPS felts, in the standard OEM bags and in three types of test bags, lost from 47-58% of their strength during their initial fourteen months of service (average loss of 3.7%/month). The rate of strength loss declined to an average of 1.2%/month during the 14-29 month service interval and 0.6%/month during the 29-44 month service interval, but the cumulative strength loss of the PPS felts was 75-85% after 44 months, as shown in Table 2.

Despite this substantial loss of fabric strength, these bags are in excellent condition, both physically and in terms of their filtration capabilities. Except for the fabric strength, all types of these bags are

remarkably similar to the used PIPP bags of the same type that were tested after 14 and 29 months of service, both in their physical appearance and in their permeability and residual dust loading values, as shown in Tables 3 and 4. The OEM bags should easily last another year, or possibly two. The two remaining types of the original 100% PPS felt test bags (Dual Density/9065 and BHA-TEX), which had much lower original strength than the standard PPS felt and also have degraded somewhat more, may be in more imminent danger of failing, as their Mullen burst strengths have dropped to 58 and 90 psi (net) respectively.

The absence of significant wear or excessive dust penetration on these bags can, in our opinion, be attributed primarily to the very low pulsing frequency that has been required and to the use of support cages made with "starred" rings (rather than the much more common circular rings). These factors combine to mitigate wear of the fabric, even though its strength has been greatly reduced.

All the used PIPP bags, except for the membrane test bags, have exhibited significantly greater internal dust darkening (penetration) in their top sections, while remaining quite clean inside for most of their length. This phenomenon was quite apparent on the 14-month old bags, especially on the high-perm bags, as shown in the photos of the internal surfaces of top, middle, and bottom specimens, which are linked on the web page at http://gfts.com/photos/report_4394.htm. The 29-month old bags were perhaps slightly darker inside their tops than the 14-month old bags, as shown in the photos that are linked on the web page at http://gfts.com/photos/report_4528.htm. A side-by-side comparison of the 29-month and 44-month bag sections show no real difference in internal dust darkening for each bag type. Dust penetration inside the top of "long" (>20 foot) pulse-jet bags is a relatively common occurrence due to overcleaning of the bag tops caused by the larger and more powerful pulse values required for these longer bags.

In addition to the visible evidence of dust darkening, the permeability values are much lower and imbedded dust loading (removed by washing vacuumed samples) values are much greater in the top sections. For all used bags ≥ 14 months old (excluding the high-perm and membrane bags), the average as-received permeability was 33% lower (4.7 vs. 7.0 cfm), and the vacuumed permeability was 43% lower (16.6 vs. 29.1 cfm) in the top than in the middle and bottom. The imbedded dust loading averaged about 1.0 oz/yd^2 (2-3 times) greater, and the total dust loading averaged about 1.1 oz/yd^2 (50%) greater in the top than in the middle and bottom sections.

Complete data sheets showing all raw data obtained on all sections of all bags tested are presented in Appendices #1 - #5 which were submitted electronically (as PDF files) on September 28, 2009.

P84 Bags: The P84 felt did not lose nearly as much strength as the various PPS felts, only 43% vs. 75-85%, after 44 months of service. Its permeability values were about equal to that of the standard PPS felt, although its imbedded and total dust loading values were somewhat lower (refer to Tables 3 and 4). The one negative feature of the P84 bags was the inability to extract the support cages from them. These bags were made slightly (0.08″ on average) smaller in flat width than the standard PPS bags, and they also shrank slightly more in flat width than the PPS bags (refer to Table 5). Although the greater strength retention of the P84 bags might ultimately result in a longer life than the PPS bags, it is unlikely that it would be an increase sufficient to justify paying twice the price.

Dual Density PPS (9065) Bags: These bags do not appear to be performing much differently from the standard PPS bags in terms of filtration properties (permeability and dust loading), although the vacuumed and washed perms are about 10 cfm greater (as a result of its higher new fabric perm). In the most recent set of used bags, this fabric actually appeared somewhat more dust darkened internally than the standard PPS bag. At each service interval, this fabric was always darker in color and had lost a greater percentage of its strength than the standard PPS felt (reasons unknown). Since it had 30% lower strength than the standard PPS when new, its strength is at a dangerously low value of 58 psi, but the bags may last another year due to the low pulse frequency and the starred cage ring design, as previously discussed. Although these bags were made 0.10″ smaller in flat width than the standard PPS bags, they have experienced essentially zero shrinkage in flat width, so their cages can be extracted without difficulty.

PPS / PTFE Membrane (BHA-TEX) Bags: These bags differ greatly from any of the other test bags in that they have almost no dust darkening on their internal surface, and they have much lower permeability and residual dust loading values (refer to Tables 3 and 4). It is likely that these bags would need to be pulsed more frequently than the other bag types to maintain the same ΔP. (Perhaps the results of ADA-ES' in situ drag testing will provide additional insight into this issue.) The strength loss of the PPS felt base fabric has been about the same percentage-wise as for the standard PPS felt, although the fabric with the membrane has always been darker in color. As with the P84 bags, the cages have never been able to be extracted from the membrane bags in place. These used bags are also only 8″ in flat width, and we suspect that they were made to be smaller initially but cannot be certain (no new bags were inspected). The membrane, which is very fragile, has remained in remarkably good condition to date, likely as a result of the relatively tight bag fit, low pulse frequency, and starred cage rings.

Toray Composite Felt Bags: These bags accumulated a much heavier external dust cake due to the "fuzzy" surface produced by the glass fibers and to the absence of a singed finish (refer to Table 4). However, the as-received permeability values are comparable to the other (non-membrane) fabrics, while the vacuumed perms are somewhat lower (refer to Table 3.) This fabric was much weaker initially, but it lost only 52% of its strength due to its 40% non-PPS (glass and PTFE) batt fabric content (refer to Table 2). These used bags were nominally 1-2″ longer than any of the other bags, but their new length was undetermined.

High-Perm PPS Felt Bags: These bags (all three types) bled severely at their tops and had to be removed after fourteen months of service. Refer to the previously cited photos for evidence of this bleeding. For all three types combined, the average permeability was 10.6 cfm as-received (75% greater than the standard PPS), 75.4 cfm vacuumed (3 times greater than standard PPS), and 140 cfm washed (4.3 times greater than standard PPS). The residual dust loading values; external, imbedded, and total; all were about three times that of the standard PPS felt after fourteen months.

PPS Felt with PTFE Scrim Bags: These bags demonstrated the well-known fact that PTFE scrim-supported PPS felt retains much more strength than 100% PPS felt when operating in flue gas conditions that are degrading to PPS. (Refer to the bottom of Table 2.) Unfortunately, since these were also high-perm felts, the bags had to be removed due to bleeding, and their testing terminated. As previously stated for the P84 bags, it is unlikely that any increase in bag life would be sufficient

to justify paying a 75-125% premium over the standard 100% PPS bags, considering the successful operation of the standard bags in this unit to date.

PS050 Dual Density PPS Bags: Since the washed weight of this fabric was significantly lower (16.5 vs 18.0 oz/yd^2) and the washed permeability significantly higher (53.5 vs 40.7 cfm) than the new sample of this fabric that was submitted, we have reason to believe that the new sample may not have been representative. (This fabric was initially stated to be a 16 oz/yd^2 fabric.) Regardless, this bag after 13 months of service appeared to have distinctly greater dust darkening internally than the standard PPS control bag installed two months longer. Its as-received and vacuumed permeabilities were 85% and 62% (respectively) greater than the control bag. The lower degree of strength loss (−29%) shown for the PS050 fabric in Table 2 (compared to −43% for the standard PPS control bag) was based on the strength of the original (and non-representative?) sample submitted. Additional exposure time may be required to obtain a decent evaluation of this material, but it doesn't look like a promising candidate at this time.

Used Fabric pH Data

As-received (dirty) fabric pH tests (5.0 g per 100 ml distilled water) have been performed on a total of seven used bags; five standard PPS after 29, 41, and 44 months of service, and two P84 bags after 29 and 44 months of service. The PPS bags had pH values ranging from 4.45 - 4.86, and the P84 bags had pH values of 4.56 and 4.66.

Table 1: We Energies Presque Isle Units 7-9 – TOXECON Retrofit
Test Bags and OEM bags – Fabric Physical Properties

General Fabric Type *	Standard PPS (OEM Bags)	High-Perm PPS w/PPS Scrim	High-Perm PPS w/ 2.2 oz PTFE Scrim	High-Perm PPS w/ 3.8 oz PTFE Scrim	Dual-Density PPS	P84	BHA-Tex PPS/PTFE Membrane
Midwesco Style No.	1378	9056	9054	9055	9065	1342	***
Batt Fiber: Type - Denier / Brand-	 PPS 2.7 / unspecified	 PPS 7.0 / Torcon	 PPS 7.0 / Torcon	 PPS 7.0 / Torcon	 PPS ** / Torcon	 Polyimide P84	 PPS Unspecified
Weight (oz/yd^2)	18.0	16.1	16.8	18.3	15.5	13.1	14.6
Thickness (inches)	0.084	0.116	0.116	0.117	0.085	0.090	0.075
Apparent Density (oz/yd^2)	0.166	0.107	0.111	0.121	0.141	0.113	0.150
Permeability (cfm/ft^2 @ 0.5″ WG)	31.6	137	132	114	42.8	35.3	5.19
Mullen Burst (psi): Gross - Net -	 607 557	 373 328	 370 325	 383 338	 429 394	 391 351	 502 462
% Shrinkage - Length (2 hr @ 400°F)	0.82	0.38	1.38	0.50	1.25	0.78 (@500°F)	1.25
% Shrinkage - Width (2 hr @ 400°F)	0.32	0.0	0.0	0.63	+0.05	0.62(@500°F)	0.0
Finish: Filtration Surface Non-Filtration Surface	 Singed Plain	 Singed Singed	 Singed Plain	 Singed Plain	 Singed Plain	 Singed Plain	 PTFE Membrane Plain
Scrim Construction****							
Fiber Type	PPS	PPS (Torcon)	PTFE (Profilen)		PPS (Torcon)	P84	PPS
Weight oz/yd^2	3.0	3.0	2.2	3.8	3.0	3.0	3.0
Count (per inch, W x F)	19 x 14	21 x 13	21 x 20	37 x 34	20 x 14	22 x 15	20 x 14

* All are scrim-supported needled felts.
** 50/50 blend of 0.9 denier and 2.0 denier on the filtration surface; 100% 7.0 denier on the non-filtration surface
*** GE Energy (BHA) Style QR033
**** All are plain weave fabrics. All PPS and P84 yarns are spun type, and PTFE yarns are twisted slit-film type. Weights and counts are nominal or specified values.

Table 2: PIPP 7-9 Fabric Strength – New vs. Used Bags
(Installed prior to December 2005 startup, except as noted)

Felt Type	Removal Date	Length of Service (months)	Mullen Burst (psi, net)	% Loss vs. New
Standard PPS (OEM)	New Fabric	0	557	N.A.
	1/6/06	<1	463	–16%
	March 2006	<3	374	–33%
	2/26/07	14	268	–52%
	5/21/08	15 [a]	248	–55%
	8/27/09	15 [b]	315	–43%
	5/21/08	29	185	–67%
	May 2009	41	151	–73%
	8/27/09	**44**	**142**	**–75%**
Dual Density PPS (9065)	New Fabric	0	394	N.A.
	2/26/07	14	166	–58%
	5/21/08	29	102	–74%
	8/27/09	**44**	**58**	**–85%**
PPS w/PTFE Membrane	New Fabric	0	462	N.A.
	March 2006	<3	321	–31%
	2/26/07	14	224	–52%
	5/21/08	29	123	–73%
	8/27/09	**44**	**90**	**–81%**
P84	New Fabric	0	351	N.A.
	March 2006	<3	348	–1%
	2/26/07	14	308	–12%
	5/21/08	29	238	–32%
	8/27/09	**44**	**199**	**–43%**
Toray Composite	New Fabric	0	223	N.A.
	2/26/07	14	149	–33%
	5/21/08	29	109	–51%
	12/3/08	**35**	**106**	**–52%**
Dual Density PPS (PS050)	New Fabric	0	405	N.A.
	8/27/09	13 [c]	288	–29%
High-Perm PPS w/PPS Scrim	New Fabric	0	328	N.A.
	2/26/07	14	173	–47%
High-Perm PPS w/2.2 oz/yd^2 PTFE Scrim	New Fabric	0	325	N.A.
	2/26/07	14	256	–21%
High-Perm PPS w/3.8 oz/yd^2 PTFE Scrim	New Fabric	0	338	N.A.
	2/26/07	14	298	–12%

a. Installed 2/26/07 to replace bag removed for testing
b. Installed 5/21/08 to replace bag removed for testing
c. PS050 test bags installed July 2008.

Table 3: PIPP 7-9 Fabric Permeability - New vs. Used Bags
(Installed prior to December 2005 startup, except as noted)

Felt Type	Removal Date	Length of Service (months)	Permeability (cfm/ft^2 @ 0.5″ WG)		
			As-Received	Vacuumed	Washed (or New)
Standard PPS (OEM)	New Fabric	0	–	–	31.6
	March 2006	<3	13.9	31.4	–
	2/26/07	14	6.02	25.9	32.6
	5/21/08	15 [a]	4.92	22.8	31.7
	8/27/09	15 [b]	5.47	27.0	38.0
	5/21/08	29	5.55	22.0	34.0
	May 2009	41	7.34	23.8	38.0
	8/27/09	44	5.99	22.2	32.9
Dual Density PPS (9065)	New Fabric	0	–	–	42.8
	2/26/07	14	9.17	39.6	45.3
	5/21/08	29	6.14	33.4	43.9
	8/27/09	44	7.04	34.0	50.7
PPS w/PTFE Membrane	New Fabric	0	–	–	5.19
	March 2006	<3	2.70	11.4	–
	2/26/07	14	2.76	13.6	–
	5/21/08	29	2.82	11.4	12.9
	8/27/09	44	2.57	10.1	23.0
P84	New Fabric	0	–	–	35.3
	March 2006	<3	11.6	28.5	–
	2/26/07	14	9.01	26.0	32.1
	5/21/08	29	6.29	23.7	31.7
	8/27/09	44	6.10	25.0	31.0
Toray Composite	New Fabric	0	–	–	35.1
	2/26/07	14	5.73	17.0	26.9
	5/21/08	29	5.44	17.6	26.9
	12/3/08	35	5.76	19.7	30.0
Dual Density PPS (PS050)	New Fabric	0	–	–	40.7
	8/27/09	13 [c]	10.1	43.8	53.5

a. Installed 2/26/07 to replace bag removed for testing
b. Installed 5/21/08 to replace bag removed for testing
c. PS050 test bags installed July 2008.

Table 4: PIPP 7-9 Used Bags – Residual Dust Loading
(Installed prior to December 2005 startup, except as noted)

Felt Type	Removal Date	Length of Service (months)	Based on Fabric Weights (oz/yd^2); Avg. Top/Mid/Bot			Total based on bag weight (lb)
			Removed by Vacuuming	Removed by Washing	Total	
Standard PPS (OEM)	March 2006	<3	–	–	–	0.6
	2/26/07	14	2.5	0.6	3.1	0.7
	5/21/08	15 [a]	2.0	0.7	2.7	0.6
	8/27/09	15 [b]	1.5	0.9	2.4	0.8
	5/21/08	29	2.3	0.9	3.1	0.9
	May 2009	41	1.9	1.0	2.9	0.6
	8/27/09	44	2.5	1.2	3.7	1.0
Dual Density PPS (9065)	2/26/07	14	2.2	0.6	2.8	1.0
	5/21/08	29	2.2	0.8	3.0	0.9
	8/27/09	44	2.3	1.1	3.4	0.7
PPS w/PTFE Membrane	March 2006	<3	–	–	–	0.9 [d]
	2/26/07	14	0.6	0.2	0.8	0.8
	5/21/08	29	1.3	0.2	1.5	0.6
	8/27/09	44	0.7	0.2	0.9	0.9
P84	March 2006	<3	–	–	–	0.9
	2/26/07	14	1.7	0.3	2.0	1.0
	5/21/08	29	1.9	0.6	2.5	0.8
	8/27/09	44	2.2	0.5	2.8	0.9
Toray Composite	2/26/07	14	2.4	1.3	3.7	2.0 [d]
	5/21/08	29	4.3	1.1	5.4	2.5
	12/3/08	35	4.7	1.3	6.0	2.7
Dual Density PPS (PS050)	8/27/09	13 [c]	1.9	0.8	2.6	0.8

a. Installed 2/26/07 to replace bag removed for testing
b. Installed 5/21/08 to replace bag removed for testing
c. PS050 test bags installed July 2008.
d. Based on estimated new weights of 4.0 lb for the PTFE membrane bags and 4.6 lb for the Toray bags

.

Table 5: PIPP 7-9 Bag Dimensions and Weights – New vs. Used
(Installed prior to December 2005 startup, except as noted)

Felt Type	Removal Date	Length of Service (months)	Length [d] (inches)	Flat Width (inches)	Circumference; cut open (inches)	Weight (lb)
Standard PPS (OEM)	New Bag QA	0	314.8	8.21	N.A.	5.10
	March 2006	<3	313 3/4	8 1/8 - 8 1/4	16 1/4 - 16 7/16	5.73
	2/26/07	14	314	8 5/32 - 8 7/32	16 3/8	5.85
	5/21/08	15 [a]	313 1/4	8 1/16 - 8 1/8	16 1/4 - 16 5/16	5.69
	8/27/09	15 [b]	313 1/4	8 3/16 - 8 1/4	16 3/8 - 16 7/16	5.95
	5/21/08	29	314	8 1/16 - 8 1/8	16 5/16 - 16 3/8	6.06
	May 2009	41	313 1/8	8 1/8 - 8 1/4	16 5/16 - 16 1/2	5.7
	8/27/09	44	313 3/4	8 1/8 - 8 1/4	16 1/4 - 16 1/2	6.10
Dual Density PPS (9065)	New Bag QA	0	315.0	8.11	N.A.	4.33
	2/26/07	14	313 7/8	8 1/8 - 8 3/16	16 3/8	5.35
	5/21/08	29	313 1/2	8 1/16	16 1/4	5.31
	8/27/09	44	313 3/8	8 1/8 - 8 3/16	16 3/16 - 16 5/16	5.07
PPS w/PTFE Membrane	New Bag	0	N.A.	N.A.	N.A.	4.0 (est)
	March 2006	<3	313 (cut)	8 1/32	16 1/8 - 16 1/4	4.87
	2/26/07	14	313 3/8	8 - 8 1/16	16 1/8	4.85
	5/21/08	29	313 (cut)	8	16 3/16 - 16 1/4	4.69
	8/27/09	44	313 1/4	8	16 1/8	4.86
P84	New Bag QA	0	315.2	8.13	N.A.	3.83
	March 2006	<3	313 3/4	8 1/16 - 8 3/32	16 3/16	4.74
	2/26/07	14	313 1/2	8	16 1/16	4.85
	5/21/08	29	(cut)	8	16 1/16	4.65
	8/27/09	44	313 1/4	7 15/16 - 8	15 15/16 - 16 1/16	4.77
Toray Composite	New Bag	0	N.A.	N.A.	N.A.	4.6 (est)
	2/26/07	14	314 7/8	8 3/32 - 8 1/8	16 3/8	6.65
	5/21/08	29	314 3/4	8 5/32 - 8 3/16	16 5/16 - 16 3/8	7.25
	12/3/08	35	315 1/8	8 1/8	16 5/16	7.21
Dual Density PPS (PS050)	New Bag (1)	0	313 3/8	8 3/8 - 8 13/32	N.A.	4.63
	8/27/09	13 [c]	313 3/4	8 1/4 - 8 5/16	16 7/16 - 16 9/16	5.38

a. Installed 2/26/07 to replace bag removed for testing
b. Installed 5/21/08 to replace bag removed for testing
c. PS050 test bags installed July 2008.
d. At seam from top of bag to disc stitching
N.A. = Not available

Grubb Filtration Testing Services, Inc.

8006 Route 130 North
Post Office Box 1156
Delran, NJ 08075

TEL (856) 461-1800
FAX (856) 461-1613
www.GFTS.com

Laboratory Report No. 4236
Date: March 16, 2006

Prepared For: WE ENERGIES
Presque Isle Power Plant
2701 Lakeshore Boulevard North
Marquette, Michigan 49855

Reference: Purchase Order No. 4500733229

Subject: PIPP UNIT 7-9 TOXECON BAGHOUSE
Analysis of Used Bag Removed January 11, 2006

Request and Sample Description

One used PPS felt filter bag was submitted for "a standard bag test". This bag had been removed from compartment/bank 5B of the TOXECON baghouse on January 6, 2006, after only three weeks of service at partial load conditions (filtering flue gas from only one of the three boilers). Refer to the attached Bag Layout sheet for details. The bag was submitted primarily (we believe) to obtain baseline data prior to the initiation of activated carbon injection, but there was also mention of some unspecified moisture issues that had been observed during the inspection. Had this bag been exposed to, or affected by moisture?

Summary and Conclusions

Except for a very thin film of dust on its external surface and a slight discoloration of the PPS felt, this bag appeared to be like new. There was no evidence that it had been exposed to any liquid (or condensed) moisture. Due to its appearance and its brief service at low flow conditions, it was decided that any fabric weight and permeability testing would be meaningless.

The PPS felt had turned a light golden-tan color (from its original beige/off-white), and its Mullen burst strength was 16% lower than that of the new fabric (463 vs. 554 psi, net). This slight discoloration and strength loss is normal for PPS felt after its initial exposure to flue gas in a boiler baghouse.

The dimensions of the bag were within the range measured on the new bags during QA inspection, so no significant shrinkage had occurred in service.

Bag Measurements (Used vs. New)

	Used Bag	New Bags (QC Data)
Length (inches)*	315 $^{3}/_{8}$	315 $^{1}/_{4} \pm ^{3}/_{8}$
Flat Width (inches)	8 $^{3}/_{16}$ - 8 $^{1}/_{4}$	8 $^{1}/_{8}$ - 8 $^{1}/_{4}$
Circumference (inches)	16 $^{3}/_{8}$ - 16 $^{9}/_{16}$	Not Measured
Bag Weight (lb)	5.37	5.1

* Measured at the seam, from top of bag to the upper row of disc stitching.

Bag Construction

The bag was made of 18 oz/yd^2, scrim-supported PPS felt, singed on its external face, and it was constructed according to Wheelabrator's specifications. It had a separate woven glass top cuff with a double-beaded snap band, a disc bottom with a 3" high reinforcement (both self-material), and a lapped and fused vertical seam. The circumferential stitching at its top and bottom was sewn with PTFE-coated glass thread.

Observations

As received, the bag had been cut at its midpoint for about 75% of its circumference, presumably to permit disassembly of the two-piece cage during bag removal. Otherwise, the bag looked essentially like new in terms of its physical condition. The external surface of the bag had a very thin, discontinuous layer of beige dust with some underlying dark gray patches. Much of the underlying bag fabric, as well as the Midwesco stamp, was clearly visible through the thin, patchy dust layer, which was easily removed by vacuuming leaving no visible residue.

The internal surface of the bag was pristine, except where contaminated by dust that had entered its open top and cut middle during its removal and shipment. The vertical cage wire impressions (16) were very faint, and no impressions of the "star-shaped" cage rings were visible. The vertical wire impressions were discontinuous at the cage junction, which is distinctly smaller in diameter than the cage body, but there was no evidence that the bag had crumpled or necked in at the cage constriction. There was a faint impression of the cage pan on the inside of the bottom disc, indicating that they had been about level with each other during operation.

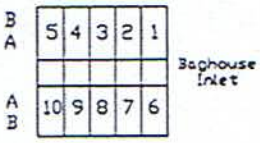
The fabric was a light, golden-tan color both inside and out (after vacuuming), distinctly darker than the new PPS felt which is a beige/off-white color.

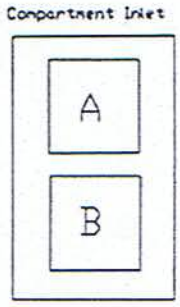
Presque Isle Power Plant Units 7-9 Baghouse Bag Layout

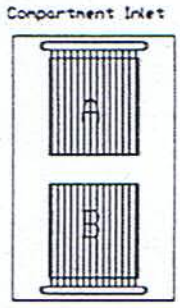
Date 1-11-06

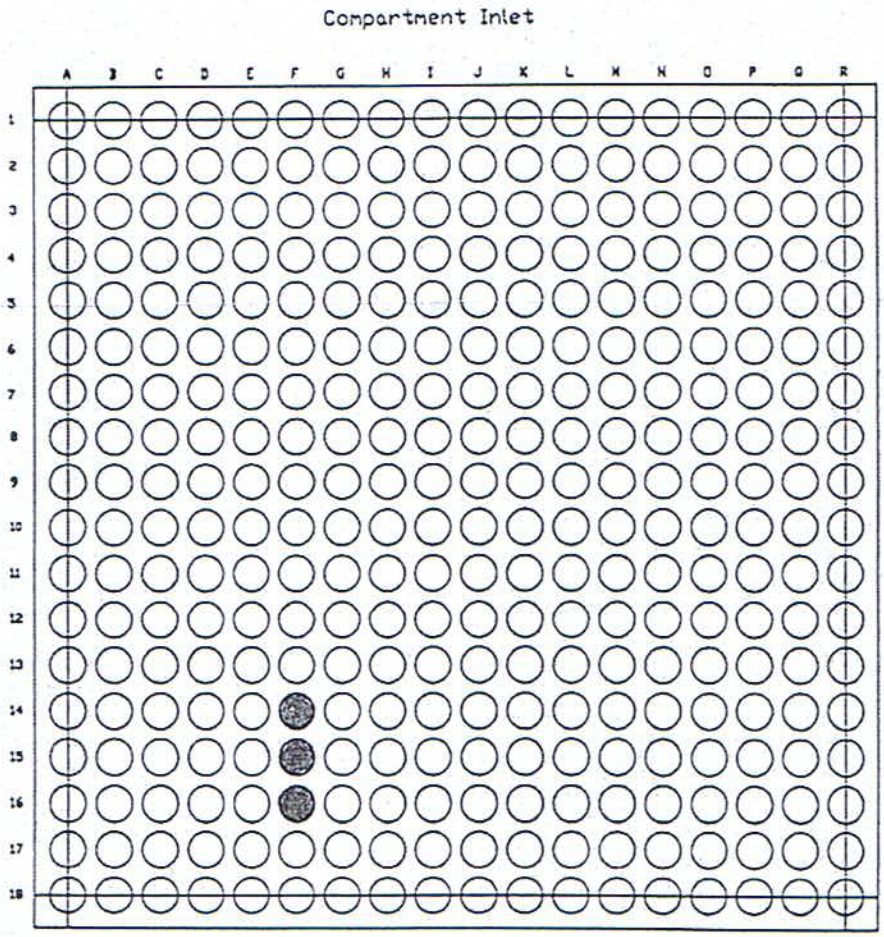
Compartment/Bank 5B

Baghouse Key:







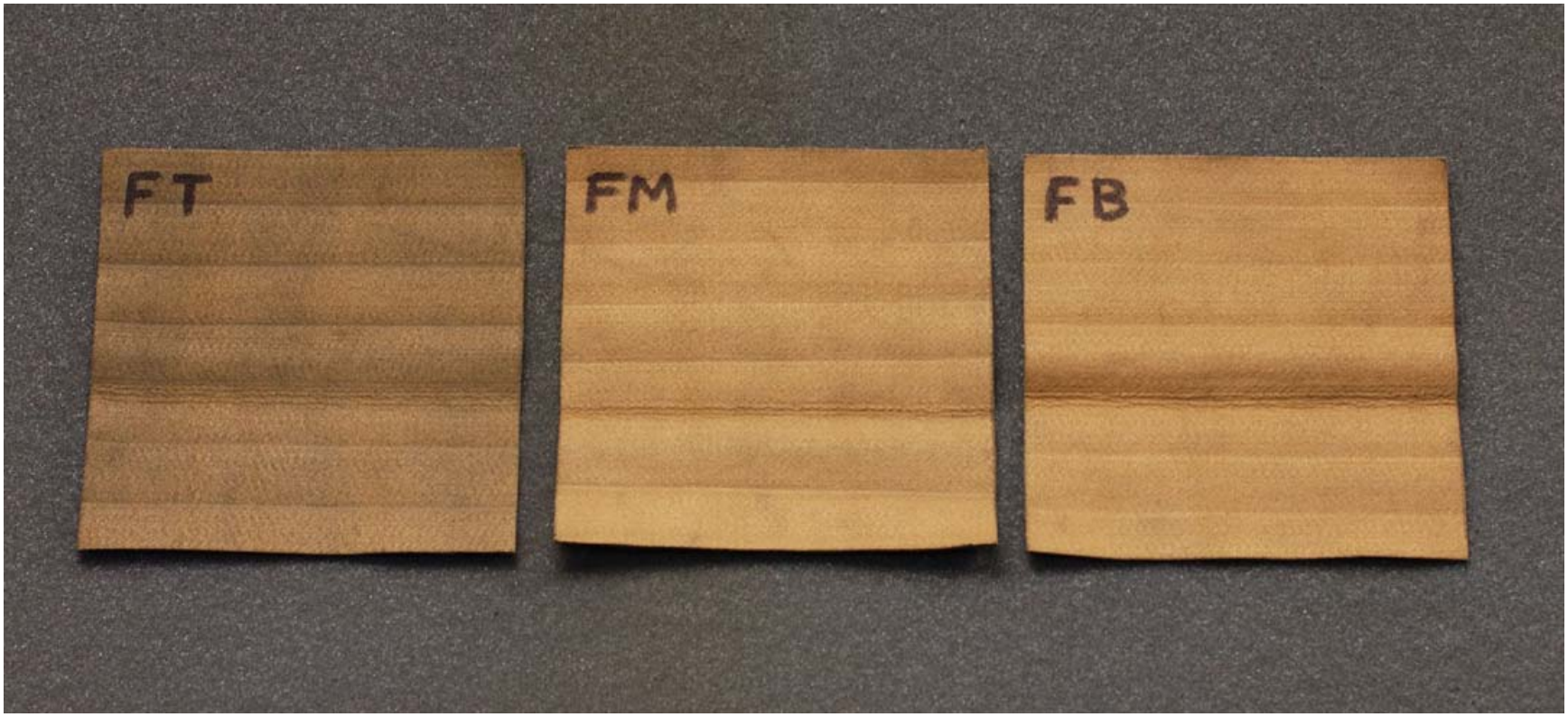


Bag F15 was not installed in compartment. Noticed during compartment inspection on 1-6-06. The bags highlighted in red were replaced. Two bags will be sent out for inspection.

#3 + #4 send to different compartment
221-4443

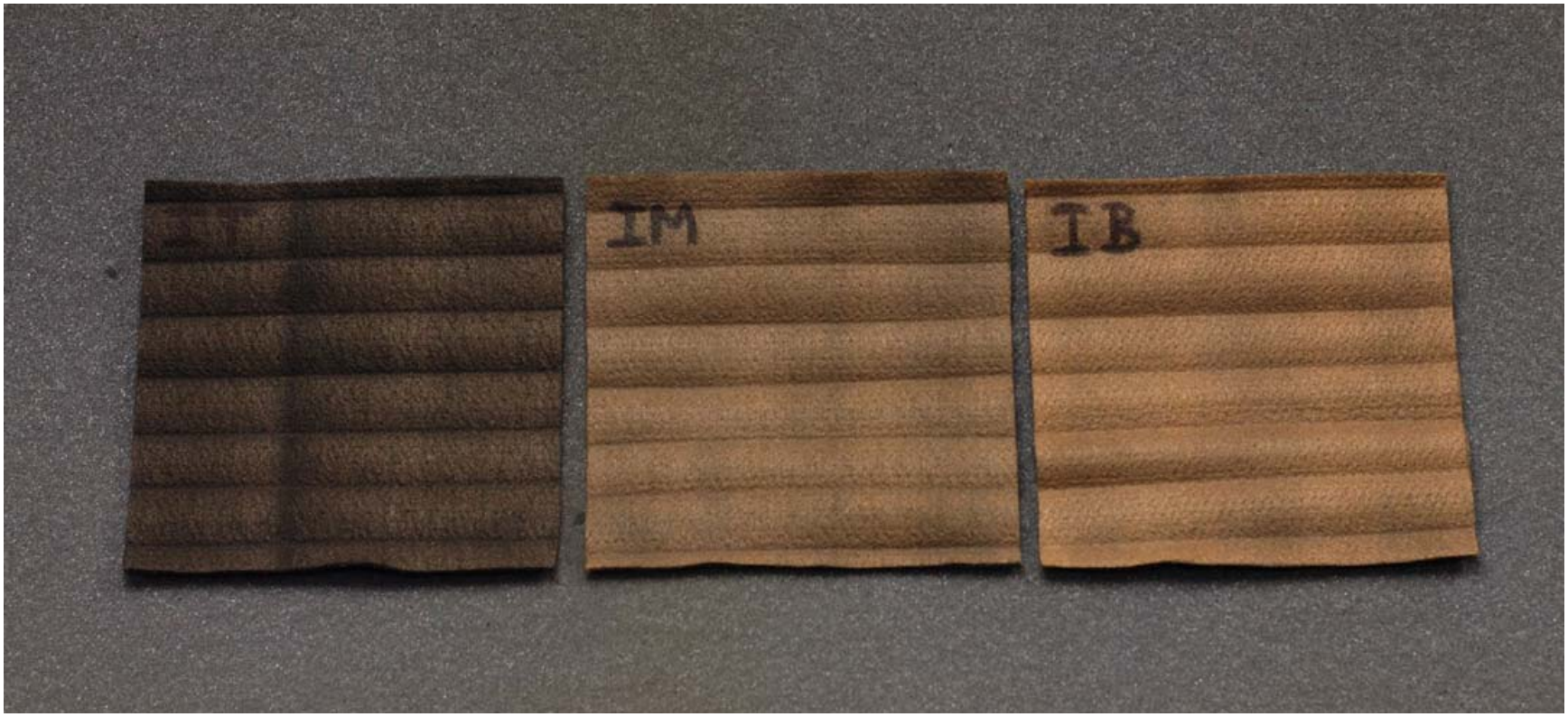
1.0 GFTS REPORT #4394 - PHOTOS

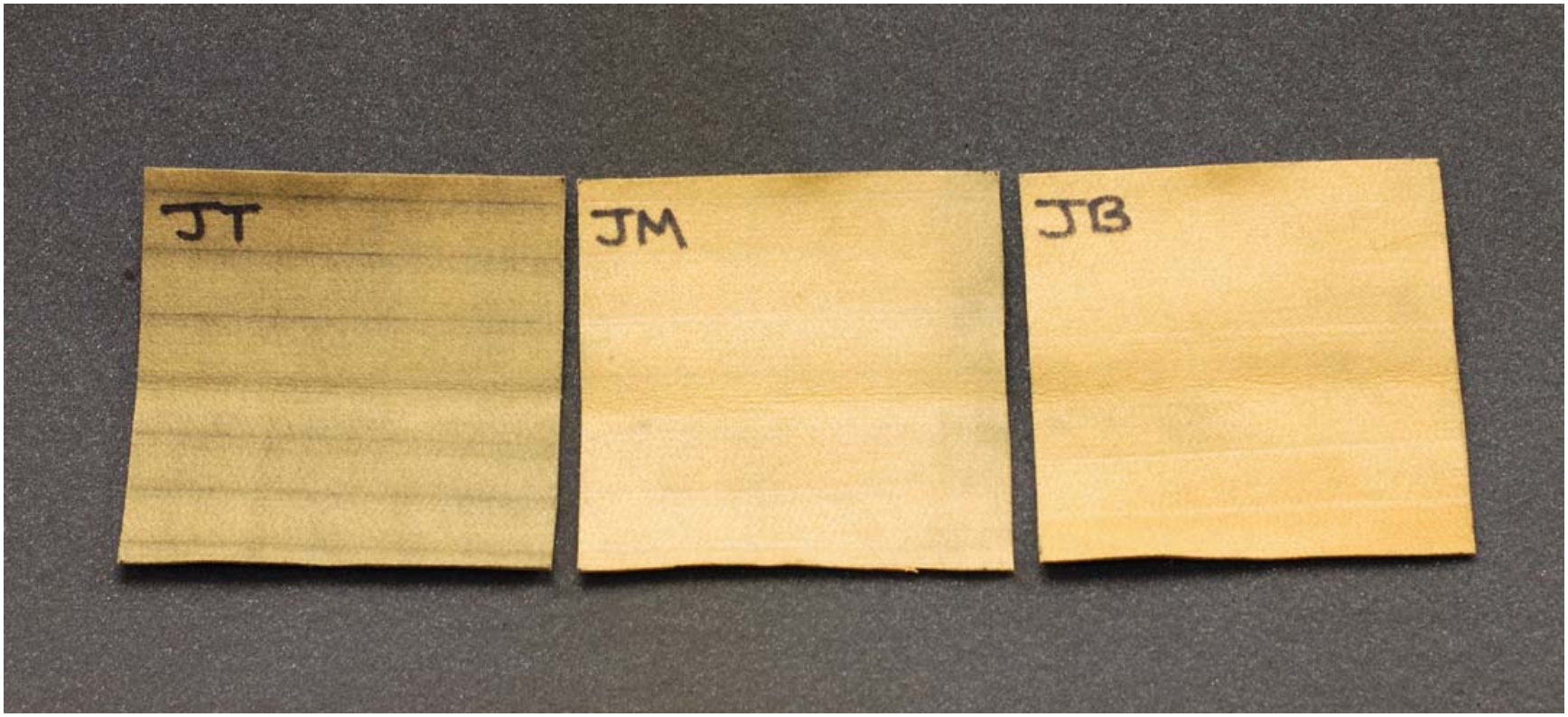
These are photos of the internal surface of vacuumed weight square specimens from the top, middle and bottom of each bag sample. All photos on this page were taken with a Nikon D100 digital SLR camera and a 50 mm f/1.4 Nikkor lens; all were manually exposed for the same 1/15 second at f/5.6, ISO 400 (automatic white balance under ambient fluorescent lighting).


FT
FM
FB

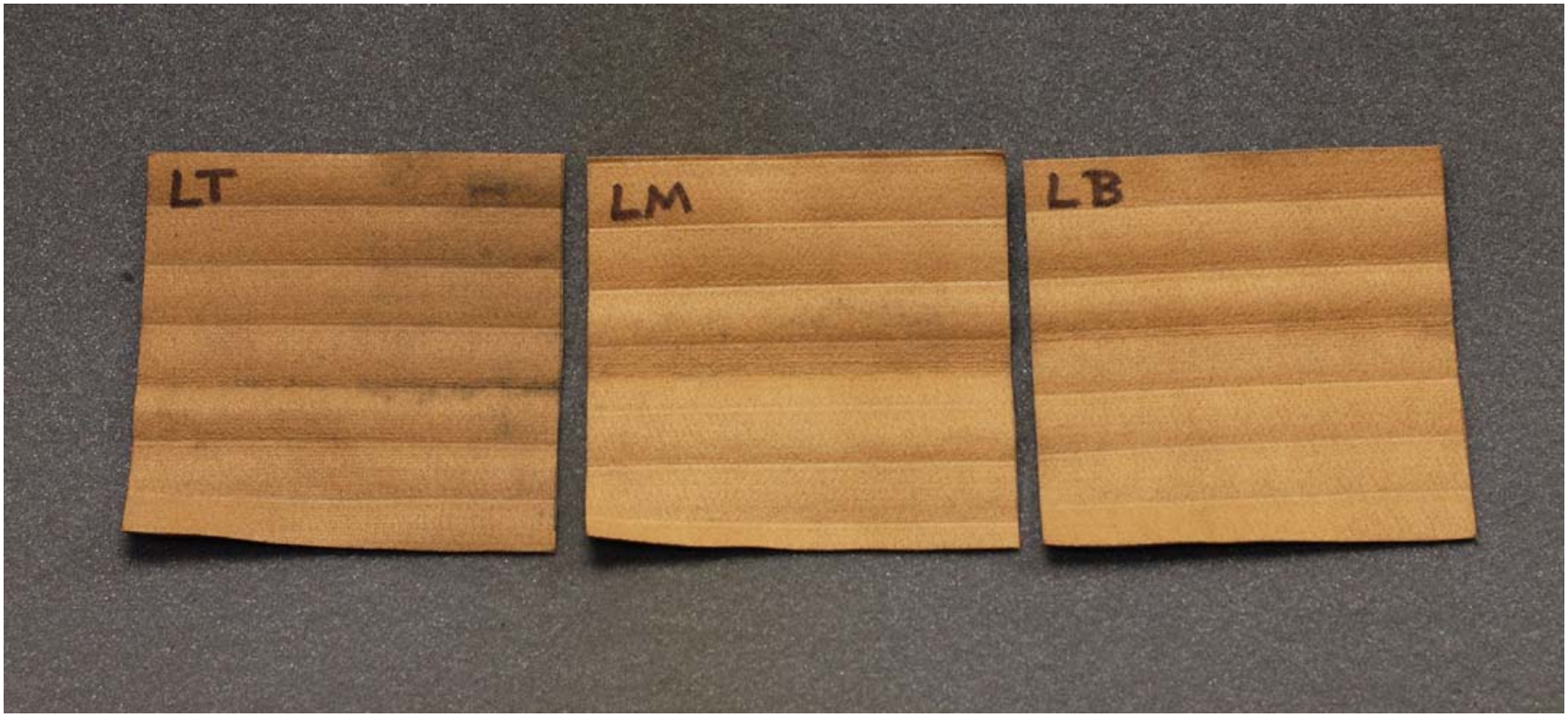
GM
GB

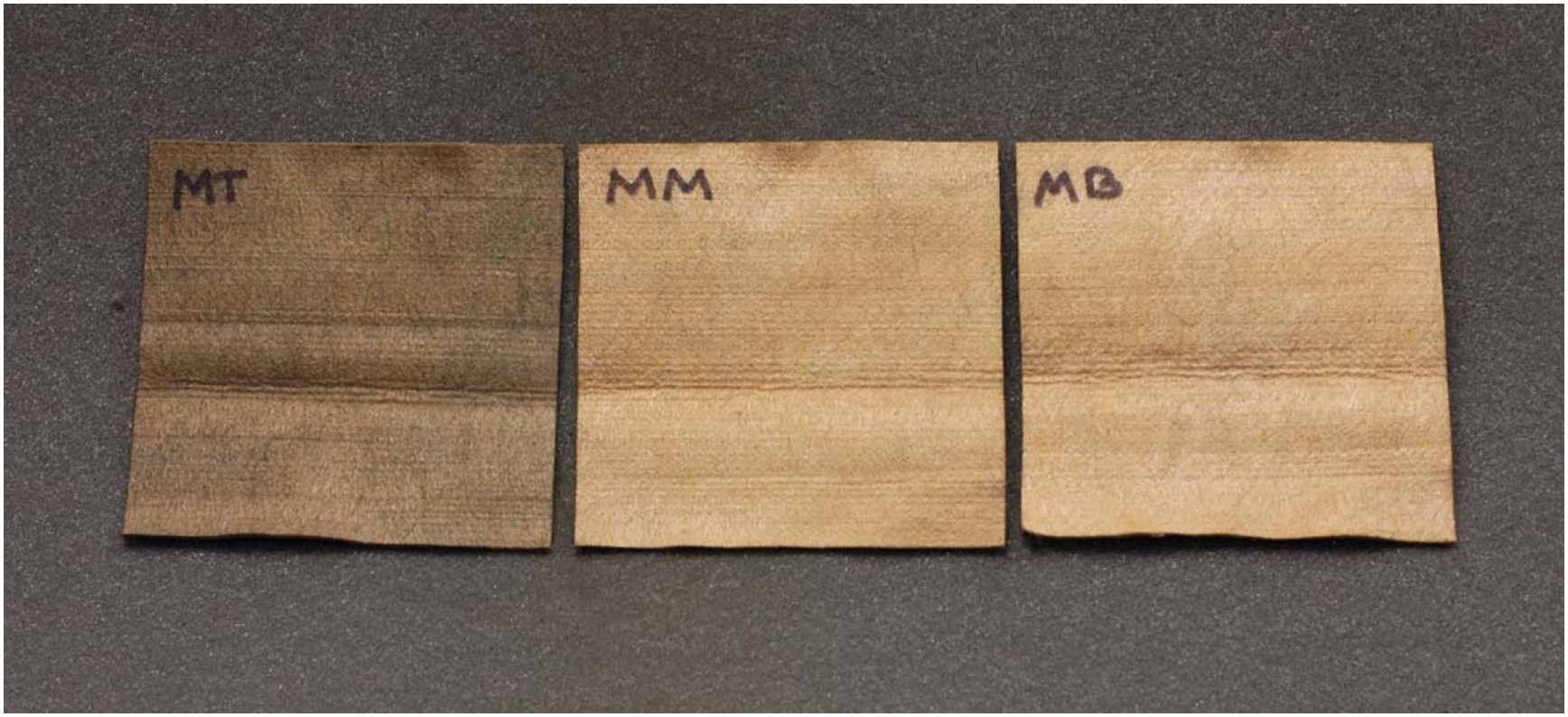
HT
HM
HB


IM
IB


JT
JM
JB

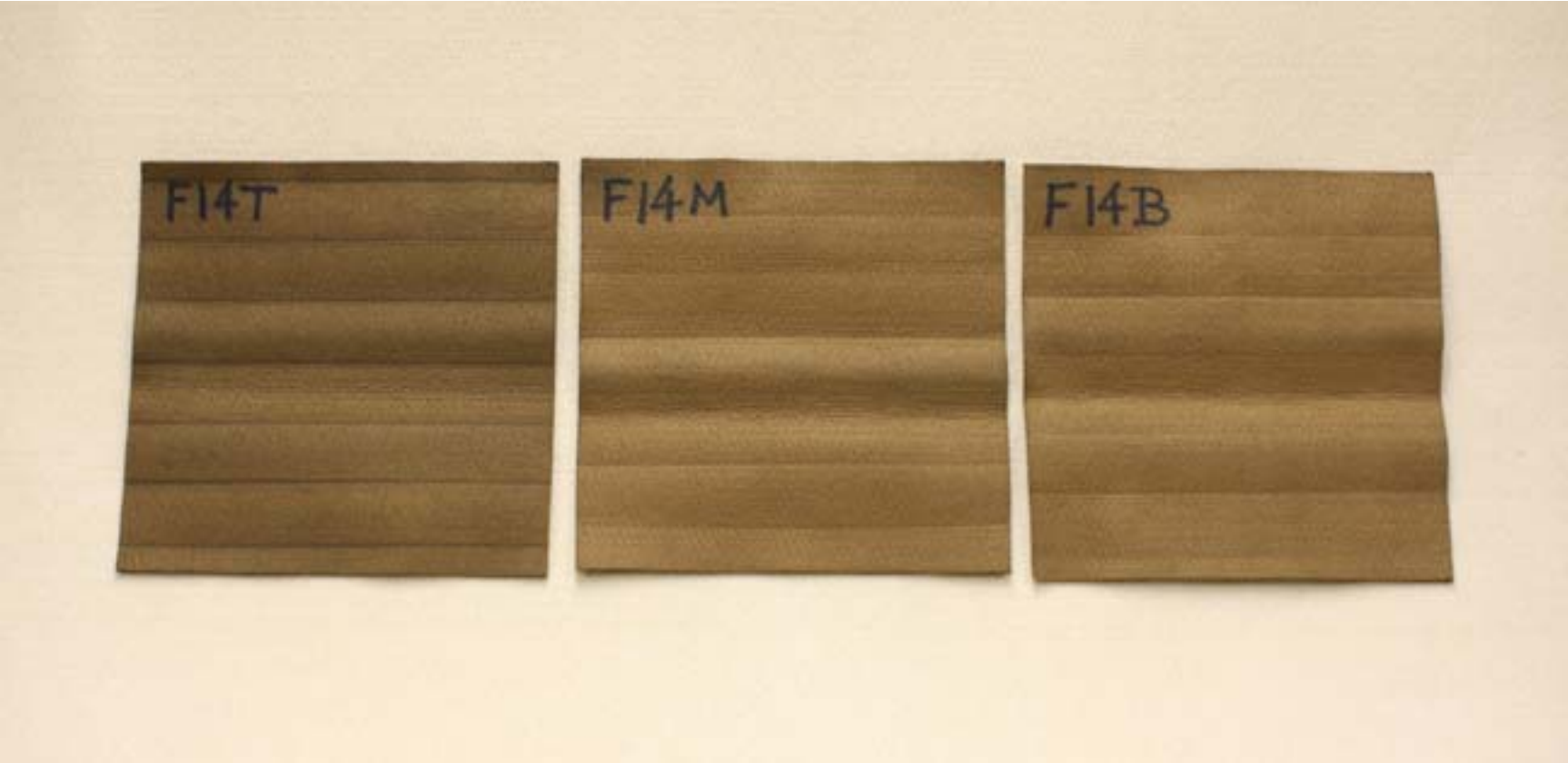
KT
KM
KB

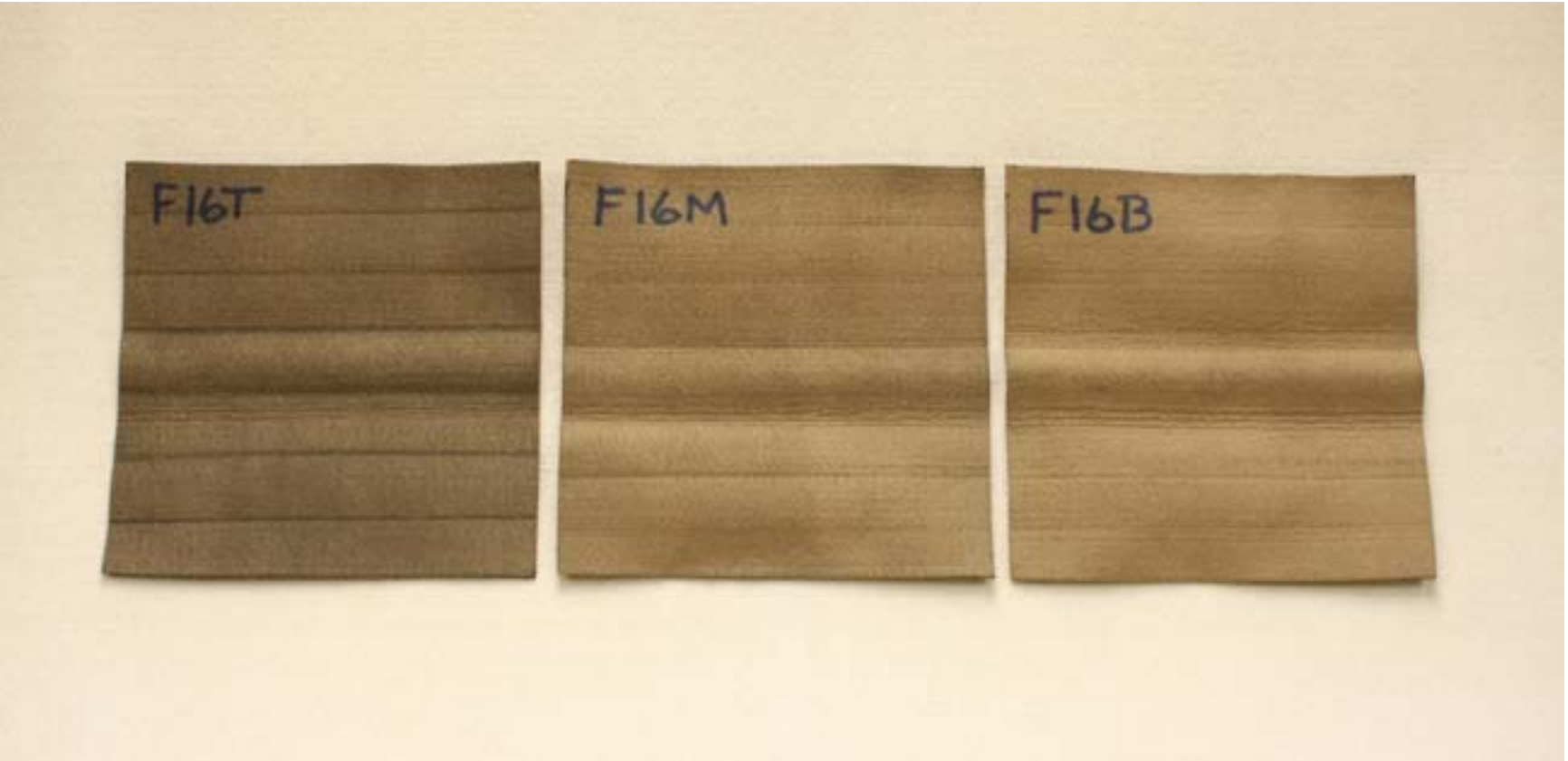

LT
LM
LB

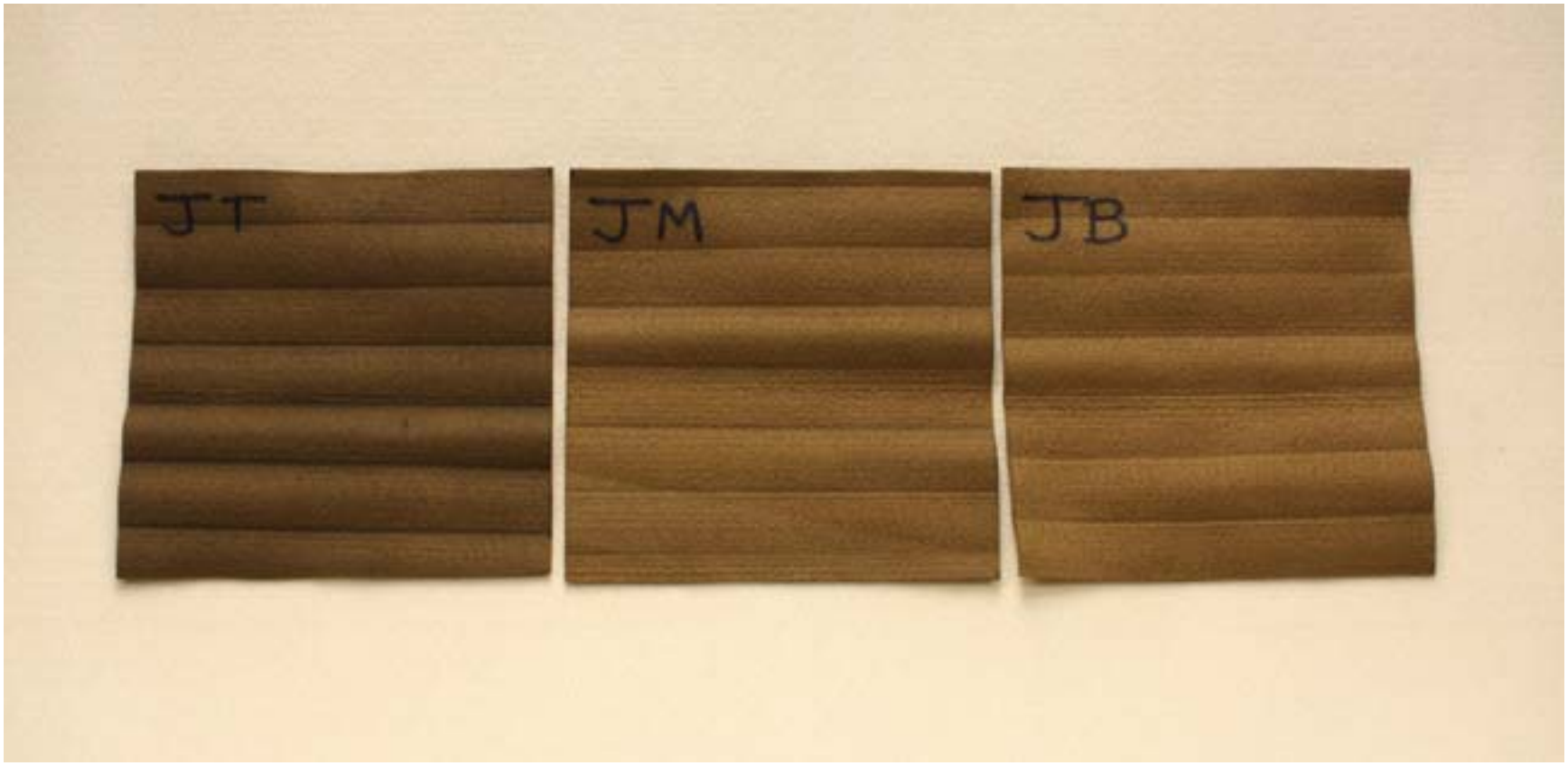

MT
MM
MB

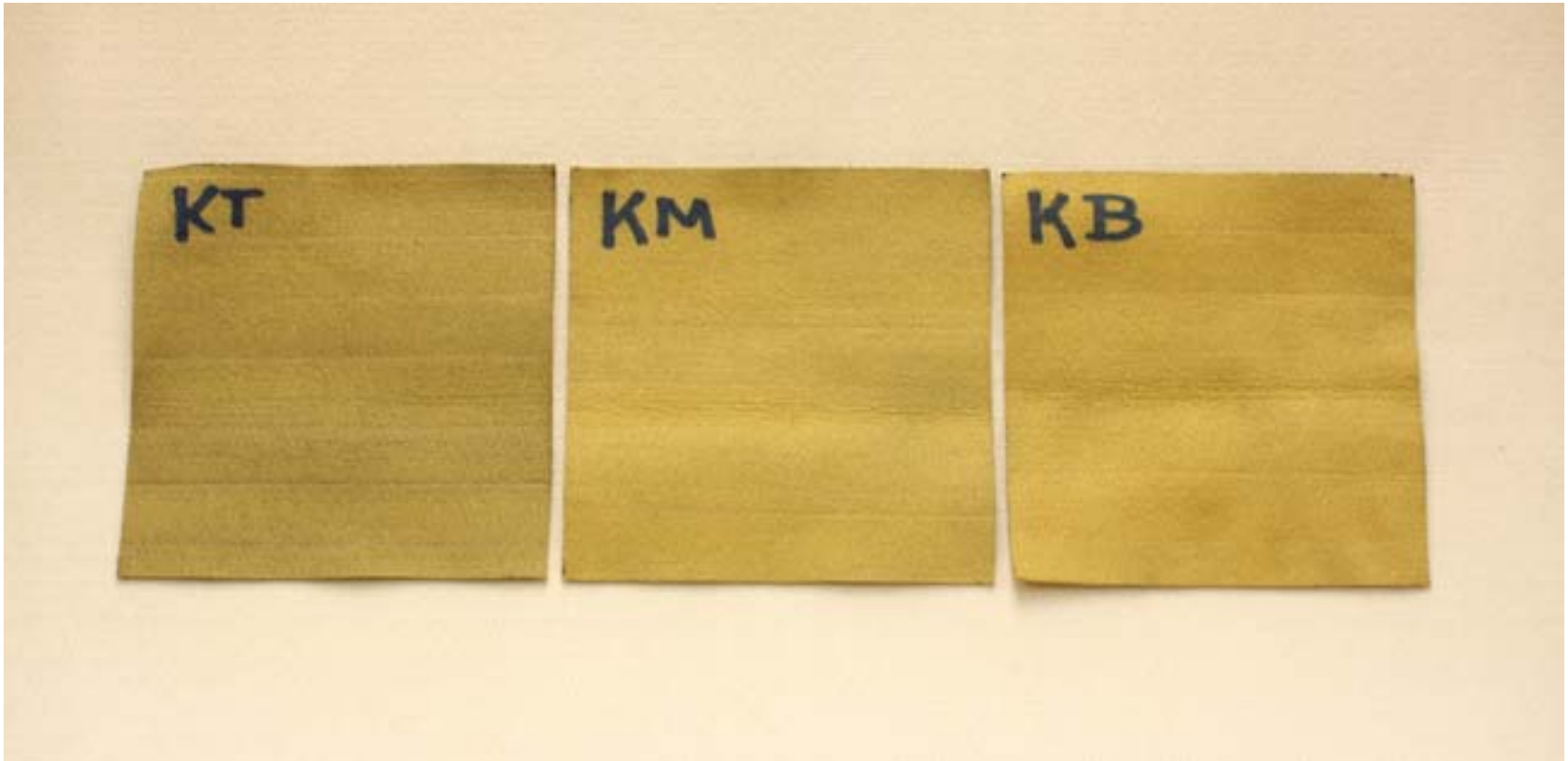
1.0 GFTS REPORT #4528 - PHOTOS

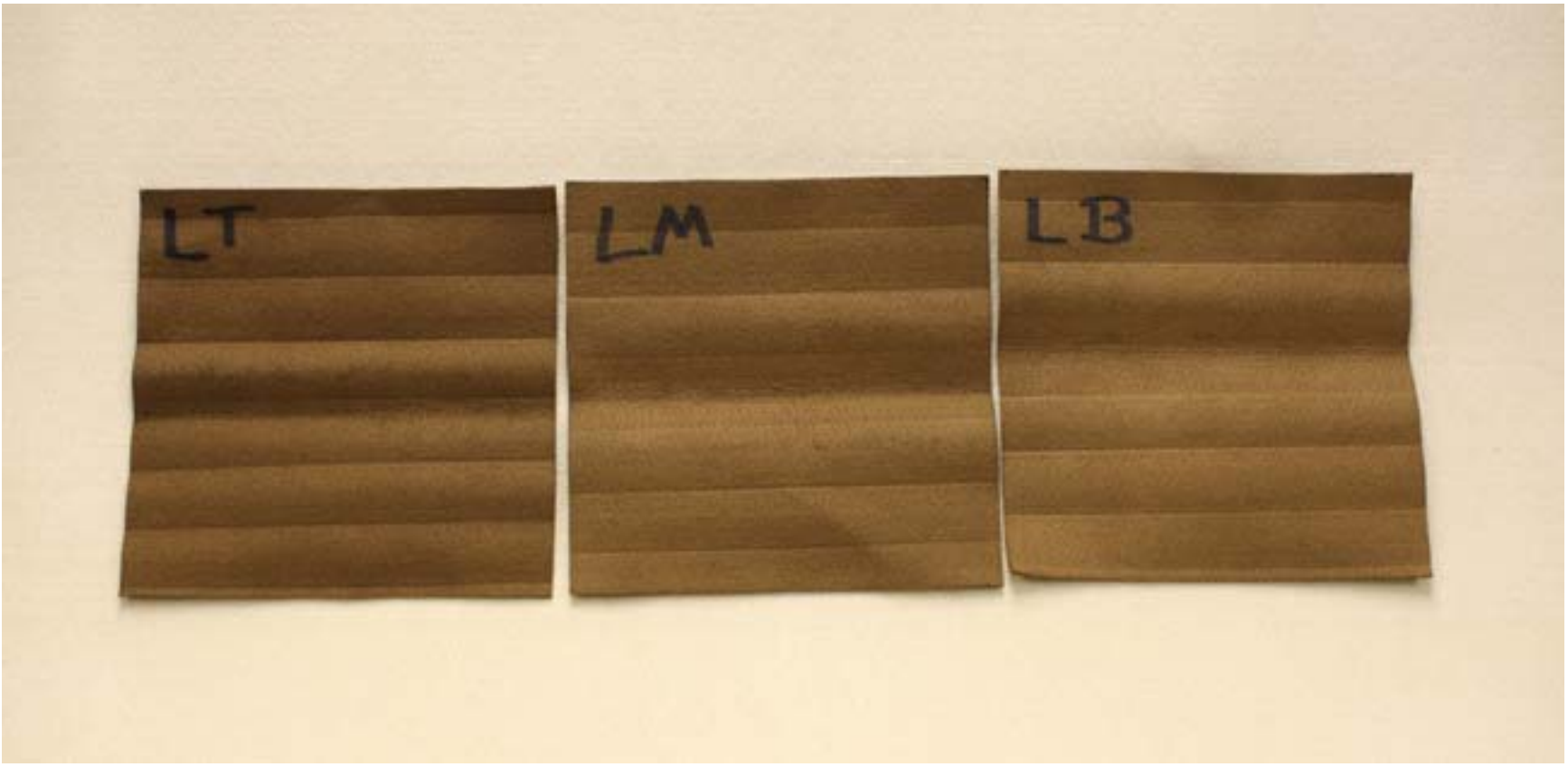
These are photos of the internal surface of vacuumed weight square specimens from the top, middle and bottom of each bag sample. All photos on this page were taken with a Canon 40D digital SLR camera and a 30 mm f/1.4 Sigma lens; all were manually exposed for the same 1/50 second at f/4.0, ISO 400 (automatic white balance under ambient fluorescent lighting).

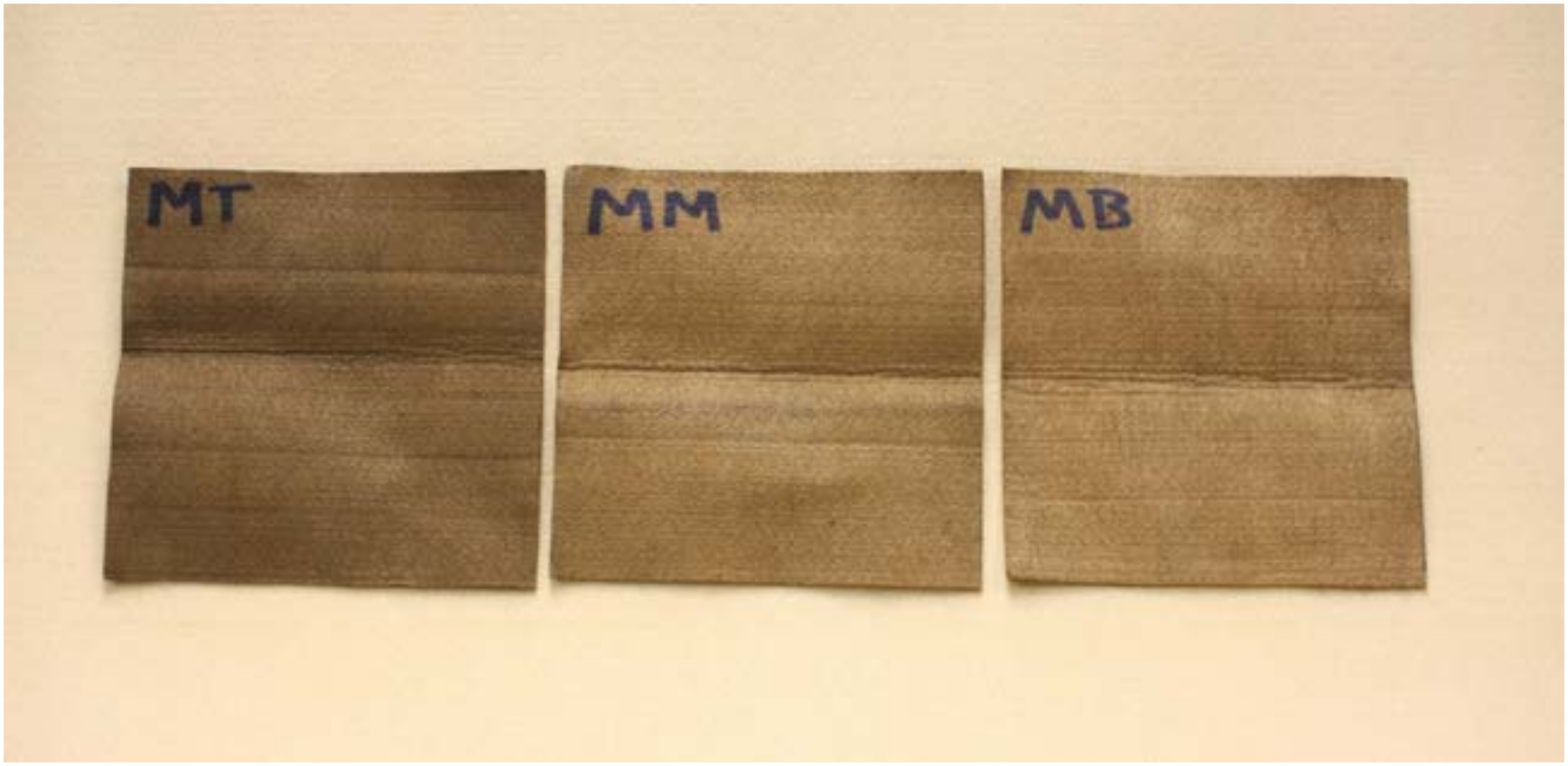

F14T
F14M
F14B


F16T
F16M
F16B


JT
JM
JB


KT
KM
KB


LT
LM
LB


MT
MM
MB

GFTS Report #4584
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag M15
Toray Composite Felt (removed 12/03/2008)

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	3.65	3.79	4.07	3.84
	Middle:	4.07	5.96	6.02	5.35
	Bottom:	6.26	6.72	11.3	8.09
	O.A. Average:				5.76

		#1	#2	#3	Avg.
Vacuumed,	Top:	11.3	11.9	12.1	11.77
	Middle:	20.0	20.7	17.7	19.5
	Bottom:	31.1	26.1	26.1	27.8
	O.A. Average:				19.7

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	98	130	122	117	77
	Middle:	113	143	114	123	83
	Bottom:	225	213	158	199	159
	O.A. Average:				146	106

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	23.5	3.6	19.9	2.1	17.8	5.7	29.2
Middle:	23.4	3.4	20.0	1.0	19.0	4.4	30.0
Bottom:	26.6	7.1	19.5	0.7	18.8	7.8	30.9
Average:	24.5	4.7	19.8	1.3	18.5	6.0	30.0

GFTS Report #4624
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Used Bag ID #7
OEM Standard PPS (Module #1)

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	5.14	5.56	5.69	5.46
	Middle:	5.69	4.34	8.22	6.08
	Bottom:	8.03	9.92	9.12	9.02
	O.A. Average:				6.85

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	17.6	18.3	14.9	16.9
	Middle:	22.2	33.1	27.0	27.4
	Bottom:	29.4	33.1	29.0	30.5
	O.A. Average:				24.9

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	182	183	191	185	145
	Middle:	192	178	175	182	142
	Bottom:	191	213	205	203	163
	O.A. Average:				190	150

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	21.5	2.3	19.2	1.5	17.7	3.8	38.8
Middle:	20.1	1.8	18.3	0.6	17.7	2.4	37.9
Bottom:	21.1	1.7	19.4	0.6	18.8	2.3	32.2
Average:	20.9	1.9	19.0	0.9	18.1	2.8	36.3

GFTS Report #4624
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Used Bag ID #17
OEM Standard PPS (Module #1)

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	3.65	5.29	7.25	5.40
	Middle:	6.88	6.72	9.50	7.70
	Bottom:	10.8	11.7	8.68	10.4
	O.A. Average:				7.83

		#1	#2	#3	Avg.
Vacuumed,	Top:	12.6	13.2	13.1	13.0
	Middle:	22.4	26.1	30.9	26.5
	Bottom:	26.1	28.4	30.6	28.4
	O.A. Average:				22.6

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	178	195	176	183	143
	Middle:	178	207	174	186	146
	Bottom:	223	207	196	209	169
	O.A. Average:				193	153

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	21.3	2.0	19.3	2.2	17.1	4.2	42.8
Middle:	19.9	1.6	18.3	0.5	17.8	2.1	37.6
Bottom:	20.2	1.9	18.3	0.5	17.8	2.4	38.7
Average:	20.5	1.8	18.6	1.1	17.6	2.9	39.7

GFTS Report #4649
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag F11
Standard PPS; 2005 OEM

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	3.38	4.07	4.40	3.95
	Middle:	4.47	5.36	4.75	4.86
	Bottom:	7.50	6.26	3.89	5.88
	O.A. Average:				4.90

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	16.2	14.2	11.5	14.0
	Middle:	24.9	27.4	23.0	25.1
	Bottom:	27.6	27.6	25.6	26.9
	O.A. Average:				22.0

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	163	152	140	152	112
	Middle:	175	181	205	187	147
	Bottom:	203	208	208	206	166
	O.A. Average:				182	142

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	19.4	2.1	17.3	1.5	15.8	3.6	34.4
Middle:	20.7	2.4	18.3	0.6	17.7	3.0	30.9
Bottom:	20.6	2.7	17.9	0.6	17.3	3.3	32.1
Average:	20.2	2.4	17.8	0.9	16.9	3.3	32.5

GFTS Report #4649
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag F16
Standard PPS; 5/21/2008 (replacement)

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	4.07	2.90	4.51	3.83
	Middle:	7.35	4.91	2.87	5.04
	Bottom:	6.88	6.78	8.99	7.55
	O.A. Average:				5.47

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	15.3	18.1	15.3	16.2
	Middle:	28.6	27.2	32.6	29.5
	Bottom:	35.1	35.2	35.6	35.3
	O.A. Average:				27.0

Mullen Burst (psi)
Tare Pressure: 45

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	324	316	330	323	278
	Middle:	375	400	370	382	337
	Bottom:	337	373	413	374	329
	O.A. Average:				360	315

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	19.6	1.7	17.9	1.3	16.6	3.0	38.1
Middle:	19.6	1.7	17.9	0.3	17.6	2.0	34.4
Bottom:	19.0	1.0	18.0	1.1	16.9	2.1	41.5
Average:	19.4	1.5	17.9	0.9	17.0	2.4	38.0

GFTS Report #4649
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag J10
9065 (Dual Density); 2005

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	5.69	6.14	6.14	5.99
	Middle:	6.72	5.49	7.25	6.49
	Bottom:	10.4	7.65	7.84	8.63
	O.A. Average:				7.04

		#1	#2	#3	Avg.
Vacuumed,	Top:	24.3	21.5	21.5	22.4
	Middle:	33.5	37.3	33.3	34.7
	Bottom:	47.6	44.9	42.2	44.9
	O.A. Average:				34.0

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	98	81	95	91	51
	Middle:	113	101	102	105	65
	Bottom:	94	108	96	99	59
	O.A. Average:				98	58

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	18.2	2.3	15.9	2.0	13.9	4.3	51.9
Middle:	17.5	2.3	15.2	0.7	14.5	3.0	51.3
Bottom:	17.4	2.3	15.1	0.5	14.6	2.8	48.9
Average:	17.7	2.3	15.4	1.1	14.3	3.4	50.7

GFTS Report #4649
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag K9
P84; 2005

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	3.91	5.49	4.08	4.49
	Middle:	4.52	8.90	9.38	7.60
	Bottom:	5.56	8.31	4.34	6.07
	O.A. Average:				6.05

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	20.5	20.5	18.1	19.7
	Middle:	26.3	29.8	28.4	28.2
	Bottom:	25.6	27.4	24.5	25.8
	O.A. Average:				24.6

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	203	229	229	220	180
	Middle:	250	235	225	237	197
	Bottom:	234	253	290	259	219
	O.A. Average:				239	199

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	16.5	2.3	14.2	0.8	13.4	3.1	31.9
Middle:	15.5	1.9	13.6	0.4	13.2	2.3	32.2
Bottom:	16.6	2.5	14.1	0.4	13.7	2.9	29.0
Average:	16.2	2.2	14.0	0.5	13.4	2.8	31.0

GFTS Report #4649
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag L11
BHA-TEX; 2005

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	2.11	2.10	2.44	2.22
	Middle:	2.61	3.04	2.71	2.79
	Bottom:	2.37	3.35	2.44	2.72
	O.A. Average:				2.58

		#1	#2	#3	Avg.
Vacuumed,	Top:	8.72	8.77	11.2	9.56
	Middle:	10.2	9.12	8.81	9.38
	Bottom:	10.6	9.33	14.2	11.4
	O.A. Average:				10.1

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	113	114	116	114	74
	Middle:	133	139	126	133	93
	Bottom:	138	145	145	143	103
	O.A. Average:				130	90

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	16.6	1.1	15.5	0.2	15.3	1.3	24.0
Middle:	16.2	0.3	15.9	0.1	15.8	0.4	23.0
Bottom:	16.9	0.7	16.2	0.2	16.0	0.9	21.9
Average:	16.6	0.7	15.9	0.2	15.7	0.9	23.0

GFTS Report #4649
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag N16
GE PS050; July 2008

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	7.45	6.67	6.26	6.79
	Middle:	11.9	9.74	8.86	10.2
	Bottom:	11.3	12.9	16.0	13.4
	O.A. Average:				10.1

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	22.1	27.8	18.7	22.9
	Middle:	46.3	54.8	53.1	51.4
	Bottom:	55.8	55.3	60.0	57.0
	O.A. Average:				43.8

Mullen Burst (psi)
Tare Pressure: 45

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	359	309	297	322	277
	Middle:	348	347	332	342	297
	Bottom:	316	371	320	336	291
	O.A. Average:				333	288

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	20.6	2.2	18.4	1.8	16.6	4.0	53.1
Middle:	18.2	1.8	16.4	0.3	16.1	2.1	54.8
Bottom:	18.6	1.6	17.0	0.2	16.8	1.8	52.5
Average:	19.1	1.9	17.3	0.8	16.5	2.6	53.5

GFTS Report #4649
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag P30
Standard PPS; 2005 OEM

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	7.45	5.49	4.91	5.95
	Middle:	6.44	6.67	9.63	7.58
	Bottom:	8.72	6.61	7.79	7.71
	O.A. Average:				7.08

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	14.7	15.1	13.4	14.4
	Middle:	22.2	23.9	22.5	22.9
	Bottom:	30.8	29.8	27.8	29.5
	O.A. Average:				22.3

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	168	165	155	163	123
	Middle:	171	206	175	184	144
	Bottom:	200	194	193	196	156
	O.A. Average:				181	141

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	22.2	2.7	19.5	2.6	16.9	5.3	31.1
Middle:	21.5	3.3	18.2	1.1	17.1	4.4	35.4
Bottom:	20.2	2.0	18.2	0.7	17.5	2.7	33.5
Average:	21.3	2.7	18.6	1.5	17.2	4.1	33.3

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag F
OEM Standard PPS

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	3.27	2.68	5.36	3.77
	Middle:	4.34	7.55	5.06	5.65
	Bottom:	5.36	14.2	6.32	8.63
	O.A. Average:				6.02

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	15.8	16.5	15.0	15.8
	Middle:	27.4	35.1	29.8	30.8
	Bottom:	29.8	33.3	30.6	31.2
	O.A. Average:				25.9

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	307	295	292	298	258
	Middle:	336	270	308	305	265
	Bottom:	345	309	313	322	282
	O.A. Average:				308	268

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	21.9	3.1	18.8	1.2	17.6	4.3	31.7
Middle:	19.9	2.4	17.5	0.5	17.0	2.9	33.9
Bottom:	20.0	1.9	18.1	0.3	17.8	2.2	32.1
Average:	20.6	2.5	18.1	0.7	17.5	3.1	32.6

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag G
High-permeability PPS with 2.2 oz/yd² PTFE scrim

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	20.6	13.1	1.64	11.8
	Middle:	4.53	2.25	2.55	3.11
	Bottom:	10.2	7.35	21.9	13.2
	O.A. Average:				9.37

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	98.8	79.6	14.2	64.2
	Middle:	55.3	51.3	60.9	55.8
	Bottom:	70.7	62.8	58.4	64.0
	O.A. Average:				61.3

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	307	298	305	303	263
	Middle:	288	295	279	287	247
	Bottom:	293	295	310	299	259
	O.A. Average:				296	256

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	24.4	6.0	18.4	2.5	15.9	8.5	145
Middle:	27.8	9.5	18.3	2.2	16.1	11.7	150
Bottom:	23.9	7.3	16.6	0.6	16.0	7.9	151
Average:	25.4	7.6	17.8	1.8	16.0	9.4	149

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag H
High-permeability PPS with 3.8 oz/yd² PTFE scrim

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	11.5	3.81	10.2	8.50
	Middle:	3.53	2.44	2.99	2.99
	Bottom:	5.76	4.52	6.38	5.55
	O.A. Average:				5.68

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	62.8	19.6	30.2	37.5
	Middle:	38.3	37.5	59.5	45.1
	Bottom:	80.3	59.0	69.9	69.7
	O.A. Average:				50.8

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	306	337	327	323	283
	Middle:	341	323	345	336	296
	Bottom:	342	360	359	354	314
	O.A. Average:				338	298

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	32.6	5.7	26.9	9.4	17.5	15.1	131
Middle:	27.7	6.1	21.6	3.8	17.8	9.9	132
Bottom:	26.2	6.7	19.5	2.1	17.4	8.8	137
Average:	28.8	6.2	22.7	5.1	17.6	11.3	133

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag I
High-permeability PPS with PPS scrim

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	44.2	19.6	20.5	28.1
	Middle:	4.08	3.10	6.20	4.46
	Bottom:	21.1	16.0	16.0	17.7
	O.A. Average:				16.8

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	122	97.9	108	109
	Middle:	113	103	113	110
	Bottom:	127	121	122	123
	O.A. Average:				114

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	205	235	201	214	174
	Middle:	208	200	215	208	168
	Bottom:	205	226	222	218	178
	O.A. Average:				213	173

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	25.6	9.2	16.4	2.0	14.4	11.2	151
Middle:	23.3	7.5	15.8	0.6	15.2	8.1	134
Bottom:	20.5	4.5	16.0	0.6	15.4	5.1	133
Average:	23.1	7.1	16.1	1.1	15.0	8.1	139

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag J (but actually bag K)
P84

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	4.98	7.60	6.44	6.34
	Middle:	4.91	14.7	6.78	8.80
	Bottom:	9.08	14.4	12.1	11.9
	O.A. Average:				9.01

		#1	#2	#3	Avg.
Vacuumed,	Top:	19.4	23.9	24.9	22.7
	Middle:	26.5	27.6	28.8	27.6
	Bottom:	25.6	27.2	30.4	27.7
	O.A. Average:				26.0

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	346	319	333	333	293
	Middle:	336	394	330	353	313
	Bottom:	385	395	293	358	318
	O.A. Average:				348	308

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	16.0	1.9	14.1	0.7	13.4	2.6	34.6
Middle:	15.3	1.6	13.7	0.0	13.7	1.6	28.8
Bottom:	14.6	1.6	13.0	0.2	12.8	1.8	32.8
Average:	15.3	1.7	13.6	0.3	13.3	2.0	32.1

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag K (but actually bag J)
Dual-Density PPS (9065)

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	2.05	8.86	13.1	8.00
	Middle:	7.20	9.76	9.21	8.72
	Bottom:	9.92	12.6	9.84	10.8
	O.A. Average:				9.17

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	27.8	24.9	25.9	26.2
	Middle:	46.9	46.9	41.5	45.1
	Bottom:	50.1	45.6	46.9	47.5
	O.A. Average:				39.6

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	183	192	201	192	152
	Middle:	204	203	217	208	168
	Bottom:	224	213	218	218	178
	O.A. Average:				206	166

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	18.9	2.5	16.4	1.1	15.3	3.6	46.3
Middle:	18.8	2.2	16.6	0.4	16.2	2.6	42.8
Bottom:	17.7	1.8	15.9	0.3	15.6	2.1	46.9
Average:	18.5	2.2	16.3	0.6	15.7	2.8	45.3

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag L
PPS with PTFE membrane

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	2.25	2.18	2.09	2.17
	Middle:	2.81	3.21	2.68	2.90
	Bottom:	2.68	3.86	3.10	3.21
	O.A. Average:				2.76

		#1	#2	#3	Avg.
Vacuumed,	Top:	15.3	12.1	10.4	12.6
	Middle:	13.8	11.0	15.3	13.4
	Bottom:	15.9	14.0	14.6	14.8
	O.A. Average:				13.6

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	242	252	260	251	211
	Middle:	264	270	250	261	221
	Bottom:	288	268	282	279	239
	O.A. Average:				264	224

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	16.3	0.6	15.7	0.3	15.4	0.9	43.5
Middle:	14.9	0.6	14.3	0.1	14.2	0.7	51.3
Bottom:	15.9	0.6	15.3	0.1	15.2	0.7	44.9
Average:	15.7	0.6	15.1	0.2	14.9	0.8	46.6

GFTS Report #4394
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag M
Toray Composite Felt

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	3.86	3.02	3.77	3.55
	Middle:	5.63	8.26	2.18	5.36
	Bottom:	4.89	15.7	4.25	8.28
	O.A. Average:				5.73

		#1	#2	#3	Avg.
Vacuumed,	Top:	8.36	7.94	9.29	8.53
	Middle:	24.2	18.5	19.0	20.6
	Bottom:	15.9	25.6	24.0	21.8
	O.A. Average:				17.0

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	157	160	174	164	124
	Middle:	187	183	214	195	155
	Bottom:	187	213	222	207	167
	O.A. Average:				189	149

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	24.4	2.7	21.7	2.3	19.4	5.0	23.5
Middle:	24.3	2.2	22.1	0.9	21.2	3.1	23.8
Bottom:	22.0	2.3	19.7	0.7	19.0	3.0	33.5
Average:	23.6	2.4	21.2	1.3	19.9	3.7	26.9

GFTS Report #4528
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag F14
OEM Standard PPS

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	3.79	4.32	3.93	4.01
	Middle:	5.83	6.67	4.91	5.80
	Bottom:	3.50	10.1	6.94	6.85
	O.A. Average:				5.55

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	11.7	13.7	13.8	13.1
	Middle:	23.5	27.2	24.0	24.9
	Bottom:	21.9	29.2	32.6	27.9
	O.A. Average:				22.0

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	215	203	215	211	171
	Middle:	227	211	233	224	184
	Bottom:	275	228	218	240	200
	O.A. Average:				225	185

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	20.4	2.2	18.2	1.6	16.6	3.8	34.4
Middle:	20.0	2.5	17.5	0.5	17.0	3.0	33.3
Bottom:	19.5	2.1	17.4	0.5	16.9	2.6	34.2
Average:	20.0	2.3	17.7	0.9	16.8	3.1	34.0

GFTS Report #4528
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag F16
Standard PPS (installed 2/26/2007)

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	4.21	3.45	4.14	3.90
	Middle:	3.89	4.16	5.96	4.67
	Bottom:	5.56	6.14	6.99	6.20
	O.A. Average:				4.92

		#1	#2	#3	Avg.
Vacuumed,	Top:	14.7	15.7	15.0	15.1
	Middle:	23.1	29.6	24.5	25.7
	Bottom:	26.3	29.2	27.2	27.6
	O.A. Average:				22.8

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	277	283	276	279	239
	Middle:	300	268	290	286	246
	Bottom:	297	291	310	299	259
	O.A. Average:				288	248

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	21.3	1.9	19.4	1.4	18.0	3.3	33.9
Middle:	20.9	2.0	18.9	0.4	18.5	2.4	29.2
Bottom:	20.8	2.0	18.8	0.4	18.4	2.4	32.1
Average:	21.0	2.0	19.0	0.7	18.3	2.7	31.7

GFTS Report #4528
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag J
Dual-Density PPS (9065)

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	4.74	4.09	6.32	5.05
	Middle:	6.99	5.21	5.14	5.78
	Bottom:	8.99	5.49	8.45	7.60
	O.A. Average:				6.14

		#1	#2	#3	Avg.
Vacuumed,	Top:	23.2	21.9	20.8	22.0
	Middle:	42.2	41.5	31.1	38.3
	Bottom:	40.0	40.7	39.1	39.9
	O.A. Average:				33.4

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	120	121	134	125	85
	Middle:	144	131	147	141	101
	Bottom:	188	142	150	160	120
	O.A. Average:				142	102

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	19.9	1.9	18.0	1.5	16.5	3.4	42.2
Middle:	19.5	2.3	17.2	0.5	16.7	2.8	49.5
Bottom:	20.3	2.3	18.0	0.5	17.5	2.8	39.9
Average:	19.9	2.2	17.7	0.8	16.9	3.0	43.9

GFTS Report #4528
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag K
P84

Permeability (cfm)

		#1	#2	#3	Avg.
Dirty,	Top:	4.42	4.00	6.72	5.05
	Middle:	5.83	8.40	9.25	7.83
	Bottom:	5.76	5.49	6.78	6.00
	O.A. Average:				6.29

		#1	#2	#3	Avg.
Vacuumed,	Top:	19.3	21.0	20.4	20.2
	Middle:	24.7	27.0	26.3	26.0
	Bottom:	26.7	24.9	23.2	24.9
	O.A. Average:				23.7

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
Vacuumed,	Top:	279	226	250	252	212
	Middle:	296	311	288	298	258
	Bottom:	223	316	312	284	244
	O.A. Average:				278	238

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	15.7	2.2	13.5	0.9	12.6	3.1	35.2
Middle:	15.8	1.5	14.3	0.5	13.8	2.0	30.4
Bottom:	16.5	1.9	14.6	0.4	14.2	2.3	29.6
Average:	16.0	1.9	14.1	0.6	13.5	2.5	31.7

GFTS Report #4528
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag L
PPS with PTFE membrane

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	2.44	2.44	4.36	3.08
	Middle:	3.30	2.55	2.77	2.87
	Bottom:	2.25	2.99	2.29	2.50
	O.A. Average:				2.82

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	9.25	10.4	13.2	11.0
	Middle:	13.1	12.2	13.2	12.8
	Bottom:	10.0	9.84	11.7	10.5
	O.A. Average:				11.4

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	160	153	151	155	115
	Middle:	147	171	150	156	116
	Bottom:	198	170	162	177	137
	O.A. Average:				163	123

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	15.0	0.5	14.5	0.7	13.8	1.2	49.5
Middle:	15.6	0.8	14.8	0.1	14.7	0.9	39.9
Bottom:	17.6	1.4	16.2	0.1	16.1	1.5	33.3
Average:	16.1	0.9	15.2	0.3	14.9	1.2	40.9

GFTS Report #4528
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag L (second set of washed samples)
PPS with PTFE membrane

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	2.44	2.44	4.36	3.08
	Middle:	3.30	2.55	2.77	2.87
	Bottom:	2.25	2.99	2.29	2.50
	O.A. Average:				2.82

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	9.25	10.4	13.2	11.0
	Middle:	13.1	12.2	13.2	12.8
	Bottom:	10.0	9.84	11.7	10.5
	O.A. Average:				11.4

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	160	153	151	155	115
	Middle:	147	171	150	156	116
	Bottom:	198	170	162	177	137
	O.A. Average:				163	123

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	(15.0)	--	15.3	0.1	15.2	--	10.8
Middle:	(15.6)	--	14.2	0.2	14.0	--	11.9
Bottom:	(17.6)	--	15.0	0.2	14.8	--	15.9
Average:	(16.1)	--	14.8	0.2	14.7	--	12.9

GFTS Report #4528
ADA-ES/We Energies Presque Isle TOXECON Baghouse
Sample Bag M
Toray Composite Felt

Permeability (cfm)

		#1	#2	#3	Avg.
***Dirty*,**	Top:	4.18	2.84	3.13	3.38
	Middle:	5.07	5.69	3.10	4.62
	Bottom:	4.82	9.38	10.8	8.33
	O.A. Average:				5.44

		#1	#2	#3	Avg.
***Vacuumed*,**	Top:	10.5	10.5	10.8	10.6
	Middle:	23.3	22.1	19.3	21.6
	Bottom:	17.6	23.8	20.4	20.6
	O.A. Average:				17.6

Mullen Burst (psi)
Tare Pressure: 40

		#1	#2	#3	Avg.	Net
***Vacuumed*,**	Top:	105	130	118	118	78
	Middle:	172	168	178	173	133
	Bottom:	134	163	175	157	117
	O.A. Average:				149	109

Weight per Square Yard (ounces)

	Dirty	Δ D/V	Vac'd	Δ V/W	Washed	Total Dust	Washed Perm (cfm)
Top:	23.5	4.0	19.5	1.9	17.6	5.9	21.2
Middle:	23.2	4.4	18.8	0.9	17.9	5.3	38.4
Bottom:	27.4	4.5	22.9	0.6	22.3	5.1	21.1
Average:	24.7	4.3	20.4	1.1	19.3	5.4	26.9

Appendix Z. EERC Particulate Penetration Task 1 Findings

November 15, 2007

Ms. Jean Bustard
Chief Operating Officer
ADA-ES, Inc.
8100 South Park Way, Unit B
Littleton, CO 80120

Dear Ms. Bustard:

Subject: Topical Report Entitled "Investigation of Particulate Penetration Through Fabric Filters"; EERC Fund 9662

Enclosed please find the subject topical report.

If you have any questions or comments, please contact me by phone at (701) 777-5083, by fax at (701) 777-5181, or by e-mail at cmartin@undeerc.org.

Sincerely,

Christopher L. Martin
Research Engineer

CLM/jlk

Enclosure

INVESTIGATION OF PARTICULATE PENETRATION THROUGH FABRIC FILTERS

Topical Report

Prepared for:

Jean Bustard

ADA-ES, Inc.
8100 South Park Way, Unit B
Littleton, CO 80120

Prepared by:

Christopher L. Martin

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

November 2007

EERC DISCLAIMER

LEGAL NOTICE: This research report was prepared by the Energy & Environmental Research Center (EERC), an agency of the University of North Dakota, as an account of work sponsored by ADA-ES. Because of the research nature of the work performed, neither the EERC nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement or recommendation by the EERC.

TABLE OF CONTENTS

LIST OF FIGURES ii

LIST OF TABLES ii

INTRODUCTION 1

PROCEDURE 1

RESULTS FOR THE STANDARD 2.7 DENIER BAG SAMPLE 1

RESULTS FOR THE 7 DENIER HIGH-PERM SAMPLE 5

CONCLUSIONS 10

LIST OF FIGURES

1 Backscattered image of Standard Sample 1 showing the entire fabric thickness 2

2 Backscattered image of Standard Sample 2 showing the entire fabric thickness 2

3 Backscattered image of fibers and particulate accumulations in Standard Sample 1 3

4 Comparison of secondary electron image and backscattered image of individual fabric fibers within Standard Sample 1 4

5 Comparison of secondary emission image and backscatter image of a particulate accumulation within Standard Sample 1 4

6 Annotated backscattered image of Standard Sample 2 5

7 Element distribution maps in relation to the original image of the Standard Sample 2 cross section 6

8 Backscattered image of High-Perm Sample 1 showing the entire fabric thickness..... 6

9 Backscattered image of High-Perm Sample 2 showing the entire fabric thickness..... 7

10 Secondary electron image of an individual fabric fiber within High-Perm Sample 2 7

11 Magnified backscattered image of embedded particulates and fabric fibers within High-Perm Sample 1..... 8

12 Comparison of secondary electron image and backscattered image of accumulated particulates within High-Perm Sample 2..... 9

LIST OF TABLES

1 Presque Isle Power Plant Bag Samples Received from Grubb Filtration 2

2 Composition Data Corresponding to the Sample Points Highlighted in the Bottom Image of Figure 12 10

INVESTIGATION OF PARTICULATE PENETRATION THROUGH FABRIC FILTERS: TASK 1, INITIAL INVESTIGATION

INTRODUCTION

ADA-ES, as part of its TOXECON™ demonstration project at the Presque Isle Power Plant (PIPP), is investigating particulate penetration (fly ash and activated carbon [AC]) into the fabric of the baghouse filters. The Energy & Environmental Research Center (EERC) has gained experience in examining fabric filter cross sections using scanning electron microscopy and tagged image spectroscopy. At the request of ADA-ES, the EERC has completed an initial survey of two bag samples from PIPP (Task 1 according to proposal 2008-0025). Findings from Task 1 are summarized in this report.

PROCEDURE

The EERC has received four PIPP bag samples from Grubb Filtration for examination. These samples are listed in Table 1.

The standard 2.7 denier polyphenylene sulfide and the high-perm 7 denier Torcon samples were selected for the initial examination. Two swatches of fabric (each approximately a 2-inch square) were cut from each bag sample to create two samples per bag type. Portions were cut from each swatch and embedded in epoxy. When hard, these samples were cut and polished to allow inspection of the intact cross section.

A variety of analysis techniques were tried on these samples to provide an indication of the type of data that can be generated using this approach. Secondary electron imaging (SEI) was used for surface features and detailed visual images while backscattered electron imaging (BEI) was used to distinguish objects by their material composition. Energy dispersive x-ray (EDX) analysis was also conducted on selected specimens to collect elemental composition data.

RESULTS FOR THE STANDARD 2.7 DENIER BAG SAMPLE

Low-magnification backscattered images of the standard fabric cross sections are provided in Figures 1 and 2. The normal flow direction for the flue gas is noted for each image. Note that there are some accumulated particulates on the “dirty” side of each sample. The key features of the cross-sectional images are highlighted in the magnified view of Figure 3.

Table 1. Presque Isle Power Plant Bag Samples Received from Grubb Filtration

Bag Type	Midwesco Style Number
Standard 2.7 denier PPS	1378
High-Perm 7 denier Torcon	9056
P84	1342
Dual-Density Torcon PPS	9065

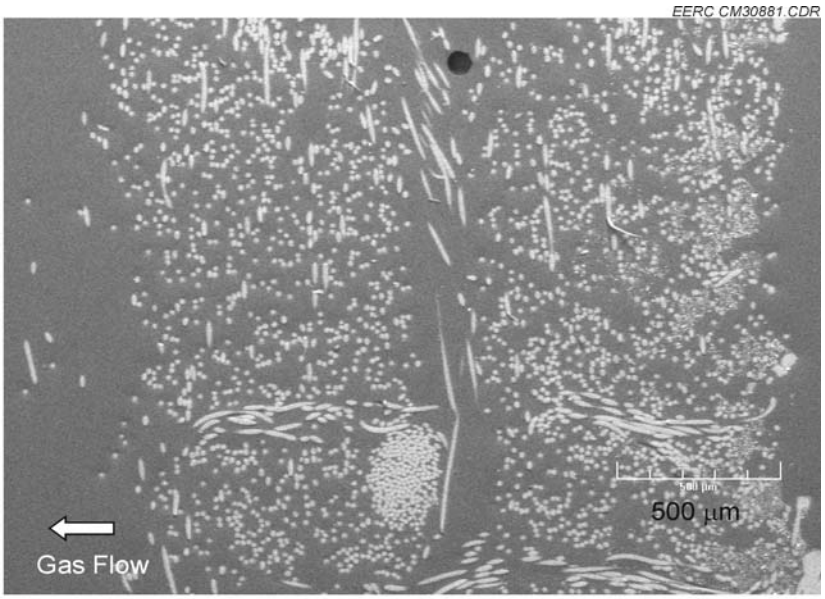


Figure 1. Backscattered image of Standard Sample 1 showing the entire fabric thickness.

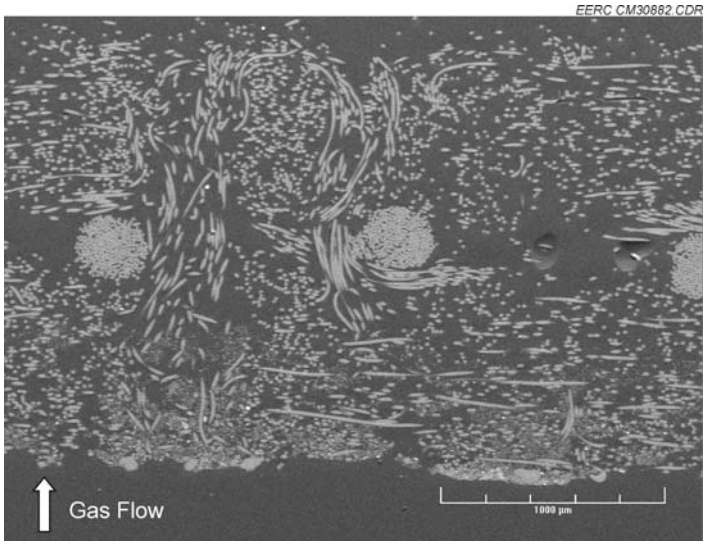


Figure 2. Backscattered image of Standard Sample 2 showing the entire fabric thickness.

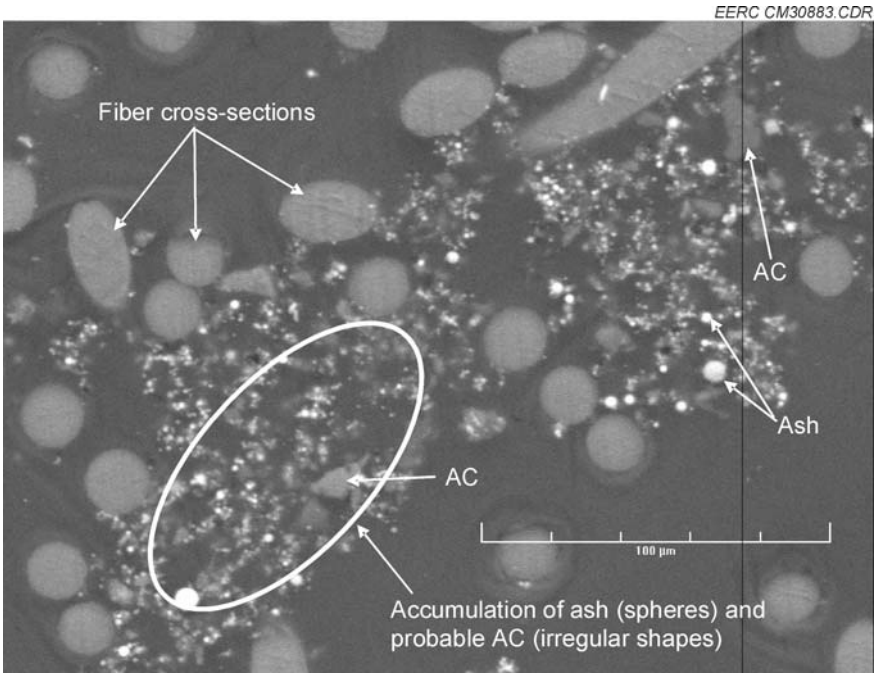


Figure 3. Backscattered image of fibers and particulate accumulations in Standard Sample 1.

A comparison of SEI and BEI is shown in Figures 4 and 5 for magnified portions of Standard Sample 1. As shown in Figure 4, surface details, such as those on the exposed fiber surfaces and resin inclusions, that are visible in the secondary electron image mostly disappear in the backscattered version. The backscattered versions of Figure 4 and 5 also display higher contrast between the sample constituents and the mounting resin.

Fiber diameters of the standard bag were measured. Based on several measurements, the fiber diameter was determined to be approximately 17 µm.

Regarding particulate penetration into the standard bag, an annotated version of the Standard Sample 2 cross section highlighting the maximum depth of particulate penetration is shown in Figure 6. In the figure, the maximum visible depth of particulate penetration is indicated by the dashed black line and is approximately 0.7 mm into the fabric from the dirty side of the filter. The penetration is roughly one-third to one-half of the overall fabric thickness, which is approximately 1.9 mm. Note that the three bundles of fibers, one of which is shown to have a diameter of 0.3 mm in Figure 6, appear to be strands of a thread running perpendicular to the page.

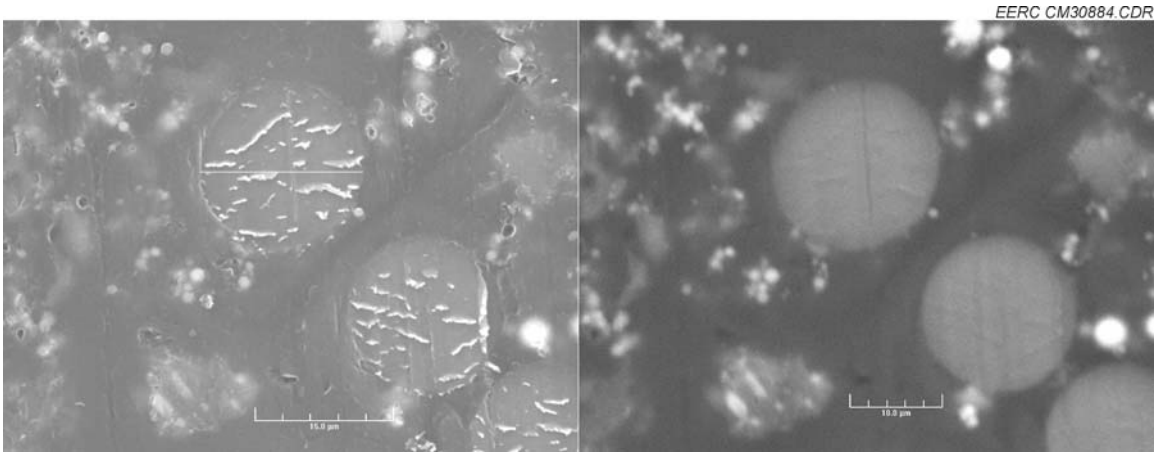


Figure 4. Comparison of secondary electron image (left) and backscattered image (right) of individual fabric fibers within Standard Sample 1.

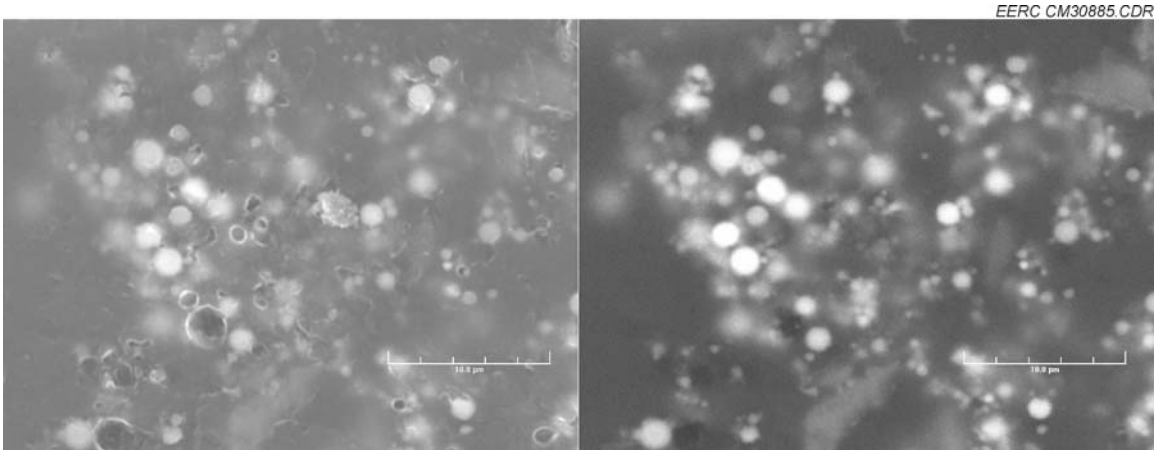


Figure 5. Comparison of secondary emission image (left) and backscatter image (right) of a particulate accumulation within Standard Sample 1.

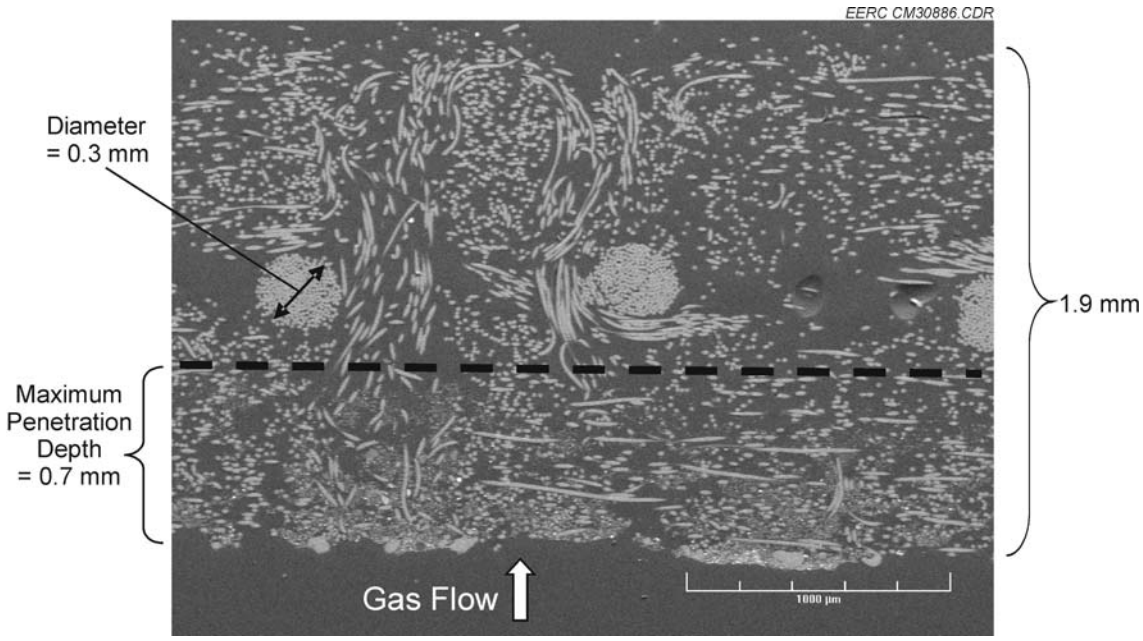


Figure 6. Annotated backscattered image of Standard Sample 2.

For a more comprehensive indication of particulate penetration, EDX analysis was conducted for an area of Standard Sample 2. The original backscattered image and the resulting element distribution maps for selected elements are shown in Figure 7. The mapped elements include aluminum, calcium, and silicon, which are typical core constituents of the fly ash, and their presence is used to indicate the distribution of fly ash in the fabric cross section. As Figure 7 clearly shows, all of the core constituents are concentrated in a zone that begins at the dirty surface of the fabric and extends 0.5–0.7 mm into the fabric. Beyond this zone, the interior of the fabric is almost completely devoid of aluminum, calcium, and silicon, indicating that fly ash has not penetrated that far and is consistent with the visual inspection of Figures 1, 2, and 6.

Carbon, from penetrating AC particles, could not be distinguished from the high levels of background carbon using EDX. However, evidence of AC in the particulate accumulations was observed as indicated in Figure 3. This finding is discussed in more detail with the high-perm sample.

RESULTS FOR THE 7 DENIER HIGH-PERM SAMPLE

Backscattered images of the high-perm fabric cross sections are presented as Figures 8 and 9. The normal gas flow for each image is left to right. In comparison to the standard samples (Figures 1 and 2), the high-perm fabric appears less structured, the embedded material extends further into the fabric, and particulate accumulations are observed throughout the cross sections. The observation of particulates extending to the “clean” side of the fabric would indicate that some particulates are migrating through the fabric and are likely being reentrained and carried away by the filtered flue gas.

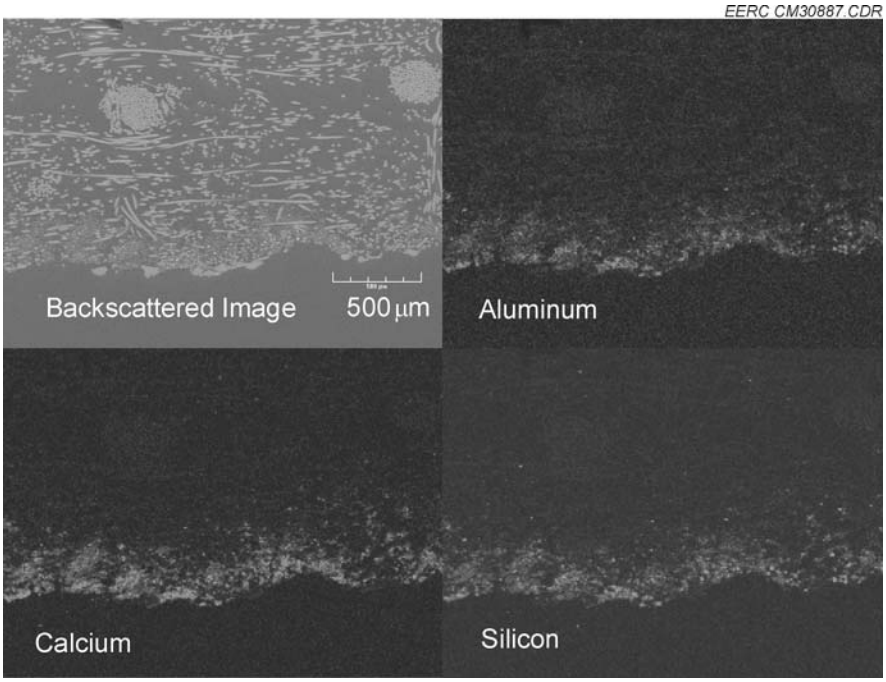


Figure 7. Element distribution maps in relation to the original image of the Standard Sample 2 cross section. The direction of normal gas flow through the filter is bottom to top in these images.

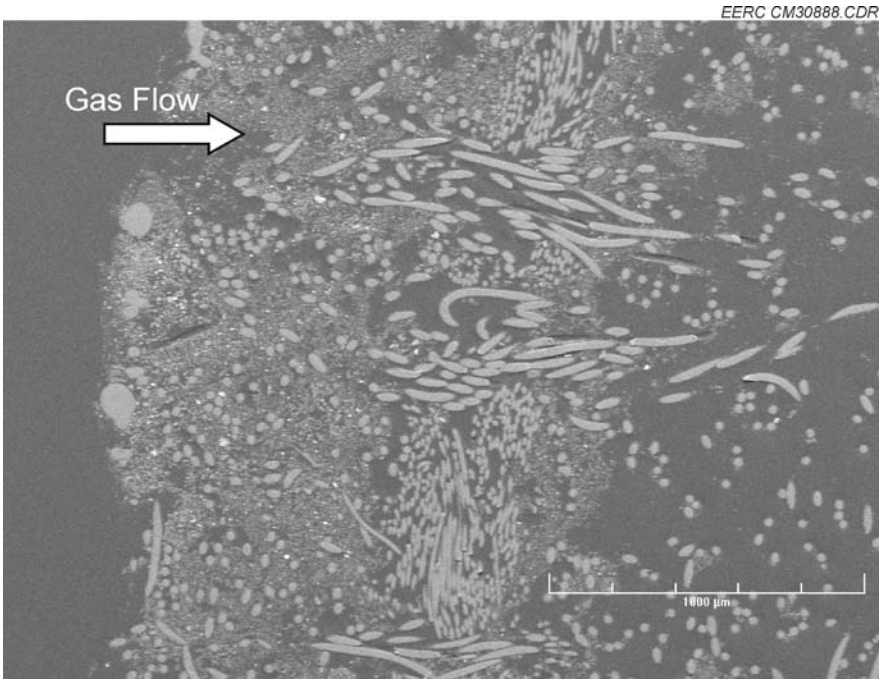


Figure 8. Backscattered image of High-Perm Sample 1 showing the entire fabric thickness.

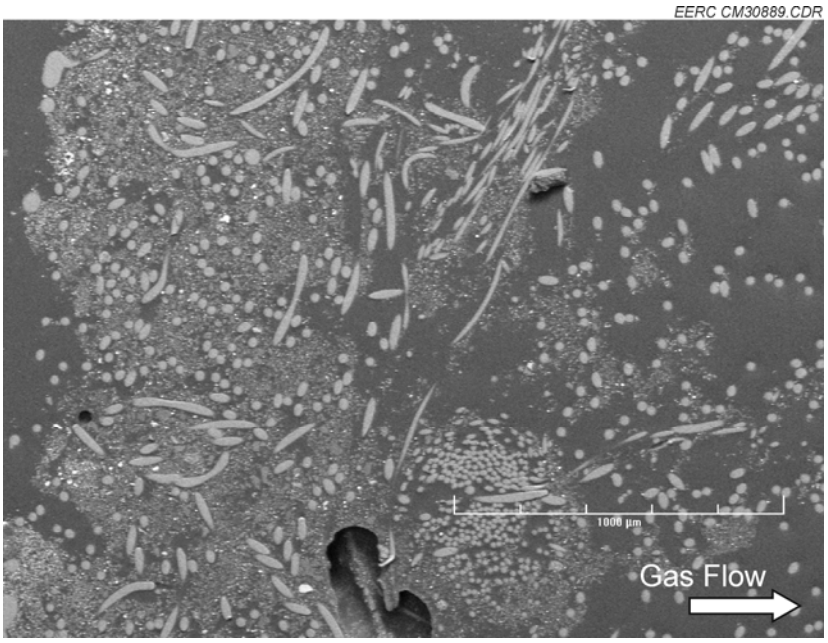


Figure 9. Backscattered image of High-Perm Sample 2 showing the entire fabric thickness.

Figure 10 is a secondary electron image of an individual fabric fiber from High-Perm Sample 2. As with the standard bag samples, several measurements of fiber diameter were made for the high-perm samples. The measurements indicate that the high-perm fiber diameter is approximately 28 µm.

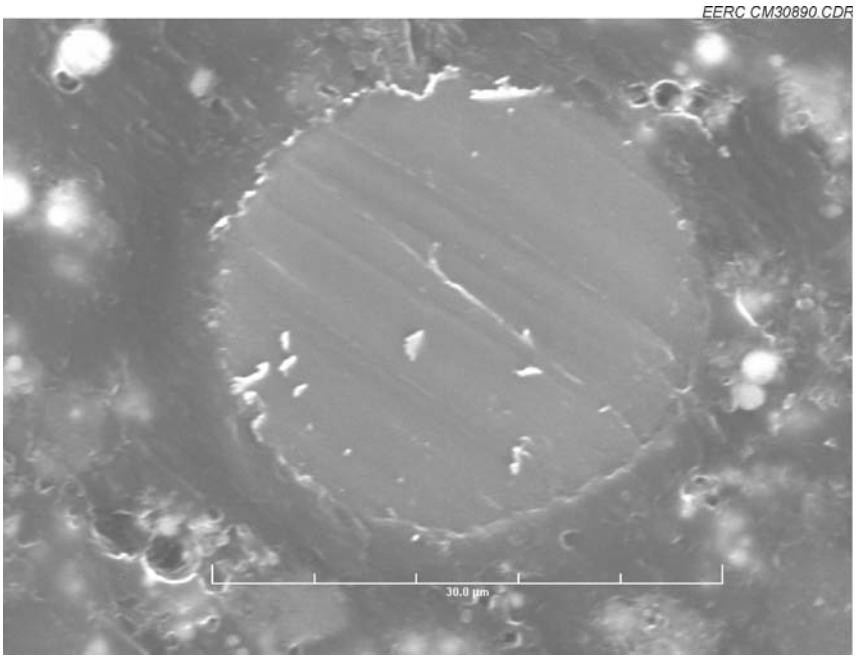


Figure 10. Secondary electron image of an individual fabric fiber within High-Perm Sample 2.

A higher magnification view of the high-perm fabric fibers with the embedded particulate matter is shown in Figure 11. In the figure the embedded material is composed of spherical particulates, presumably fly ash, and many irregularly-shaped particulates that are suspected to be activated carbon.

Higher magnification secondary electron and backscattered images of the embedded dust is shown as Figure 12. The suspected AC particles are highlighted in the secondary electron (top) image. In the backscattered (bottom) image of Figure 12, the location of several EDX point analyses are indicated by the numbered cross marks. Several of the suspected AC particles and surrounding fly ash particles were selected for analysis and the results are presented in Table 2.

The EDX point analyses presented in Table 2 indicate that the suspect particles have higher carbon contents relative to nearby fly ash particles. The absolute value of carbon composition is biased by the high background carbon level, which is indicated by the significant carbon content of the fly ash points, Numbers 5 and 6. Along with the higher carbon content, the particles are also considered to be AC because they are irregular in shape and have dimensions characteristic of AC, approximately 5–20 μm.

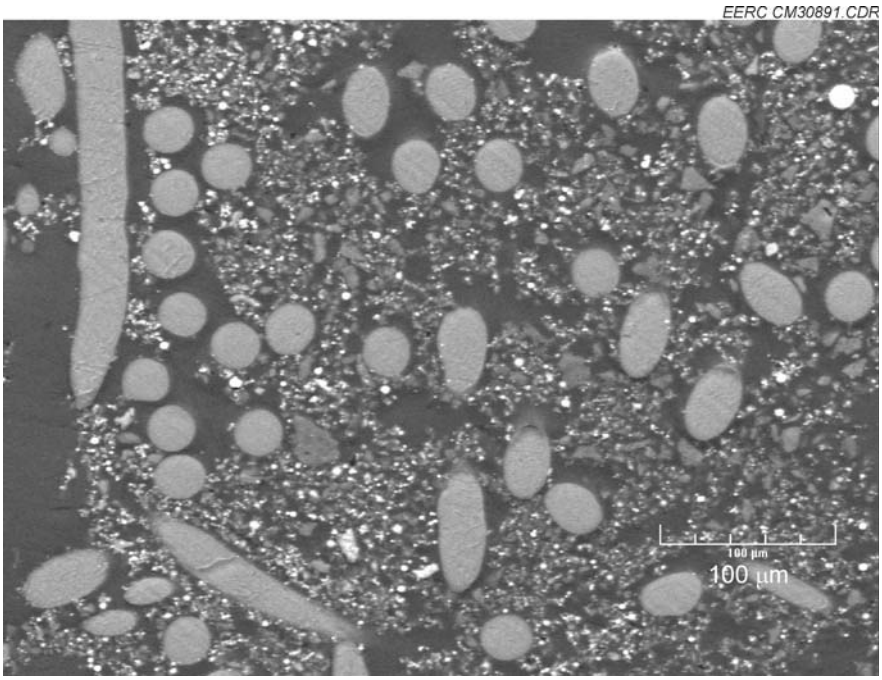


Figure 11. Magnified backscattered image of embedded particulates and fabric fibers within High-Perm Sample 1.

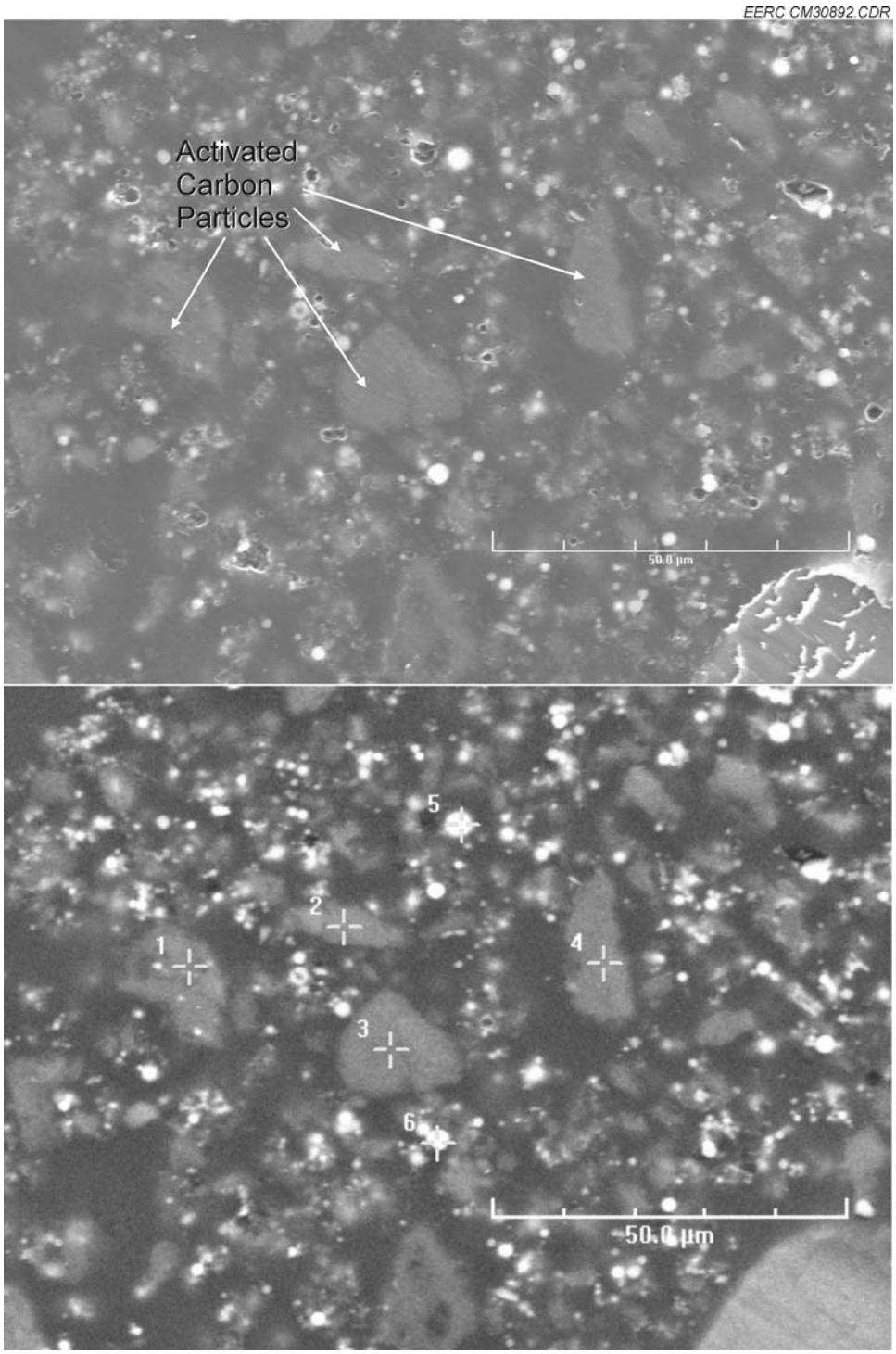


Figure 12. Comparison of secondary electron image (top) and backscattered image (bottom) of accumulated particulates within High-Perm Sample 2. Composition data corresponding to the numbered points in the backscattered image are provided in Table 2.

Table 2. Composition Data Corresponding to the Sample Points Highlighted in the Bottom Image of Figure 12

Tag	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Fe	O	C
1	0.23%	0.31%	0.12%	0.18%	0.00%	4.01%	0.09%	0.00%	2.61%	0.00%	0.31%	1.76%	90.38%
2	0.21%	0.28%	0.29%	0.20%	0.04%	3.77%	0.00%	0.00%	1.93%	0.00%	0.78%	1.25%	91.25%
3	0.09%	0.32%	0.28%	0.07%	0.00%	4.49%	0.01%	0.00%	2.70%	0.00%	0.45%	2.34%	89.25%
4	0.02%	0.36%	0.43%	0.08%	0.00%	4.07%	0.19%	0.00%	2.84%	0.00%	0.34%	1.57%	90.10%
5	0.00%	1.48%	8.19%	4.50%	0.54%	1.17%	0.00%	0.00%	16.23%	0.35%	3.00%	3.35%	61.20%
6	0.00%	3.21%	4.54%	2.88%	0.26%	2.29%	0.00%	0.00%	19.04%	0.24%	5.16%	3.85%	58.54%

CONCLUSIONS

- The standard bag sample had particulate penetration limited to approximately 0.7 mm into the fabric while the high-perm sample had visible particle accumulations throughout both cross sections.

- Activated carbon was identified in the embedded particulates of the high-perm samples. Similar particles are also observed in the embedded material of the standard bag.

- Quantification of carbon content in the embedded material will be difficult using EDX-based approaches because of the high amount of background carbon interference. Qualitative, visual inspection appears possible.

- The standard bag primary fiber diameter was measured to be approximately 17 μm while that of the high-perm bag was 28 μm. This agrees fairly well with the known fabric denier values of 2.7 and 7 for the standard and high-perm samples, respectively. Ideally, the ratio of denier values: 2.7/7 = 0.386, should be equal to the square of the fiber diameter ratio: $(17/28)^2 = 0.369$.

Appendix AA. EERC Particulate Penetration Task 2 Findings

December 31, 2007

Ms. Jean Bustard
Chief Operating Officer
ADA-ES, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

Dear Ms. Bustard:

Subject: Topical Report Entitled "Investigation of Particulate Penetration Through Fabric Filters – Task 2, Presque Isle Power Plant Samples"; EERC Fund 9662

Enclosed please find the subject topical report.

If you have any questions or comments, please contact me by phone at (701) 777-5083, by fax at (701) 777-5181, or by e-mail at cmartin@undeerc.org.

Sincerely,

Christopher L. Martin
Research Engineer

CLM/sah

Enclosure

INVESTIGATION OF PARTICULATE PENETRATION THROUGH FABRIC FILTERS

Task 2, Presque Isle Power Plant Samples

Topical Report

Prepared for:

Jean Bustard

ADA-ES, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120

Prepared by:

Christopher L. Martin

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

December 2007

EERC DISCLAIMER

LEGAL NOTICE: This research report was prepared by the Energy & Environmental Research Center (EERC), an agency of the University of North Dakota, as an account of work sponsored by ADA-ES, Inc. Because of the research nature of the work performed, neither the EERC nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement or recommendation by the EERC.

TABLE OF CONTENTS

LIST OF FIGURES ii

LIST OF TABLES iii

INTRODUCTION 1

PROCEDURE 1

RESULTS FOR THE P84 SAMPLE 2

RESULTS FOR THE DUAL-DENSITY SAMPLE 6

SUPPLEMENTARY FIBER MEASUREMENTS 10

CONCLUSIONS 12

LIST OF FIGURES

1 Images of P84 Sample 1 showing entire fabric cross section 2

2 Images of P84 Sample 2 showing entire fabric cross section 2

3 P84 Sample 1 image highlighting the fiber's cross-sectional shape 3

4 Magnified view of the surface dust layer of P84 Sample 1 4

5 Image of P84 Sample 1 highlighting deeply embedded dust agglomerations 5

6 Detail of embedded ash agglomeration circled in Figure 5 6

7 Images of dual-density Sample 1 showing entire fabric cross section..... 7

8 Images of dual-density Sample 2 showing entire fabric cross section..... 7

9 Image of dual-density Sample 2 highlighting the different fiber diameters 8

10 Detail image of the accumulated surface material on dual-density Sample 1..... 9

11 Image of dual-density Sample 1 highlighting embedded dust agglomerations 9

12 Detail of embedded ash agglomeration circled in Figure 11 10

13 Set of EDX measurements made across an individual fiber of the dual-density filter 11

14 Elemental composition data across an individual fiber cross section 11

LIST OF TABLES

1 Presque Isle Power Plant Bag Samples Received from Grubb Filtration 1

2 Composition Data Corresponding to the Sample Points Highlighted in Figure 4 4

3 Composition Data Corresponding to the Sample Points Highlighted in Figure 6 6

4 Composition Data Corresponding to the Sample Points Highlighted in Figure 12 10

INVESTIGATION OF PARTICULATE PENETRATION THROUGH FABRIC FILTERS – TASK 2, PRESQUE ISLE POWER PLANT SAMPLES

INTRODUCTION

ADA-ES, Inc., as part of its TOXECON demonstration project at the Presque Isle Power Plant (PIPP), is investigating particulate penetration (fly ash and activated carbon [AC]) into the fabric of baghouse filters. The Energy & Environmental Research Center (EERC) has gained experience in examining fabric filter cross sections using scanning electron microscopy (SEM) and tagged image spectroscopy. At the request of ADA-ES, the EERC has completed an initial survey of two bag samples from PIPP (Task 1 of EERC Proposal No. 2008-0025) and has proceeded on to Task 2, which includes an evaluation of two additional bag samples from PIPP. Findings from the Task 2 PIPP samples are summarized in this report.

PROCEDURE

The EERC has received four PIPP bag samples from Grubb Filtration for examination. These samples are listed in Table 1. The standard and high-perm samples were examined and reported under Task 1; the P84 and dual-density samples were examined as part of Task 2 and are discussed in this report.

Two swatches of fabric were cut from each bag sample to create two samples per bag type. Portions were cut from each swatch and embedded in epoxy. When hard, these samples were cut and polished to allow inspection of the intact cross section.

Based on the findings from Task 1, the analysis techniques used in Task 2 were focused on those that provided the most useful data. All images in this report are with backscattered electron imaging (BEI) which distinguishes objects by their material composition. Energy dispersive x-ray (EDX) analysis was also conducted on selected specimens to collect elemental composition data. Element mapping was performed under Task 1 to further highlight the extent of particulate penetration into the fabric. However, the mapping was not performed under Task 2 since the insight it provided was only marginally better than an overall backscattered image and the data collection consumed a significant amount of instrument time.

Table 1. Presque Isle Power Plant Bag Samples Received from Grubb Filtration

Bag Type	Midwesco Style Number
Standard 2.7-denier Polyphenylene Sulfide (PPS)	1378
High-Perm 7-denier Torcon	9056
P84	1342
Dual-Density Torcon PPS	9065

RESULTS FOR THE P84 SAMPLE

Figures 1 and 2 are composite images showing the entire fabric cross section for P84 Samples 1 and 2, respectively. The normal flow of flue gas for these images is from left to right. The accumulation of particulates on the "dirty" side of each sample should be noted. Significant particulate penetration appears shallow for both samples, typically less than 0.5 mm in most areas. However, scattered accumulations of particulates are observed throughout the cross sections of Figures 1 and 2, indicating that there may be a minor emission of particulates from the "clean" side of the filter. The overall fabric thickness is approximately 2.1 mm.

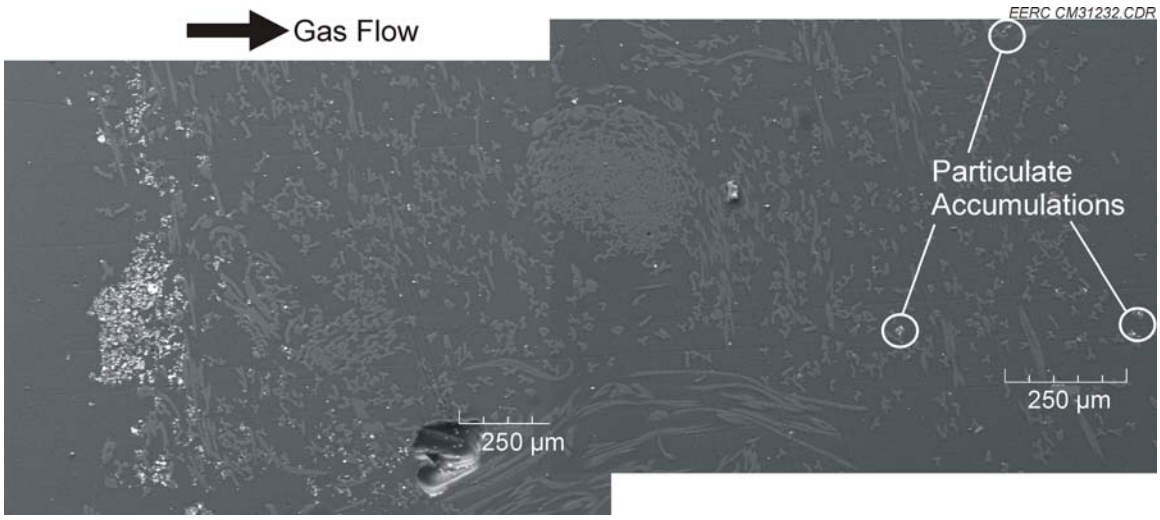


Figure 1. Images of P84 Sample 1 showing entire fabric cross section.

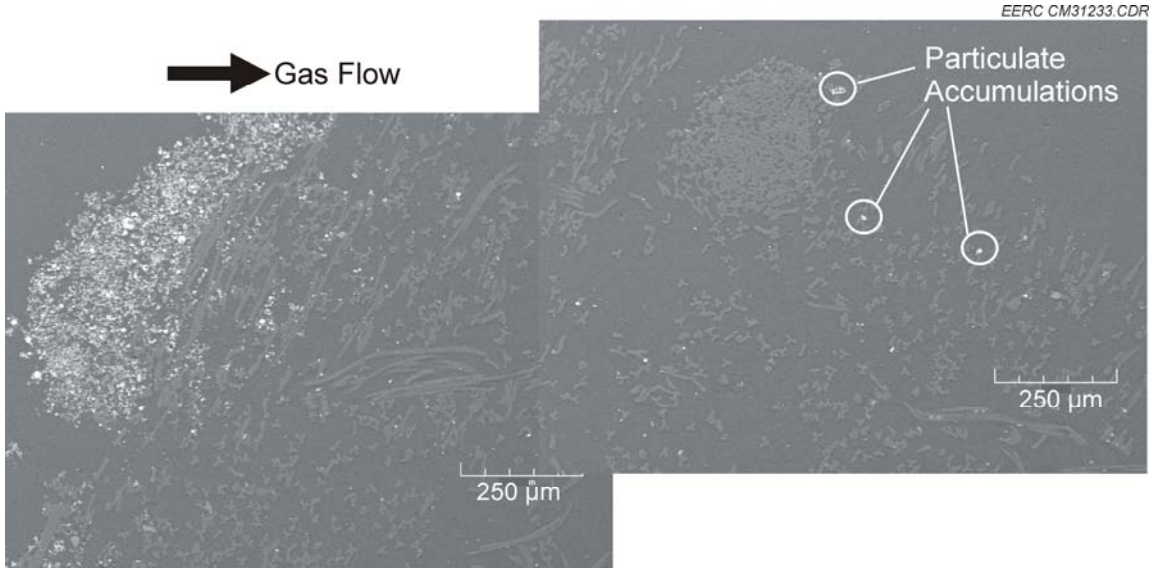


Figure 2. Images of P84 Sample 2 showing entire fabric cross section.

Figure 3 is a magnified image of the fabric material for the P84 Sample 1. Unlike all of the other fabrics examined thus far, the P84 fabric fibers are not circular in cross section. Instead, they are made up of three lobes arranged in a "Y" configuration. Measurements of the fibers indicate that the overall dimension of the "Y" is approximately 20 µm, while each lobe was approximately 8 µm in width.

Figure 4 is a detail of the outer dust layer and highlights several EDX analysis points that correspond to the composition data in Table 2. As shown in the representative image of Figure 4, there were very few ash particles greater than 10 µm and the vast majority of ash in the surface layer was composed of particles less than 5 µm. Referring to the EDX analysis numbers in Figure 4, Points 1, 8, and 14 were classified as ash particles. AC was also identified in the outer layer; Points 2–7, 10, and 12 were identified as AC. The largest particles of AC were in the size range of 10–15 µm.

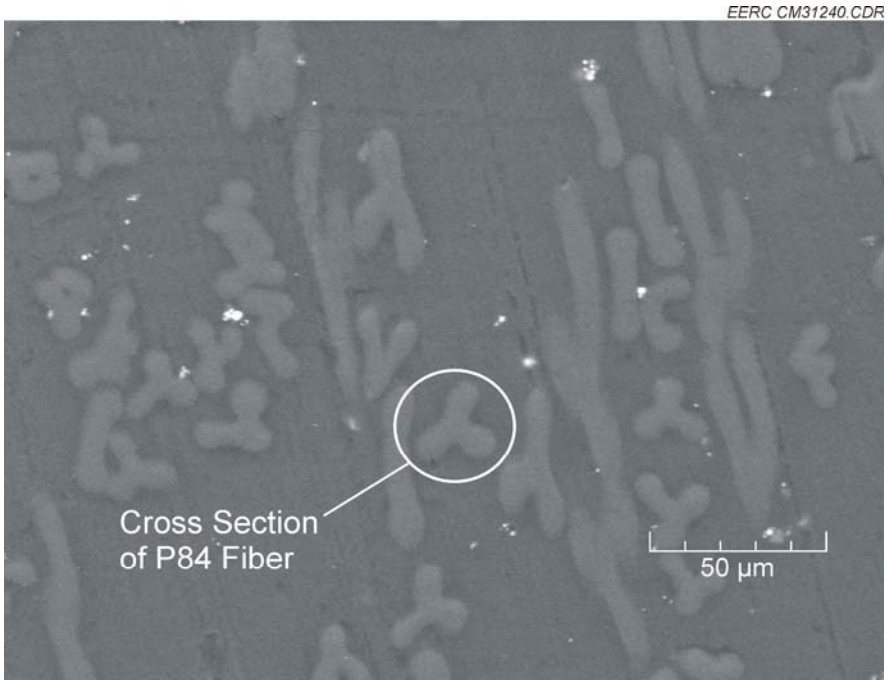


Figure 3. P84 Sample 1 image highlighting the fiber's cross-sectional shape.

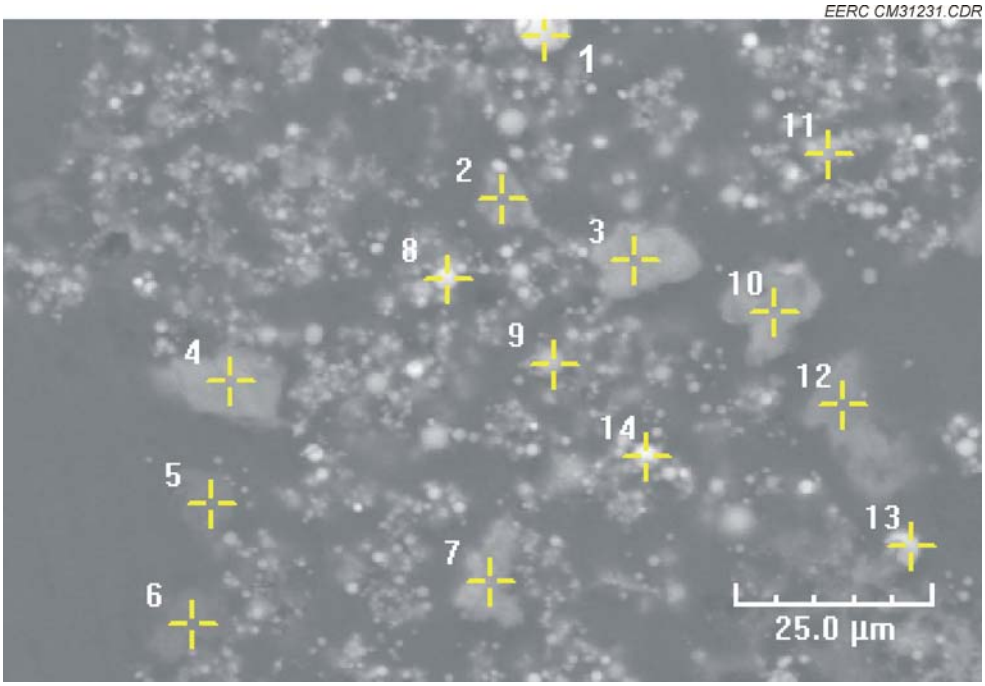


Figure 4. Magnified view of the surface dust layer of P84 Sample 1. Numbered points correspond to EDX analysis presented in Table 2.

Table 2. Composition Data Corresponding to the Sample Points Highlighted in Figure 4

Tag	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Fe	C	O
1	0.00%	2.09%	11.88%	5.77%	0.43%	1.03%	0.00%	0.00%	36.55%	3.18%	5.59%	28.52%	4.79%
2	0.69%	0.43%	0.35%	0.74%	0.00%	8.24%	0.19%	0.00%	6.71%	0.13%	0.44%	79.90%	2.16%
3	0.82%	0.45%	0.63%	0.77%	0.05%	11.78%	0.09%	0.00%	10.29%	0.38%	1.49%	68.34%	4.90%
4	1.19%	0.34%	1.15%	1.11%	0.56%	8.75%	0.06%	0.11%	5.27%	0.93%	0.80%	75.81%	3.90%
5	0.23%	0.32%	0.54%	0.54%	0.07%	2.78%	0.36%	0.00%	1.92%	0.00%	0.29%	90.09%	2.87%
6	0.32%	0.31%	0.69%	0.89%	0.07%	3.05%	0.36%	0.02%	1.94%	0.07%	0.29%	89.39%	2.59%
7	0.71%	0.17%	3.41%	4.30%	0.11%	5.78%	0.05%	0.12%	3.65%	0.26%	0.89%	77.07%	3.48%
8	0.38%	2.48%	7.21%	7.18%	0.42%	1.81%	0.00%	0.00%	14.96%	0.80%	2.33%	56.79%	5.65%
9	0.03%	0.04%	2.64%	9.54%	0.09%	1.14%	0.07%	1.24%	0.68%	0.05%	0.31%	81.45%	2.72%
10	1.01%	0.77%	0.61%	1.09%	0.24%	8.69%	0.02%	0.01%	4.61%	0.30%	0.40%	78.87%	3.38%
11	0.56%	1.20%	3.14%	4.14%	0.00%	7.06%	0.14%	0.16%	3.12%	0.46%	0.88%	76.62%	2.49%
12	0.51%	0.27%	0.79%	0.09%	0.41%	5.06%	0.01%	0.00%	2.94%	0.02%	0.53%	85.98%	3.40%
13	0.00%	0.00%	6.71%	8.19%	0.06%	0.26%	0.09%	0.37%	0.10%	0.02%	6.51%	75.42%	2.26%
14	0.11%	2.06%	8.27%	3.46%	1.07%	3.50%	0.00%	0.00%	17.58%	0.36%	4.02%	54.79%	4.71%

Figure 5 highlights several accumulations of dust embedded approximately 1 mm into the fabric. The circled area has been expanded and is shown in Figure 6. Several-point EDX analyses were conducted and are indicated by the numbered points in Figure 6. The corresponding composition data are shown in Table 3.

The EDX data support the presence of AC in the embedded particulates of Figure 5 since Points 3, 4, 5, and 8 have the appearance of AC and the composition data in Table 3 indicate a high carbon content. However, the high background level of carbon for all point analyses in Table 3 should be noted. For example, Points 1 and 6 are clearly fly ash particles, but the composition data indicate high carbon levels, roughly 40% and 77%, respectively.

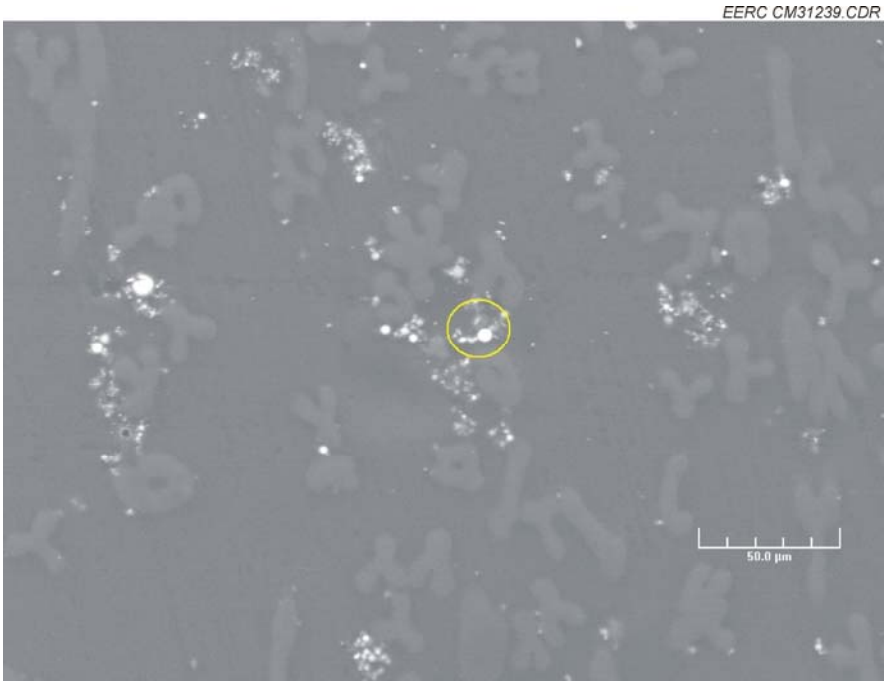


Figure 5. Image of P84 Sample 1 highlighting deeply embedded dust agglomerations.

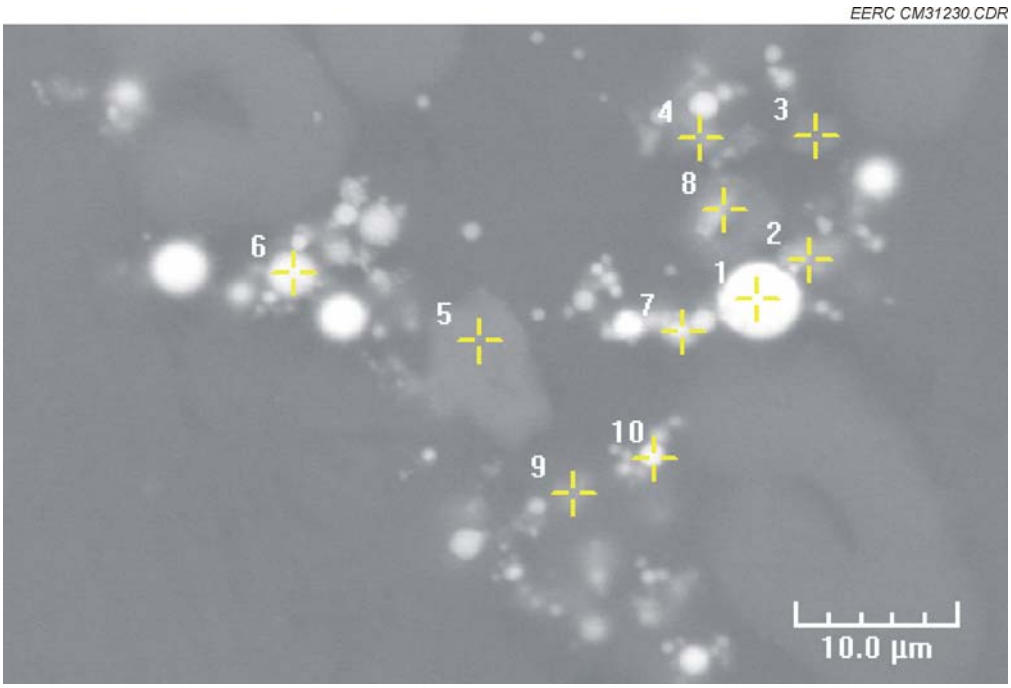


Figure 6. Detail of embedded ash agglomeration circled in Figure 5. Numbered points correspond to EDX analysis presented in Table 3.

Table 3. Composition Data Corresponding to the Sample Points Highlighted in Figure 6

Tag	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Fe	C	O
1	0.00%	2.30%	13.79%	3.62%	1.96%	0.58%	0.00%	0.00%	24.00%	1.81%	7.96%	39.98%	3.90%
2	0.07%	0.84%	2.28%	1.87%	0.33%	3.82%	0.23%	0.00%	9.72%	0.15%	1.52%	75.31%	3.84%
3	0.21%	0.43%	0.76%	0.68%	0.13%	1.83%	0.71%	0.00%	1.28%	0.02%	0.37%	90.66%	2.90%
4	0.31%	0.64%	0.89%	1.28%	0.08%	3.63%	0.28%	0.01%	2.33%	0.17%	0.44%	87.63%	2.29%
5	0.18%	0.19%	0.50%	0.69%	0.06%	2.99%	0.31%	0.00%	2.23%	0.04%	0.42%	89.79%	2.60%
6	0.49%	0.41%	3.95%	8.67%	0.08%	1.10%	0.13%	0.68%	2.88%	0.36%	0.89%	76.86%	3.50%
7	0.00%	0.27%	3.28%	3.09%	0.20%	3.08%	0.08%	0.06%	4.93%	0.97%	2.27%	78.53%	3.26%
8	0.07%	0.14%	0.22%	5.58%	0.17%	1.61%	0.07%	0.01%	1.06%	0.01%	0.18%	89.47%	1.41%
9	0.16%	0.37%	1.31%	1.50%	0.10%	2.70%	0.18%	0.07%	2.20%	0.09%	0.54%	88.81%	1.98%
10	0.13%	0.48%	3.22%	3.87%	0.05%	1.25%	0.10%	0.13%	2.88%	0.25%	0.68%	83.09%	3.87%

RESULTS FOR THE DUAL-DENSITY SAMPLE

Figures 7 and 8 show the cross-sectional views of both samples obtained from the dual-density filter. The normal flow of flue gas for these images is from left to right. As with the P84 samples, there is an accumulated dust layer on the dirty surface of the dual-density filter and a limited amount of heavy particulate penetration. The amount of significant particulate penetration into the fabric was limited to approximately 0.55 mm. The overall thickness of the dual-density fabric was approximately 2.2 mm. Figures 7 and 8 provide some evidence that particulates were migrating through the entire fabric thickness, but it was less noticeable than that observed with the P84 samples.

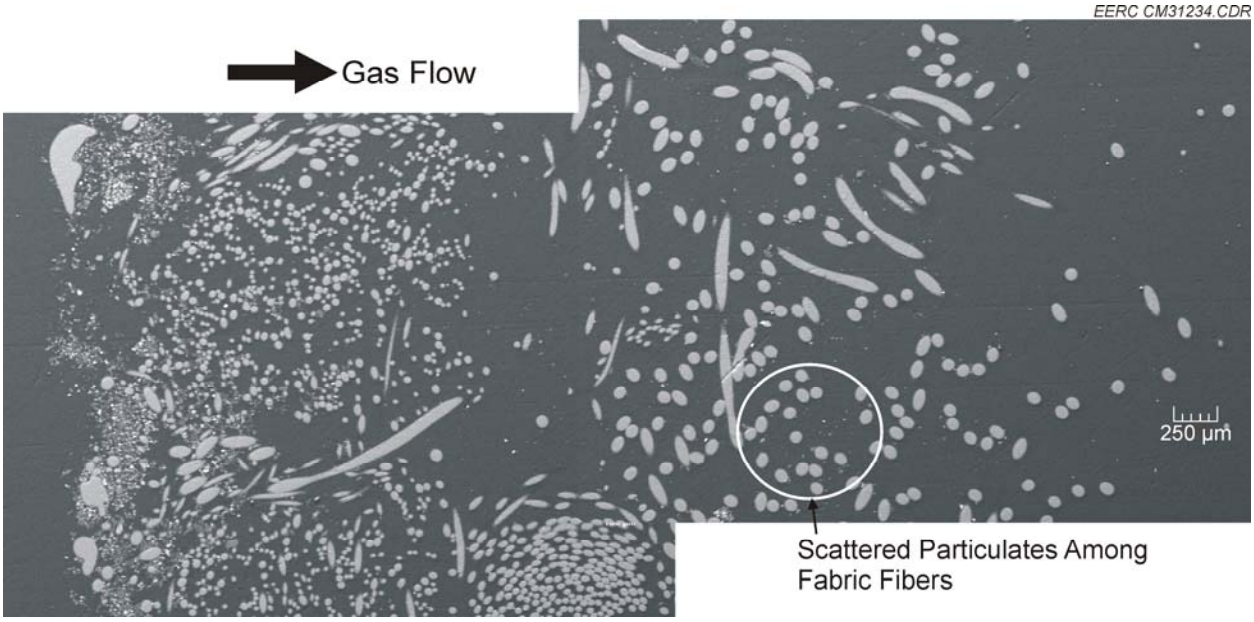


Figure 7. Images of dual-density Sample 1 showing entire fabric cross section.

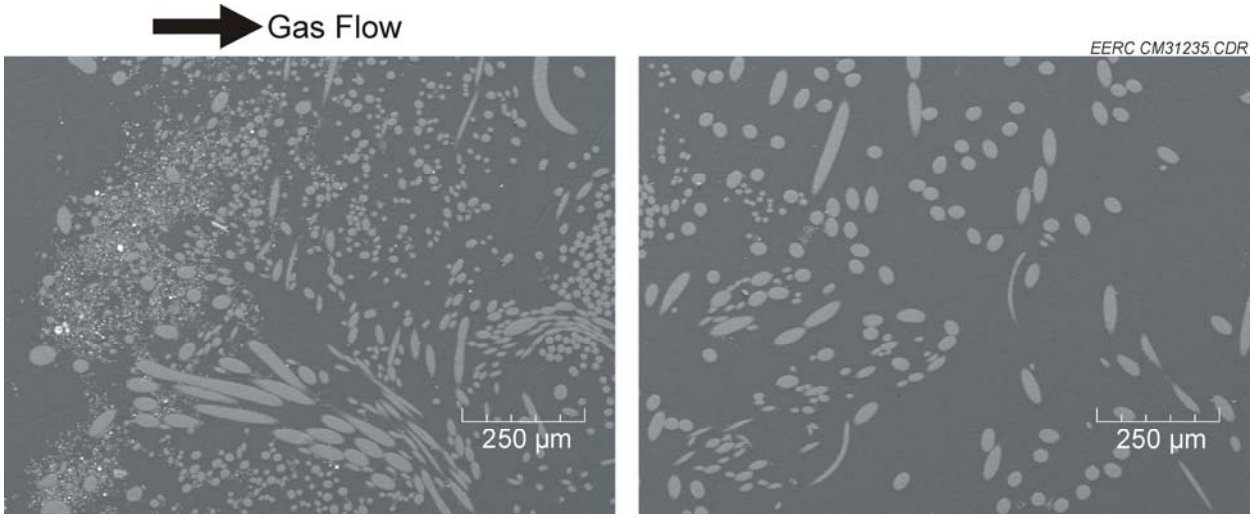


Figure 8. Images of dual-density Sample 2 showing entire fabric cross section.

The dual-density samples were composed of circular fibers with three separate diameters. The smaller fibers with approximate diameters of 11 and 18 µm made up the initial 0.9 mm (in from the dirty side) while fibers with an approximate diameter of 28 µm made up the remainder of the fabric thickness. A close-up image containing all three fiber diameters is shown in Figure 9.

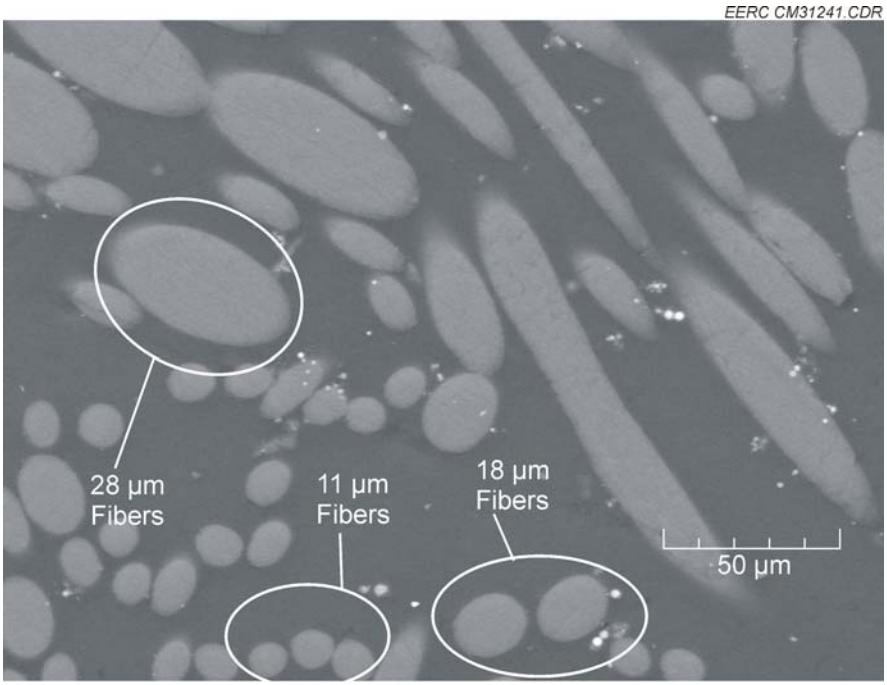


Figure 9. Image of dual-density Sample 2 highlighting the different fiber diameters.

Figure 10 shows a representative image of the accumulated surface dust layer for the dual-density filter. As with the ash accumulated on the P84 surface, the ash particles are typically less than 5 µm, and AC was observed in sizes up to approximately 15 µm.

Figure 11 is a representative view of embedded particulates approximately 1 mm in from the surface particulate layer of dual-density Sample 1. The upper right accumulation of particles in this image suggests that AC was a common constituent of the embedded material.

A highly magnified view of the area identified by the circle in Figure 11 is provided in Figure 12. EDX sample points are identified in Figure 12, and the corresponding composition data are provided in Table 4. While the composition of several of the test points suggests that the particulates are AC, e.g., 1, 2, 6, 7, and 12, these small particles were difficult to identify visually using the backscattered image of Figure 12.

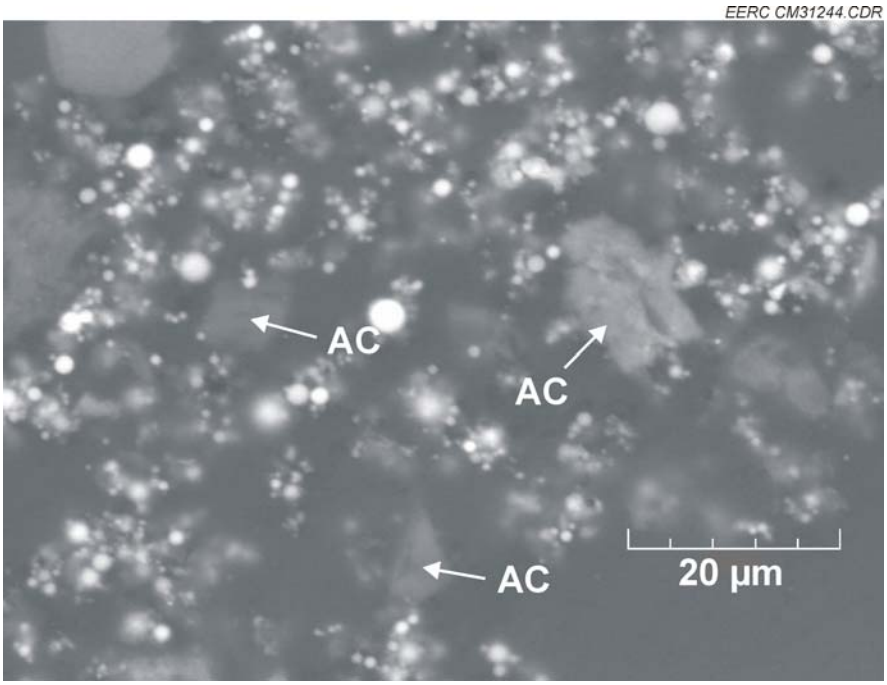


Figure 10. Detail image of the accumulated surface material on dual-density Sample 1.

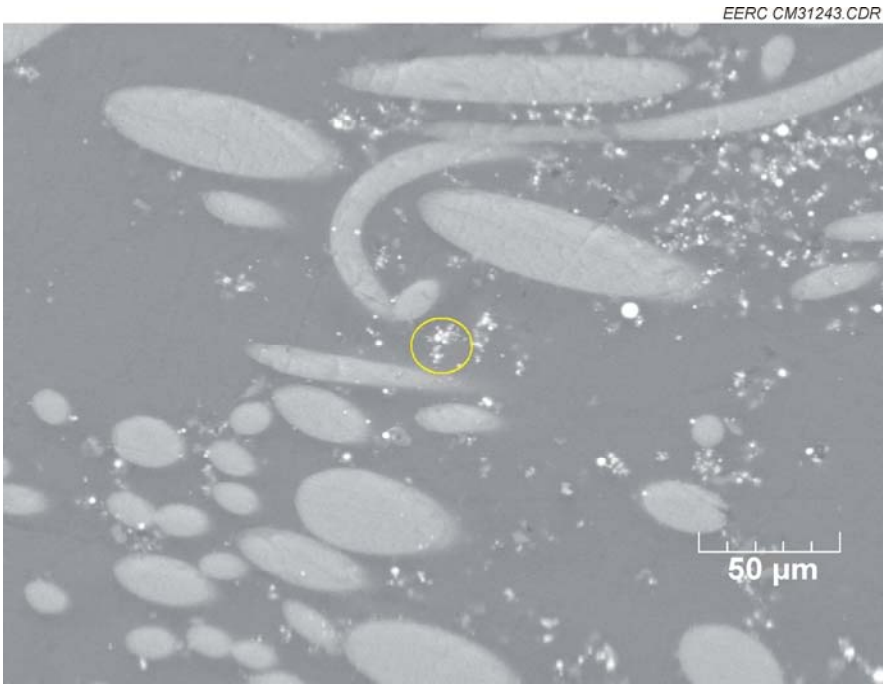


Figure 11. Image of dual-density Sample 1 highlighting embedded dust agglomerations.

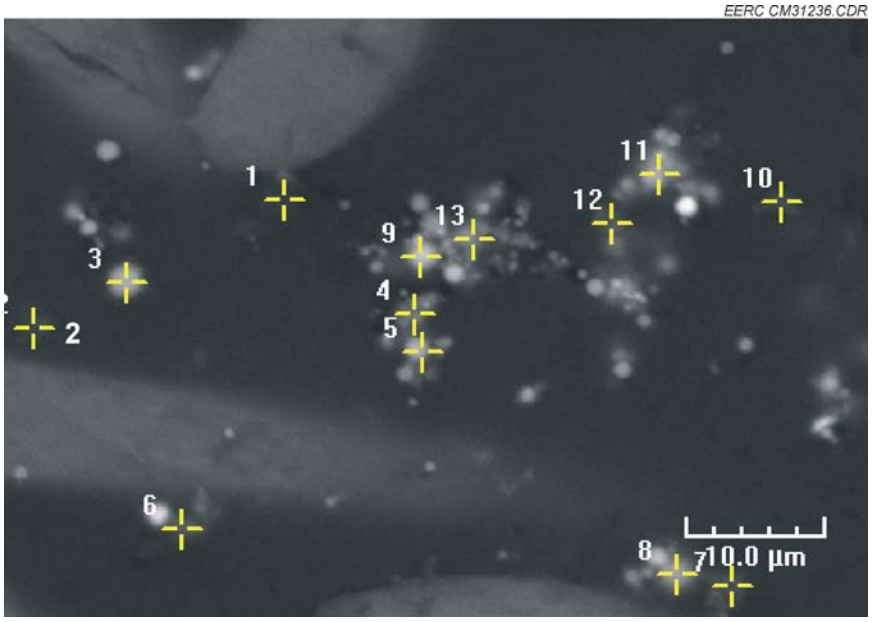


Figure 12. Detail of embedded ash agglomeration circled in Figure 11. Numbered points correspond to EDX analysis presented in Table 4.

Table 4. Composition Data Corresponding to the Sample Points Highlighted in Figure 12

Tag	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Fe	C	O
1	0.00%	0.03%	0.06%	0.04%	0.00%	4.21%	0.24%	0.00%	0.09%	0.07%	0.03%	93.88%	1.34%
2	0.03%	0.06%	0.09%	0.08%	0.00%	2.67%	0.43%	0.00%	0.30%	0.00%	0.05%	93.62%	2.66%
3	0.02%	0.03%	1.41%	5.15%	0.00%	0.97%	0.16%	0.43%	0.26%	0.07%	0.41%	88.02%	3.06%
4	0.05%	0.14%	1.35%	0.89%	0.00%	3.19%	0.23%	0.02%	1.17%	0.14%	0.30%	90.29%	2.23%
5	0.05%	0.31%	0.85%	4.37%	0.09%	2.27%	0.26%	0.06%	1.07%	0.12%	0.71%	87.08%	2.75%
6	0.01%	0.08%	0.54%	0.63%	0.00%	3.49%	0.17%	0.02%	0.40%	0.05%	0.13%	92.71%	1.78%
7	0.00%	0.06%	0.10%	0.08%	0.00%	4.21%	0.24%	0.00%	0.56%	0.02%	0.07%	92.95%	1.70%
8	0.00%	0.47%	0.98%	4.21%	0.14%	3.78%	0.14%	0.00%	8.42%	0.16%	0.79%	77.83%	3.07%
9	0.16%	1.09%	5.61%	3.70%	0.33%	2.63%	0.09%	0.00%	7.19%	0.27%	1.63%	74.42%	2.87%
10	0.03%	0.16%	0.24%	0.67%	0.00%	1.68%	1.21%	0.00%	0.87%	0.03%	0.18%	92.34%	2.60%
11	0.34%	1.13%	3.98%	7.31%	0.24%	3.15%	0.16%	0.00%	9.95%	0.86%	1.16%	69.55%	2.16%
12	0.19%	0.20%	0.89%	2.02%	0.01%	1.96%	0.41%	0.16%	0.77%	0.04%	0.57%	90.64%	2.15%
13	0.23%	0.49%	2.33%	1.43%	0.10%	4.45%	0.19%	0.00%	6.48%	0.14%	1.15%	80.59%	2.41%

SUPPLEMENTARY FIBER MEASUREMENTS

During the inspection process, it was noticed that EDX point measurements of the bag fibers resulted in slightly different composition data for points sampled in different locations on the fiber cross section. A set of systematic measurements was made across an individual fiber diameter of the dual-density filter, as shown in Figure 13. The composition data from these measurements are plotted in Figure 14 for carbon and sulfur, both key constituents of the PPS bag material. The data in Figure 14 clearly show trends in elemental composition; however, whether the trends are significant remains to be determined. This could be an artifact of the

mounting and preparation method, or it could indeed provide useful information about the fiber condition. Perhaps a sampling of several fibers as a function of flue gas exposure time could yield statistical data that could be related to macroscale properties such as fabric tensile strength or burst pressure.

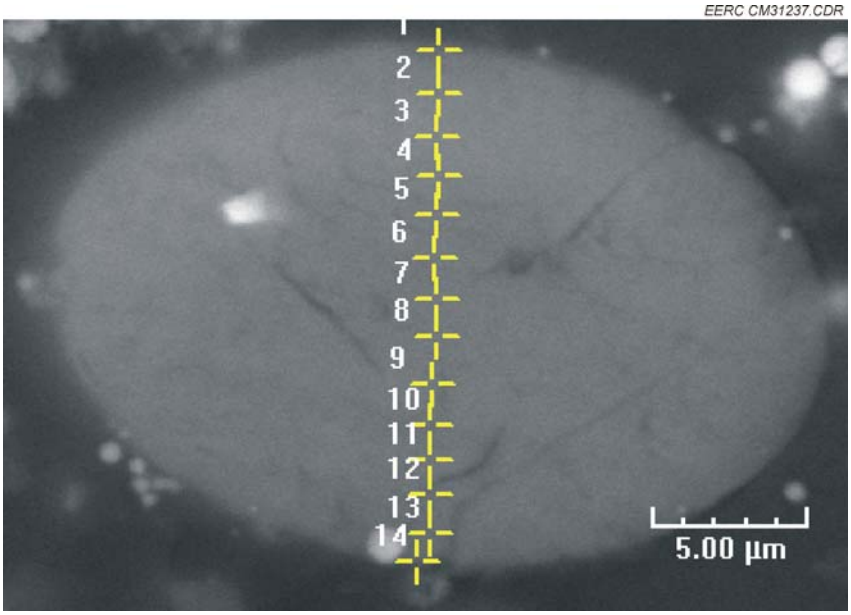


Figure 13. Set of EDX measurements made across an individual fiber of the dual-density filter.

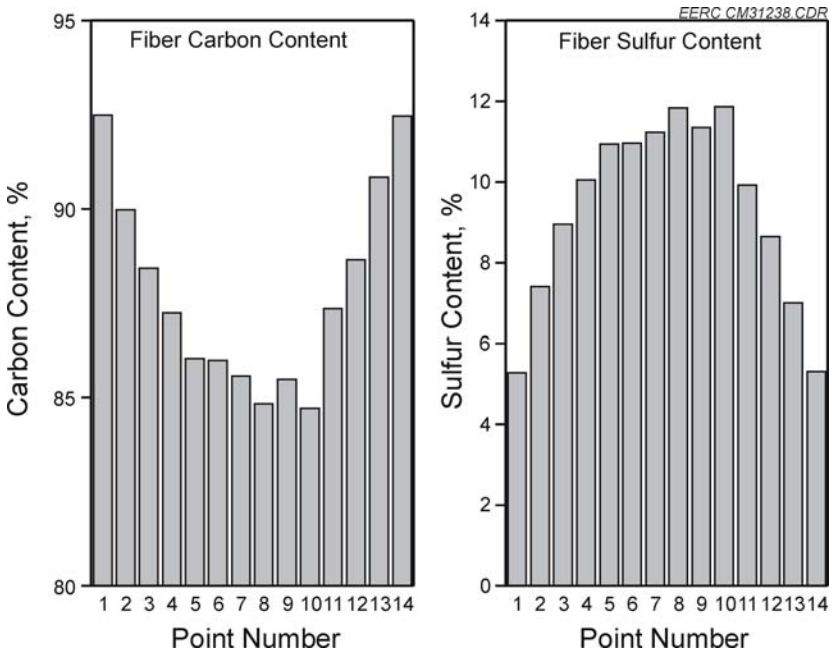


Figure 14. Elemental composition data across an individual fiber cross section. Point numbers refer to the points identified in Figure 13.

CONCLUSIONS

- In terms of particulate penetration, both the P84 and dual-density samples from PIPP were similar, and neither showed significant penetration beyond approximately 0.5–0.55 mm. This is approximately one-quarter of the overall fabric thickness, which was 2.1–2.2 mm for the samples.

- Small amounts of particulates were observed throughout the entire cross sections of both samples; however, it was slightly more evident for the P84 samples than for the dual-density samples.

- Inspection of the outer dust layers from both bag types revealed that the ash generally had particle sizes smaller than 5 μm. Very few ash particles were over 10 μm. AC was also identified in this outer layer, and the largest observed particles were in the 10–15-μm-size range. Inspection of embedded particulates (approximately 1 mm in from the surface ash layer) showed that the ash particle sizes were similar to those in the material collected on the filter's surface. AC was also identified in the embedded material, and it appeared that the largest AC particles in the embedded material were closer to 10 μm in size.

- The P84 material was composed of fibers having a noncircular cross section. The fiber cross section of the P84 fabric was made up of three lobes arranged in a "Y" configuration. The overall size of the "Y" was approximately 20 μm, while each lobe was approximately 8 μm wide.

- The dual-density sample was composed of three sizes of circular fibers having three different diameters. The smaller fibers with approximate diameters of 11 and 18 μm made up the initial 0.9 mm (in from the dirty side), while fibers with an approximate diameter of 28 μm made up the remainder of the fabric thickness. This is in fair agreement with the stated fabric denier values for the dual-density fabric which are 0.9, 2, and 7 denier. Ideally, the ratio of the squares of the measured fiber diameters (1:2.7:6.5) should be equivalent to the ratio of the denier values (1:2.2:7.8).

- Analysis of the cross section of a fabric fiber clearly revealed composition changes from the fiber's outer edge to its core. Whether these data could be used to monitor fabric condition or extract other useful information is not currently known.

Appendix BB. SO_2 NO_x Reduction at PIPP – Topical Report Final

TOXECON™ Retrofit for Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers

Topical Report: Performance and Economic Assessment of Trona-Based SO_2/NO_x Removal at the Presque Isle Power Plant

Prepared for:
We Energies
DOE/NETL

Prepared by:
ADA-ES, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120
(303) 734-1727

August 18, 2008

Table of Contents

Summary 1

Introduction 1

Background 2

Test and Equipment Description 3

- **Trona Background Information** 4
- **Trona Injection Equipment** 4
- **Trona/Ash Unloading Issues** 7
- **SO_2, NO_x and Opacity Measurement** 7

Test Results 8

- **Baseline Testing** 8
- **Parametric Testing** 10
  - **Schedule and Materials Handling** 10
  - **SO_2 and NO_x Removal** 11
  - **Baghouse Pressure Drop and Cleaning Frequency** 15

Economic Assessment of Full-Scale Trona Injection 17

- **Introduction** 17
- **Process Design** 17
  - **Trona Injection System** 17
  - **Ash Handling System** 19
- **Cost Estimates and Results** 20
  - **Capital Costs** 20
  - **Operating and Maintenance Costs** 22
  - **Levelized Costs** 25
  - **Removal Cost per Ton of SO_2 Removed** 28

Conclusions 30

References 31

APPENDIX A – Cost Estimates and Results – Details 32

- **Capital Costs** 32
- **Operating and Maintenance Costs** 34
- **Levelized Costs** 39
- **Removal Cost per Ton of SO_2 Removed** 46

List of Tables

Table 1. Schedule of Activities for SO_2/NO_x Control Testing. ... 3
Table 2. Trona Injection Results. ... 11
Table 3. System Design Criteria for SO_2 Control System at Presque Isle (6000 lb/hr injection, >70% SO_2 control). ... 18
Table 4: Summary of Equipment, Balance-of-Plant, and Engineering Costs ... 21
Table 5. Total First-Year Fixed Operating & Maintenance Costs ... 23
Table 6. Variable First-Year Operating & Maintenance Costs for Power ... 24
Table 7. First-Year Variable Operating & Maintenance Costs for Sorbent Delivered by Rail and by Rail/Truck Combination to the Plant ... 24
Table 8. First-Year Variable Operating & Maintenance Costs for Landfill Waste Disposal ... 25
Table 9. First-Year Total Variable Operating & Maintenance Costs ... 25
Table 10. Economic Factors and Parameters ... 26
Table 11. Levelized Capital Costs ... 26
Table 12. Total Levelized Fixed Operating & Maintenance Costs ... 27
Table 13. Levelized Total Variable Operating & Maintenance Costs ... 27
Table 14. Total Levelized Costs (Capital and Fixed & Variable O&M Costs) ... 28
Table 15. Removal Cost per Ton of SO_2 ... 29
Table 16. Summary of Equipment, Balance-of-Plant, and Engineering Costs ... 33
Table 17. Fixed O & M Costs – Ash Handling Labor Cost Parameters ... 34
Table 18. Fixed O & M Costs – Ash Handling Labor Costs for Three SO_2 Removal Rates ... 35
Table 19. Fixed Operating & Maintenance Costs for Equipment Operating, Maintenance and Support Labor ... 35
Table 20. Total First Year Fixed Operating & Maintenance Costs ... 36
Table 21. Power Requirements to Run Trona Injection System ... 37
Table 22. Variable Operating & Maintenance Costs for Power ... 37
Table 23. Variable Operating & Maintenance Costs for Sorbent Delivered by Rail to the Plant ... 38
Table 24. Variable Operating & Maintenance Costs for Sorbent Delivered by a Combination of Rail and Truck to the Plant ... 38
Table 25. Variable Operating & Maintenance Costs for Disposing the Waste to the Landfill ... 39
Table 26. Total Variable Operating & Maintenance Costs ... 39
Table 27. Levelized Capital Costs ... 40
Table 28. Levelized Fixed Operating & Maintenance Costs for Ash Handling Labor ... 41
Table 29. Levelized Fixed Operating & Maintenance Costs for Equipment Operating, Maintenance, and Support Labor ... 41
Table 30. Levelized Total Operating & Maintenance Costs ... 42
Table 31. Levelized Variable Operating & Maintenance Costs for Power ... 42
Table 32. Levelized Variable Operating & Maintenance Costs for Sorbent Delivered by Rail to the Plant ... 43
Table 33. Levelized Variable Operating & Maintenance Costs for Sorbent Delivered by a Combination of Rail and Truck to the Plant ... 43

Table 34. Levelized Variable Operating & Maintenance Costs for Waste Disposal 44
Table 35. Levelized Total Variable Operating & Maintenance Costs 44
Table 36. Levelized Costs (Capital, Fixed, and Variable Levelized Costs) 45
Table 37. Removal Costs per Ton SO_2 Removed 46

List of Figures

Figure 1. Staging Area for Trona Injection Equipment 5
Figure 2. Trona Injection Trailer Blowers and Controls. 6
Figure 3. Injection Ports 7
Figure 4. Baseline SO_2 and NO_x Data 9
Figure 5. Unloading Reacted Trona/PAC/Ash Mixture 10
Figure 6. SO_2 Removal vs. Trona Injection Rate. 12
Figure 7. SO_2 Removal Profiles. 12
Figure 8. NOx Removal During Trona Injection. 13
Figure 9. Effect of 5926 lb/hr Trona Injection on SO_2, NO_x, and Opacity. 14
Figure 10. Effect of 5926 lb/hr Trona Injection without PAC Injection 14
Figure 11. Baghouse Operation During Trona Injection Testing. 16
Figure 12: Schematic of the Trona Injection Equipment at Presque Isle Units 7, 8 and 9 . 19

List of Acronyms

DOE	**Department of Energy**
PAC	**Powdered Activated Carbon**
NSR	**Normalized Stoichiometric Ratio**
MMacf	**Million actual cubic feet of flue gas**
O&M	**Operating & Maintenance**
EPRI	**Electric Power Research Institute**
CEM	**Continuous Emissions Monitor**
RATA	**Relative Accuracy Test Audit**
TCR	**Total Capital Requirement**

Summary

Under a DOE Clean Coal Program, activated carbon injection has been used to demonstrate continuous mercury removal at We Energies' Presque Isle Power Plant (PIPP). Trona injection tests were also performed at PIPP from July 31 through August 10, 2007. The purpose of these tests was to determine if dry trona injection prior to the TOXECON™ baghouse would result in at least 70% sulfur dioxide (SO_2) reduction, and to assess any related change in mercury removal. Some minor nitrogen oxide (NO_x) reduction was also anticipated from these tests. Balance of plant issues associated with trona injection and subsequent ash handling were also evaluated.

A temporary injection system was set up near the Units 7-9 stack with individual hoses and lances feeding each of the Unit ducts. The injection point was near the existing PAC injection ports in each duct and downstream of the plant NO_x analyzers used for boiler feedback. SO_2 and NO_x analyzers were temporarily installed upstream of the trona injection point on each of the three ducts for monitoring during the tests. Existing analyzers were used at the stack to measure SO_2, NO_x, and opacity.

During the test period, the trona injection rate was varied, which provided the data necessary to complete an SO_2 removal curve. Powdered Activated Carbon (PAC) injection continued at pre-trona injection test levels with trim control on, which allowed some variability (+/- 20%) in injection rate. PAC injection was turned off one day to determine if there was an effect from PAC on SO_2 removal. Due to a negative effect from trona injection on mercury removal, PAC injection was increased on one day to try to regain a >90% removal rate.

The goal of 70% SO_2 removal was achieved during this two week test period when using 5926 lb/hr of trona. This corresponds to an average Normalized Stiochiometric Ratio (NSR) of 1.02. The NSR is the molar ratio of the sorbent injected to that theoretically required for complete reaction with SO_2. The inlet concentration of SO_2 varied from 0.48-0.64 lb/MBtu. The highest removal was 74.1% with PAC injection at 3.8 lb/MMacf. There was very little reduction in total NO_x during the test period, although the presence of the side reaction with NO producing NO_2 was observed during when PAC injection was turned off. Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. The mercury removal slowly recovered overnight to the pre-trona injection levels of >90%.

An economic assessment of a full-scale trona injection system included equipment and other capital costs along with sorbent cost (trona and increased amount of PAC to maintain 90% removal) and O&M costs. The cost to remove SO_2 varied from $1,448/ton at 45% removal and one silo to $2,231/ton SO_2 at 70% removal with 3 silos.

Introduction

We Energies' Presque Isle Power Plant is the site of a DOE Clean Coal demonstration project being conducted under a cooperative agreement with Wisconsin Energy Corporation and the Department of Energy (DOE). The primary goal of this project is to reduce mercury emissions

using a TOXECON™ system designed to clean the combined flue gases of Units 7, 8, and 9 at the Presque Isle Plant. An additional goal is to reduce NO_x and SO_2 emissions.

TOXECON™ is an Electric Power Research Institute (EPRI) patented process in which a fabric filter system (baghouse) installed downstream of an existing particulate control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. The flue gas emissions are controlled from the three units using a single baghouse. Mercury is controlled by injection of activated carbon, while NO_x and SO_2 reduction was tested by injection of sodium-based sorbents. Both the mercury and SO_2/NO_x control sorbents were removed from the gas stream by the baghouse.

The overall objectives of this project are to demonstrate the operation of the TOXECON™ multi-pollutant control system and:

1. Achieve 90% mercury removal from flue gas through activated carbon injection (achieved).
2. Reduce particulate emissions through collection by the TOXECON™ baghouse (achieved).
3. Maintain 100% utilization of fly ash collected in the existing electrostatic precipitator (achieved).
4. Demonstrate reliable, accurate mercury CEM suitable for use in the power plant environment (achieved).
5. Evaluate the potential for 70% SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection, while maintaining 90% mercury removal.
6. Recover 90% of the mercury captured in the sorbent.

Objective #5 was the focus of the test program described in this report.

Background

Testing of SO_2/NO_x control sorbents to date in the TOXECON™/COHPAC® configuration included:

- Full-scale tests injecting sodium bicarbonate and sodium sesquicarbonate (trona) upstream of the Big Brown COHPAC® baghouse for SO_2 control.[1]
- Pilot tests of sodium and lime sorbents injected upstream of COHPAC® for SO_2 control at Southern California Edison's Mohave Station.[2]
- Slipstream tests of sodium-based materials, lime, activated carbon, and a proprietary catalyst for NO_x, SO_2, SO_3, HCl, HF, and Hg at the PSEG Hudson Generating Station.[3]

Test results indicate that sodium-based products can achieve from 30% to 70% SO_2 reduction. At normal flue gas temperatures, lime/calcium products are not effective for SO_2 control. Sodium-based sorbents also reduced NO_x by 10% to 20%. HCl removal was as high as 50% at Hudson using sodium sesquicarbonate.

Test and Equipment Description

This test effort was designed to support the overall objectives of the TOXECON™ retrofit at Presque Isle as well as to further the technical understanding of the TOXECON™ technology for both We Energies and the greater industry. Parametric and continuous tests were planned to assess the capability of trona injection upstream of the TOXECON™ baghouse to control SO_2 and NO_x. Injection equipment and measurement instrumentation were installed specifically for these tests. The following were the objectives of the testing program:

1. Quantify the trona injection rate versus SO_2/NO_x removal.
2. Record baghouse performance over the test period, showing how pressure drop, cleaning frequency and mercury removal change.
3. Determine if there is any negative effect of trona injection on emissions (NO_2 production).
4. Evaluate the technical and economic performance of trona as an option for full-scale SO_2 control.

The tests for SO_2/NO_x control were conducted in two phases, baseline and parametric testing, as shown in Table 1. Measurements were taken during July to determine baseline conditions. Parametric testing data was used to characterize the performance of trona across a range of injection concentrations and at different PAC injection concentrations. Originally, a 5 day continuous test was scheduled but due to shipping and material handling issues this phase was cancelled.

Table 1. Schedule of Activities for SO_2/NO_x Control Testing.

SO_2-NO_x Control Activity	Duration (Days)	Start Date	Boiler Load
Baseline Testing	21	07/09/2007	Normal Operation
Equipment Installation and Shakedown	2	07/30/2007	Normal Operation
Parametric Testing	10	08/1/2007	Full Load 6AM–6PM

The final test plan for injecting trona to control SO_2 and NO_x was distributed to the project team in July. The plant completed the installation of SO_2 and NO_x analyzers at each of the three ducts upstream of the sorbent injection point in early July. These analyzers provided data on untreated SO_2 and NO_x levels for both baseline and injection testing.

Plant operators kept the three units at full, steady load during the two week test period. The boiler soot blowers were used every hour on a staggered schedule with the three units to keep the flue gas temperature from fluctuating during testing. PAC injection was left unchanged initially. The logic allowed for the injection rate to vary +/- 20% to keep 91% mercury removal.

Trona Background Information

Trona is a sodium-based, naturally occurring mineral (sodium sesquicarbonate). The trona used during this test program was obtained from Solvay Chemicals, Inc. and was mined in Green River, Wyoming. The purified SOLVAir Select 200 trona was shipped by rail to Chicago then loaded into hopper trucks for delivery to Marquette, Michigan. The hopper trucks typically carried 45,000 – 48,000 lb of trona depending on the test schedule. The particle size of the trona averaged 26 µm according to the Certificate of Analysis accompanying the material.

The formula for sodium sesquicarbonate is:

$$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$$

sodium carbonate · sodium bicarbonate · water

When heated to 257-482°F in a duct or a calciner, the sodium trona decomposes to sodium carbonate according to the formula:

$$2(Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O) \rightarrow 3Na_2CO_3 + CO_2 + 5H_2O$$

When injecting trona into a coal fired power plant flue gas, it reacts with hydrochloric acid and SO_2 according to the following:

$$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O + 3HCl \rightarrow 3NaCl + 4H_2O + 2CO_2$$

$$2(Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O) + 3SO_2 \rightarrow 3Na_2SO_3 + 4CO_2 + 5H_2O$$

$$3Na_2SO_3 + 1.5O_2 \rightarrow 3Na_2SO_4$$

Review of industry literature emphasizes the benefit of injecting trona in a hot-side (greater than 700 °F) location. Trona experiences what is referred to as a "popcorn effect" where at high temperature the thermal decomposition reaction results in an expanded particle with a high surface area to mass ratio, improving the chemical availability of the sodium compound. This change improves the effectiveness by a factor of between 5 and 10. Trona will still react with SO_2 if injected at lower temperatures (typical cold-side temperature around 300 to 350 °F) but loses the reactivity otherwise gained by the particle expansion. Consequently, for lower temperature applications more trona is required to achieve the same SO_2 removal efficiency. During the first 10 days of August, the flue gas entering the baghouse at Presque Isle varied from 333 – 372 °F.

Trona Injection Equipment

The injection equipment for this test program was obtained from Bulk Conveyor Specialist, Inc. and staged near the Units 7-9 stack as shown in Figure 1. This equipment consisted of a trailer holding approximately 40 tons of trona and a separate trailer housing the blowers and controls (Figure 2). This system injected sorbent at the shipped particle size. Feed rate for the trona was from 2,200 lb/hr up to 5,900 lb/hr at full load to cover a wide range of stoichiometric ratios.

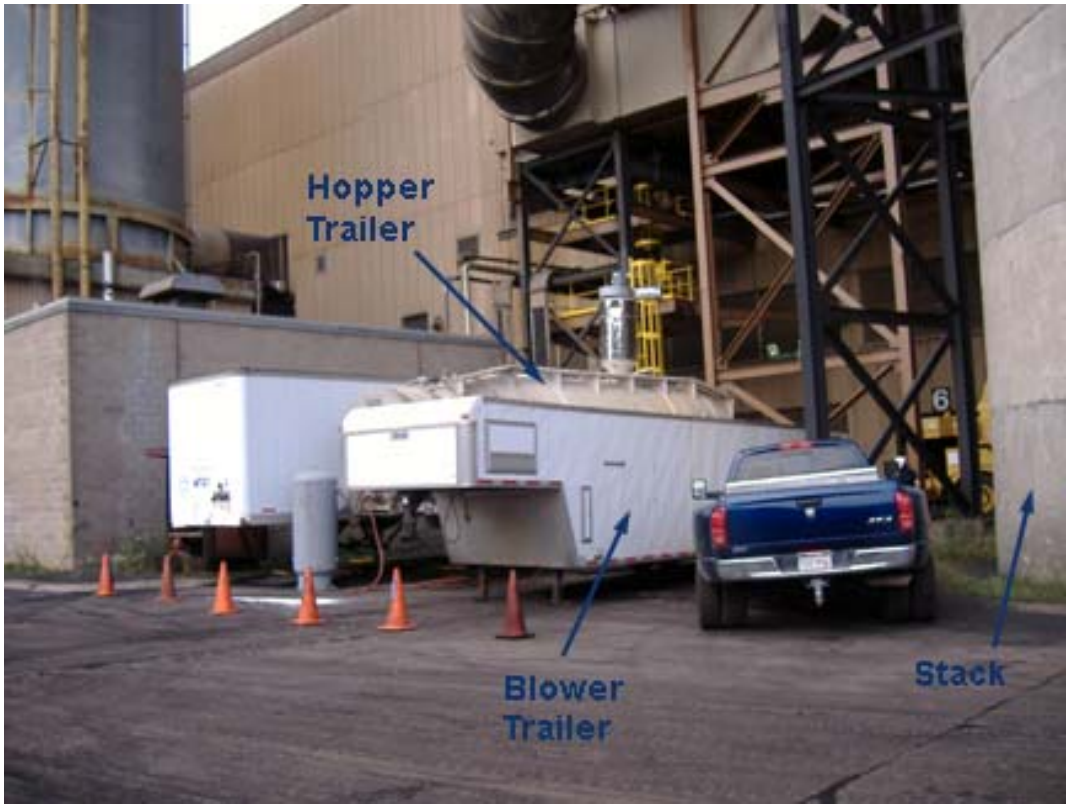


Figure 1. Staging Area for Trona Injection Equipment

Figure 2. Trona Injection Trailer Blowers and Controls.

The trona was fed to three injection lances which were located downstream of the ID fan discharges, but upstream of the point where the ducts combine. Each lance discharged sorbent into the center of its duct, where turbulent flow provided gas/sorbent mixing. The lances were located below the current PAC injection lances (white hose in Figure 3). This is downstream of the NO_x analyzer probe used for boiler feedback.

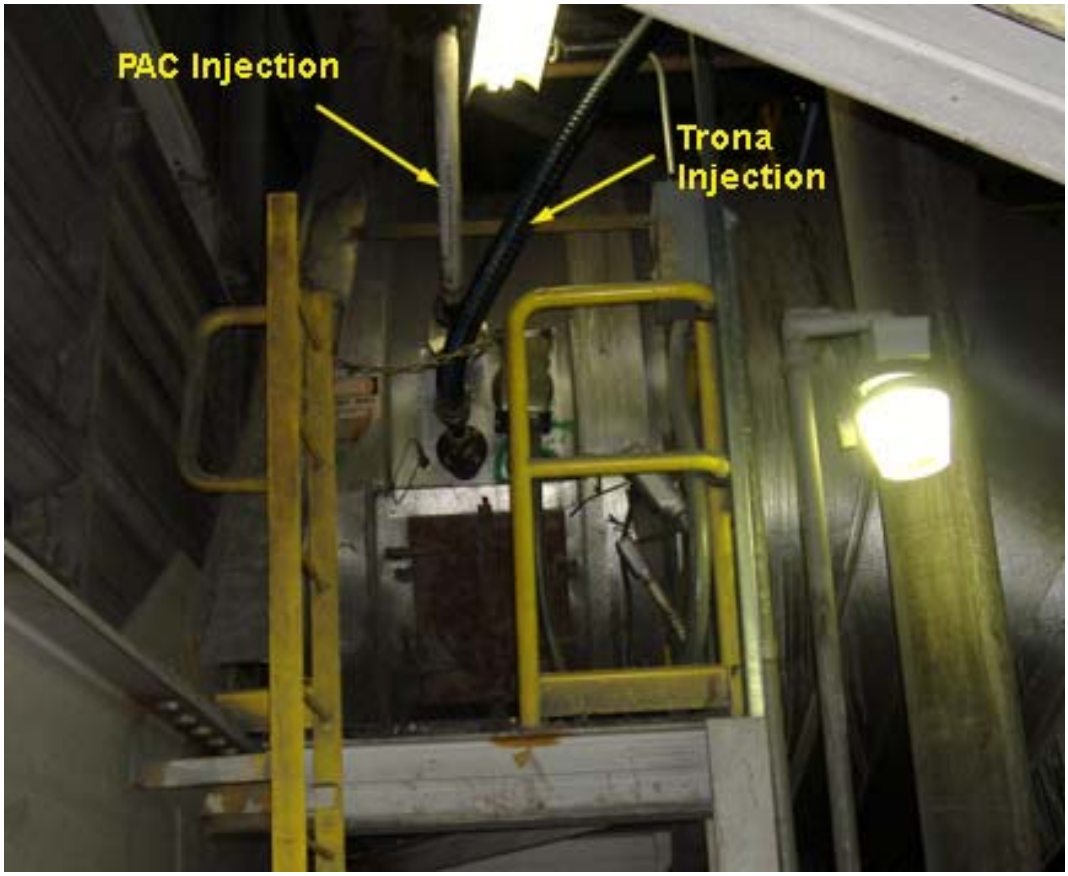


Figure 3. Injection Ports

Trona/Ash Unloading Issues

Prior to field testing, there was some concern that the reacted trona/ash/PAC from the baghouse would be difficult to unload and transport using the existing ash-handling equipment. The reacted trona hardens when wetted, and Presque Isle typically uses a wet unloader for the PAC/ash mixture. This mixture is then hauled by truck to the landfill.

Benetech, Inc. performed a series of laboratory tests on the anticipated final product from the baghouse and developed a chemical to prevent hardening of the mixture. A tanker truck of the chemical along with injection equipment was prepared and shipped to Presque Isle for the testing. Provisions were made to add this chemical to the water spray used in the wet unloader.

SO_2, NO_x and Opacity Measurement

SO_2 and NO_x monitors were installed on a temporary basis by We Energies near the exit of the ID fan on each duct to establish baseline levels coming from each boiler. At the stack, the plant continued to utilize the installed SO_2 and NO_x monitors to establish native removal across the TOXECON™ system and provide removal rates during trona injection.

Data from the inlet and stack monitors was collected continuously by the plant data acquisition system (EDS) and saved on the historian computer. The data was downloaded every week during baseline and every day during trona injection.

Prior to the trona injection testing, three Relative Accuracy Test Audits (RATAs) were performed on the SO_2 and NO_x monitors in the Units 7, 8, and 9 flues. The Unit 7 RATA was performed on June 13, 27, and 28, 2007. The Unit 8 RATA was performed on June 5 and 6, 2007. The Unit 9 RATA was performed on June 5 and 6, 2007.

The results of the RATAs reported by the testing company were:

> "The test results from this test program indicate that each CEM system meets the United States Environmental Protection Agency (USEPA) annual performance specification for relative accuracy as published in 40 CFR Part 60 and/or 40 CFR Part 75."

Test Results

Baseline Testing

The purpose of the baseline test was to establish the concentrations of pollutants leaving the air preheater and to determine if there was any native capture across the TOXECON™ fabric filter without sorbent injection. Figure 4 shows inlet and outlet data for SO_2 and NO_x for the three ducts and flues during July. As expected, none of the three graphs show any removal across the baghouse prior to trona injection. In addition to the flue gas measurements for SO_2/NO_x, ash samples were taken from the baghouse hoppers. A composite sample of ash from four hoppers was used to characterize the ash during this time.

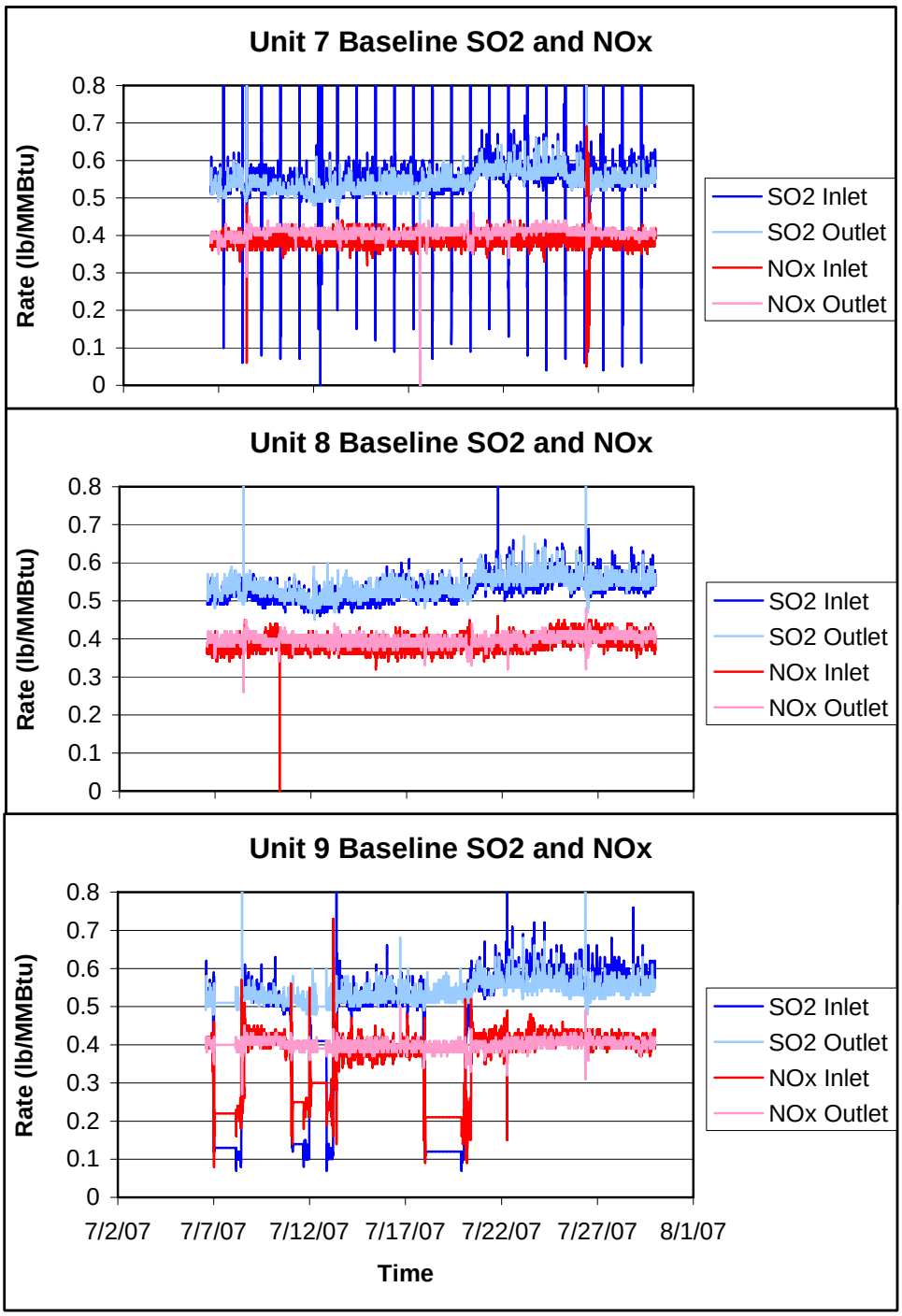


Figure 4. Baseline SO_2 and NO_x Data

Parametric Testing

Schedule and Materials Handling

The trona injection equipment was set up at Presque Isle on Monday, July 30, 2007. All of the injection hoses and lances were installed by late afternoon. Electricity was connected to the blower trailer by 3:30 pm.

The first truckload of trona arrived on site Tuesday morning. This truck carried 48,000 lbs, which partially filled the hopper truck. In order to test the wet unloader and the effect of the anti-setup chemical supplied by Benetech, four hours of injection at 2,200 lb/hr was performed on Tuesday, July 31. At the end of the four hours, the ash silo was unloaded using the chemical in the water feed to the pin mixer. The ash silo had been unloaded earlier in the day so the majority of the ash in the silo contained reacted trona.

There were no problems with hardening or setting up of the reacted trona/ash/PAC in the wet unloader or in the ash truck. Benetech also provided 10 gallons of a "trona release chemical" for spraying on the inside of the ash truck bed and the inside of the pin mixer. Bottom ash from Units 5 and 6 (bituminous coal) was used to line the bottom of the ash truck also since the efficacy of the release chemical or anti-setup chemical had not been tested at full scale yet. Figure 5 shows the material being unloaded at the landfill. The consistency was similar to wet sand. The next day the material still had not changed in consistency.

Figure 5. Unloading Reacted Trona/PAC/Ash Mixture

On Wednesday morning, August 1, the ash silo was unloaded to remove the accumulated material from overnight. This material contained significant amounts of reacted trona that had been cleaned from the bags over the course of several hours after injection had stopped. This unloading process was inadvertently performed without the anti-setup chemical, and there were no problems with the material setting up in either the mixer or the truck. Over the course of the next few days, unloading at the end of injection was done with the chemical, and in the morning without. There were no issues with setup either with or without the chemical. The wetted material showed a significant heat of reaction and was still steaming when unloaded at the landfill.

During the second week of testing, the ash silo was unloaded after injection using water only (no anti-setup chemical). Although there was a noticeable heat associated with the mixing, the material didn't set up in the pin mixer or in the truck. A sample was taken at the landfill and the next day it still hadn't set up. The reaction with water to form a solid hydrate may have occurred in the pin mixer but the action of the mixer may have kept the material from solidifying. The main risk of wetting the trona/ash/PAC without the anti-setup chemical is that if the mixer stops, the wet material in the mixer would likely solidify and would be very difficult to remove.

Parametric testing began August 1, 2007. During this test phase all three units were at full load. The original plan was to vary the sorbent injection rate from approximately 2,200 lb/hr up to 5,400 lb/hr. There was some concern that the ash system could not handle a sorbent injection rate above 5,400 lb/hr. The vacuum system used to pull ash from the hoppers and transport it to the silo was rated for 5,000 lb/hr. Adding the ash and PAC (110 lb/hr and 130 lb/hr approximately) put the highest injection rate well above the rating for the vacuum system.

SO_2 and NO_x Removal

Table 2 shows the injection rate and SO_2 removal for the test period. The maximum removal achieved during the testing was 74.1% when co-injecting 3.8 lb/MMacf PAC.

Table 2. Trona Injection Results.

Date	Trona Injection Rate (lb/hr)	Average NSR*	SO_2 Inlet (lb/MBtu)	SO_2 Removal (%)	Comments
8/1/07	2223	0.37	0.50-0.66	46.6	
8/2/07	2223	0.41	0.48-0.63	47.6	
8/3/07	4446	0.81	0.48-0.59	65.4	
8/4/07	4446	0.79	0.50-0.58	65.5	
8/5/07	5432	0.97	0.49-0.57	69.8	
8/6/07	5926	-	-	-	Difficulty feeding trona – test stopped
8/7/07	5926	1.02	0.52-0.60	70.7	
8/8/07	5926	1.02	0.52-0.66	68.5	PAC injection turned off during am
8/9/07	5926	1.03	0.49-0.62	72.1	PAC injection ramped up to 3.8 lb/MMacf
8/10/07	5926	1.02	0.51-0.64	74.1	Started PAC injection at 3.8 lb/MMacf at start of trona injection

* Normalized Stoichiometric Ratio

As seen in Table 2 and Figure 6 below, the best SO_2 removal was observed when PAC was being injected at an unusually high level for this site (3.8 lb/MMacf). This was done to try to recover the >90% mercury removal. This PAC injection rate was at the end of a test day, and the mercury removal was at 89%. During all trona injection tests, mercury removal degraded, and then slowly recovered overnight when no trona was injected (discussed below).

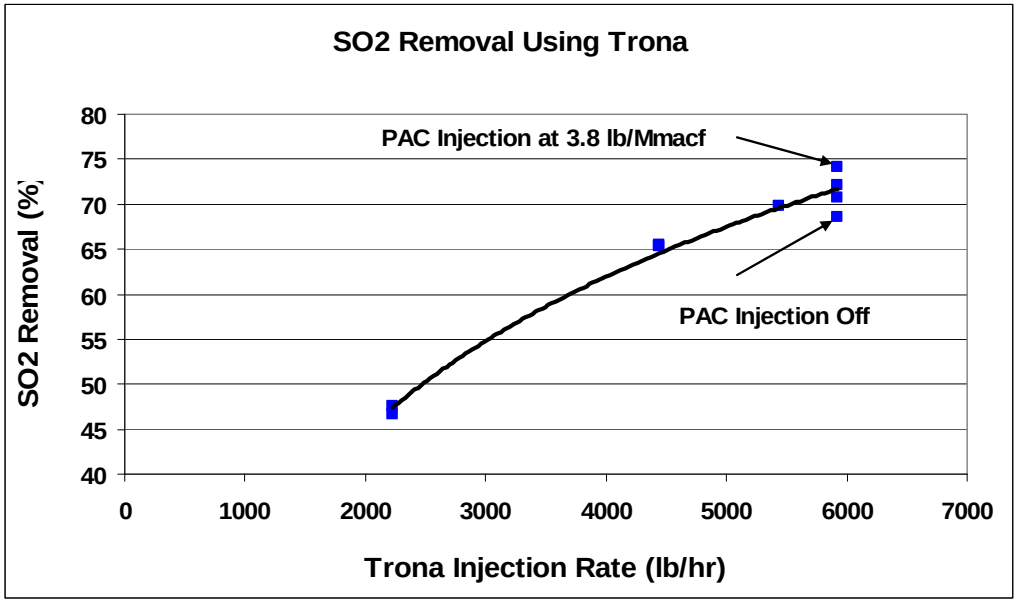


Figure 6. SO_2 Removal vs. Trona Injection Rate.

Figure 7 shows typical SO_2 removal profiles at varying trona injection rates. There was an initial rapid increase in removal but it took 3-4 hours before removal became somewhat steady. Most test periods were 8 hours, but one day was only 6 hours. When trona injection was turned off, there was an initial rapid decrease in SO_2 removal, but it didn't come back to baseline levels for 5-6 hours, which was the time required to perform a full cleaning cycle on the baghouse.

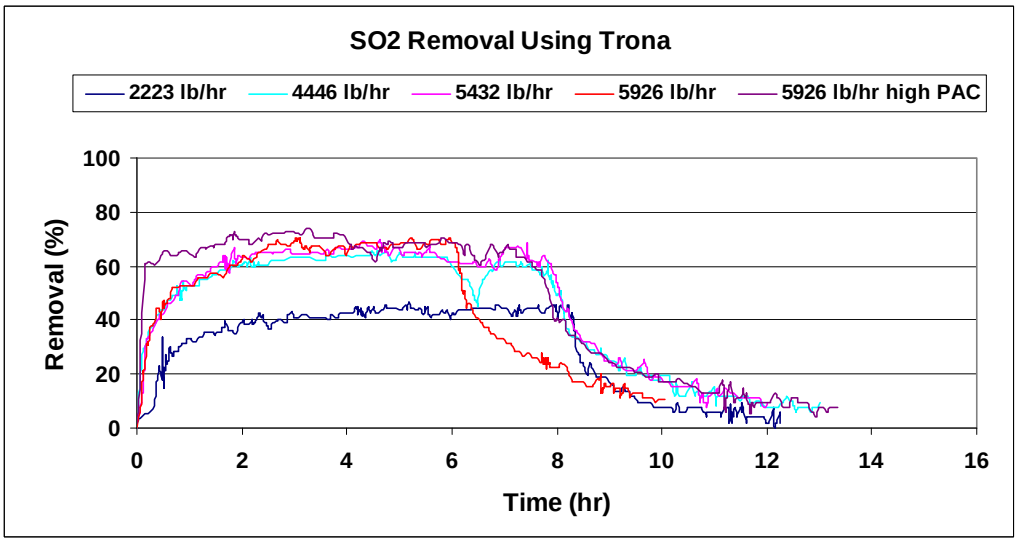


Figure 7. SO_2 Removal Profiles.

In addition to the impacts on SO_2, a small reduction in NO_x emissions was expected based upon work at other test sites. As shown in Figure 8, there was no noticeable reduction in NO_x.

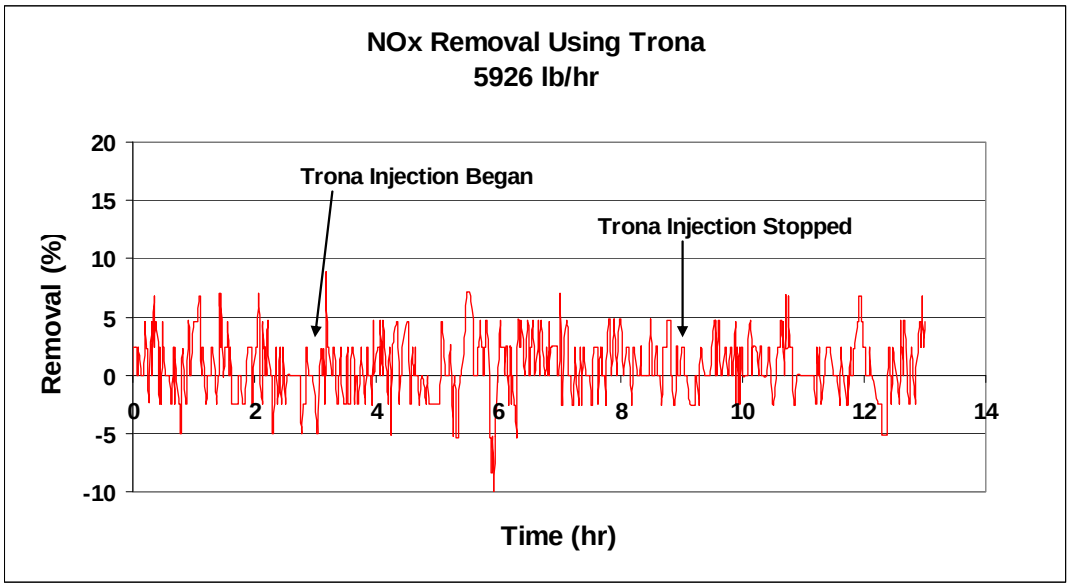


Figure 8. NOx Removal During Trona Injection.

At other test sites, a side reaction from using trona is the creation of small amounts of NO_2, which results in a brownish plume and an increase in opacity. Figure 9 shows an increase of about 0.75% in the three opacity monitors during the highest injection rate used. There was no visible brown plume during this test.

At the end of the trona injection period on August 7, PAC injection was also turned off and kept off overnight and through the start of trona injection on August 8. At mid-day on August 8 a brownish plume was seen coming from the stack. This is the first time this had occurred. The opacity levels on all three monitors increased by almost 3% (Figure 10). PAC injection was resumed at 1:00 pm and within 30 minutes the plume had been visibly reduced and the opacity decreased.

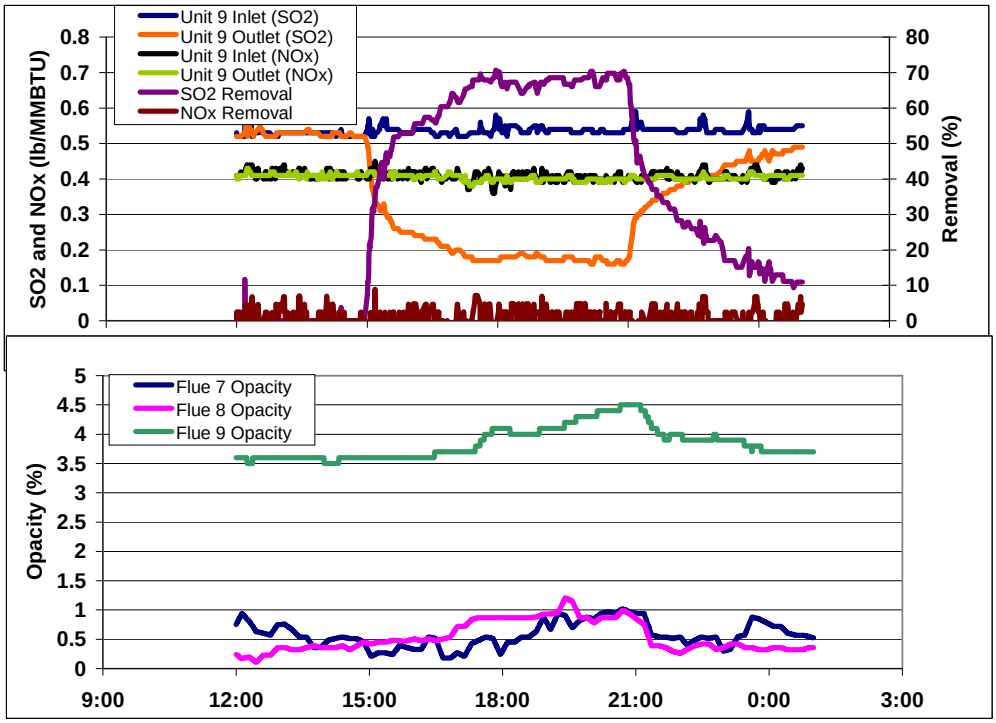


Figure 9. Effect of 5926 lb/hr Trona Injection on SO_2, NO_x, and Opacity.

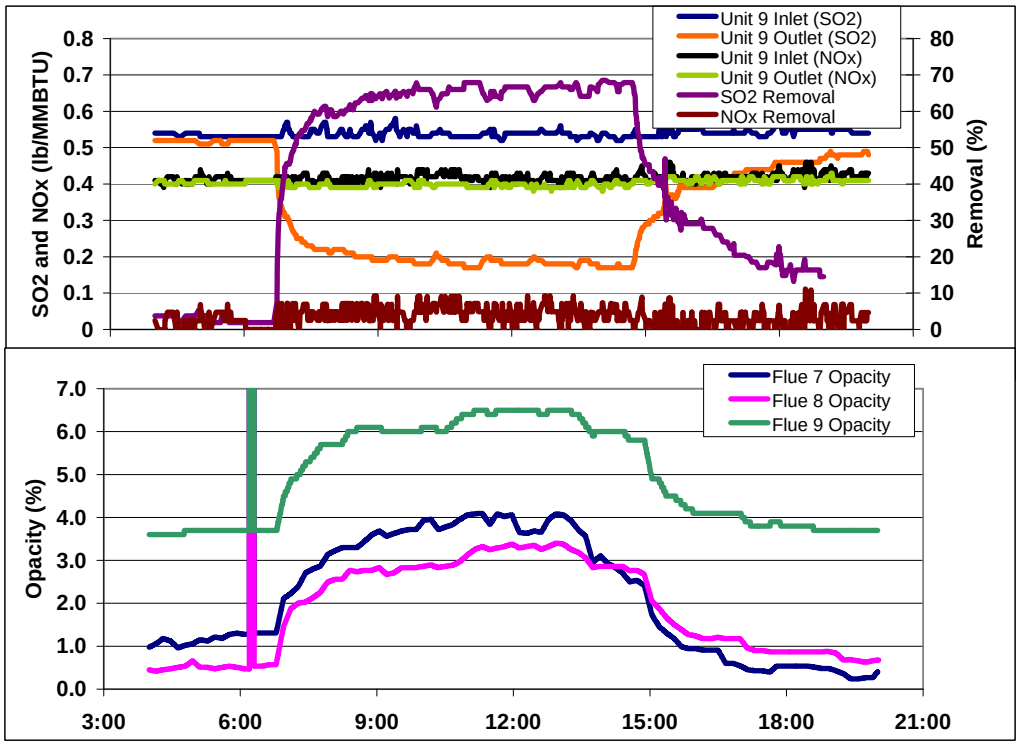


Figure 10. Effect of 5926 lb/hr Trona Injection without PAC Injection

Baghouse Pressure Drop and Cleaning Frequency

Any impacts on the cleaning cycle and pressure drop were closely monitored. The fabric filter was cleaned in an online mode for all parametric tests. Figure 11 shows the effect of trona injection on baghouse operation during the entire injection period. As mentioned earlier, mercury removal was negatively affected during trona injection, but recovered overnight. The air-to-cloth ratio didn't change during testing. The cleaning frequency increased slightly during testing.

One unexpected side effect due to trona injection into the baghouse was degradation in mercury removal. On August 9, the PAC injection was increased throughout the trona injection period to try to recover 90% mercury removal. By the end of the injection period, PAC injection was at 3.8 lb/MMacf and mercury removal was at 89%. On August 10, PAC injection was increased to 3.8 lb/MMacf at the start of trona injection and there was still a reduction in removal initially. PAC injection reached 4.6 lb/MMacf without regaining 90% mercury removal. Previous tests show an initial drop in removal, then a partial recovery after several hours.

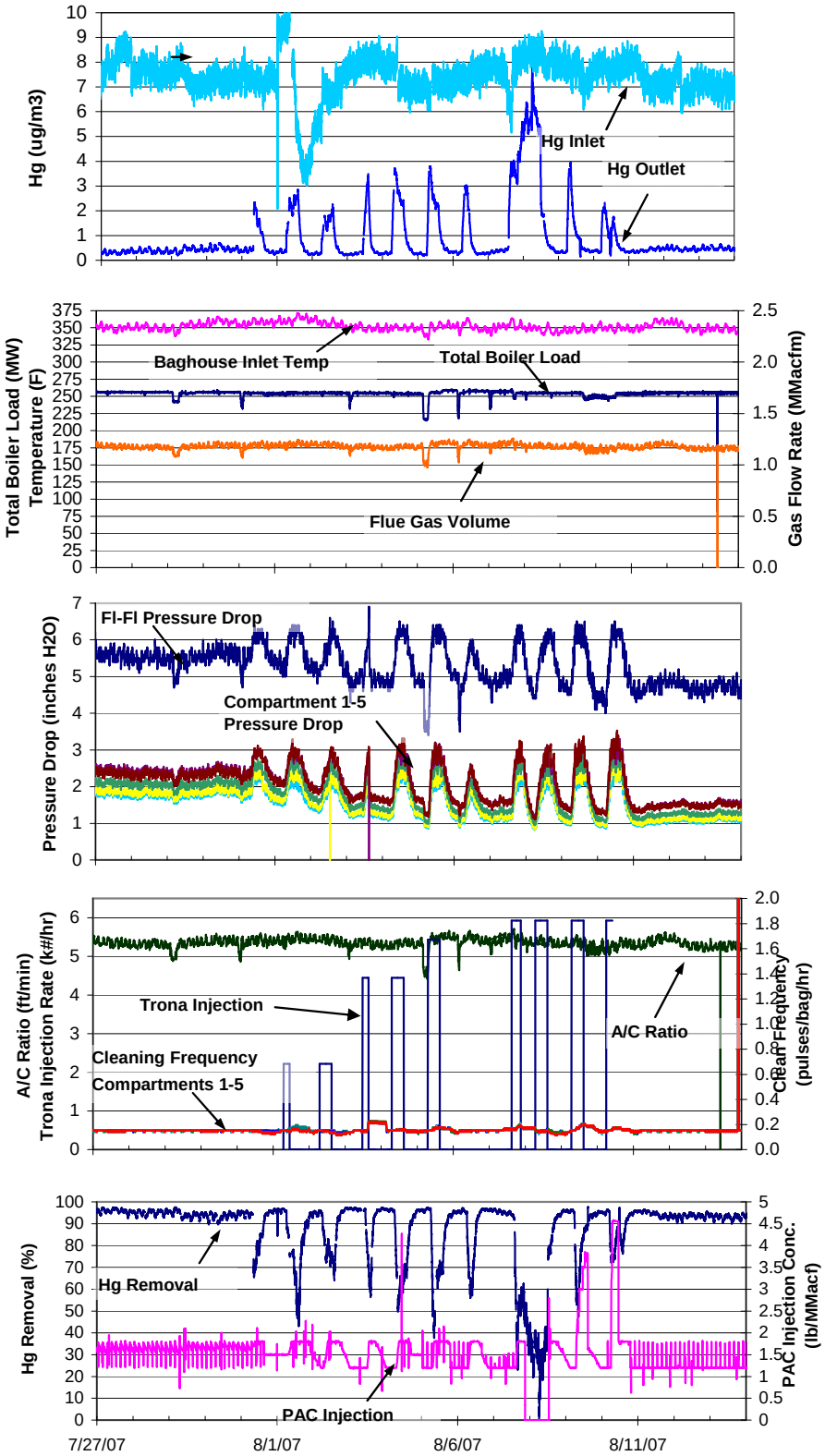


Figure 11. Baghouse Operation During Trona Injection Testing.

Economic Assessment of Full-Scale Trona Injection

Introduction

An economic assessment was performed to determine the cost for the installation and operation of a full-scale, commercial trona injection system at We Energies' Presque Isle Power Plant Units 7, 8 and 9. Based on the results from the tests described above, cost and design estimates were made for a permanent trona injection system. The design premises and the results of the economic analysis are presented here. A detailed description of the economic analysis is presented in Appendix A.

Estimates were made for sorbent usage and costs were estimated for three injection rates of 2223 lb/hr, 4446 lb/hr, and 5926 lb/hr, which include treatment for the flue gas from all three units. From the tests completed in August 2007, these injection rates correlate to SO_2 removal rates of approximately 45%, 64%, and 70%. The cost and design of process equipment has been estimated based on the test results for up to 70% SO_2 control and on the plant-specific requirements such as sorbent storage capacity, plant arrangement, sorbent transportation and delivery options, retrofit issues, controls interface, etc.

A consequence of simultaneously injecting trona for SO_2 control and injecting PAC for mercury control was significant degradation in mercury removal. August 2007 tests showed an initial drop in mercury removal, then a partial recovery after several hours. This economic assessment includes cost estimates for the increase of PAC usage required when injecting trona. Normal average injection rates at Presque Isle of PAC for 90% mercury removal were 1.5 lb/MMacf for DARCO® Hg-LH and 2.5 lb/MMacf for DARCO® Hg. To achieve 90% mercury removal while injecting trona at a rate required for 70% SO_2 removal, DARCO® Hg-LH would need to be injected at approximately 4.5 lb/MMacf and the injection rate for DARCO® Hg was assumed to be at 7.5 lb/MMacf, based on the required increase in DARCO® Hg-LH usage.. The increased requirement for PAC was not measured at the lower trona injection rates. The PAC increase was calculated based on a linear increase from baseline to the highest injection rate. PAC injection rates costs for the SO_2 removal rates are summarized below in the section regarding variable operating costs in Appendix A.

Process Design

Trona Injection System

Costs were estimated for two different equipment setups. The first setup consists of one bulk storage silo with three pneumatic conveying systems. The second setup consists of three bulk storage silos, each dedicated to a single unit with one pneumatic conveying system on each silo. Note that the silo size is the same (150,000 lbs trona/silo) for the one- and three-silo systems. The three-silo setup is the type that is installed at Mirant's Potomac Station.

The conveying distances and the storage site were assumed to be the same as the test in August 2007. The silo was sized based on the capacity to hold approximately one day worth of trona at the maximum design injection rate of 6,000 lb/hr. This would be approximately 4 truckloads

(40,000 lb) or one rail car load (200,000 lb) for the combined 3 units. The issue of material packing in the silo and inhibiting the flow-ability of the material was considered in the sizing of the silo. The 3-silo option outlined in the tables below would provide the plant with a 3-day supply of trona. Table 3 displays the design criteria for an SO_2 control system.

Table 3. System Design Criteria for SO_2 Control System at Presque Isle (6000 lb/hr injection, >70% SO_2 control).

Parameter	3-Silo System	1-Silo System
Number of silos	3	1
Number of injection trains	3	3
Design feed capacity/train (lb/hr)	2000	2000
Total trona storage capacity (lbs)	450,000	150,000
Conveying distance (ft)	300	300
Sorbent	Trona	Trona
Aerated density (lb/ft^3)	49	49
Settled density (lb/ft^3)	69	69
Particle MMD (microns)	26	26

The trona can be delivered by two methods. One option is to have the trona railed to nearby Ishpeming in 200,000-lb capacity rail cars and then transferred to self-unloading pneumatic bulk tanker trucks and delivered in 40,000-lb batches. Another option is have a rail spur installed to the plant and have rail cars directly unload to the storage silo(s). Both options have been cost estimated; however, the cost for a rail spur was not included.

The silo is equipped with a bin vent filter to contain dust during the unloading process. The silo is a shop-built, dry-welded tank with level indicators and load cells to monitor sorbent level and inventory. If only one silo is used, then that silo will have three hopper cones with a blower for each cone. If three silos are used, then each silo will have one hopper and blower.

The sorbent is fed from the hopper(s) by rotary valves into the conveying lines. The conveying air is supplied by blowers. The air provides suction to draw the sorbent into the conveyer piping and carries it to the injection lances where it is dispersed into the duct. There are three injection lances, which are located downstream of the ID fan discharges, but upstream of the point where the ducts combine. Each lance discharges sorbent into the center of its duct, where turbulent flow will provide gas/sorbent mixing. The lances will be located below the current PAC injection lances. This is downstream of the NO_x analyzer probe used for boiler feedback. Figure 12 shows the schematic of the plant and includes the two options for the trona silo(s).

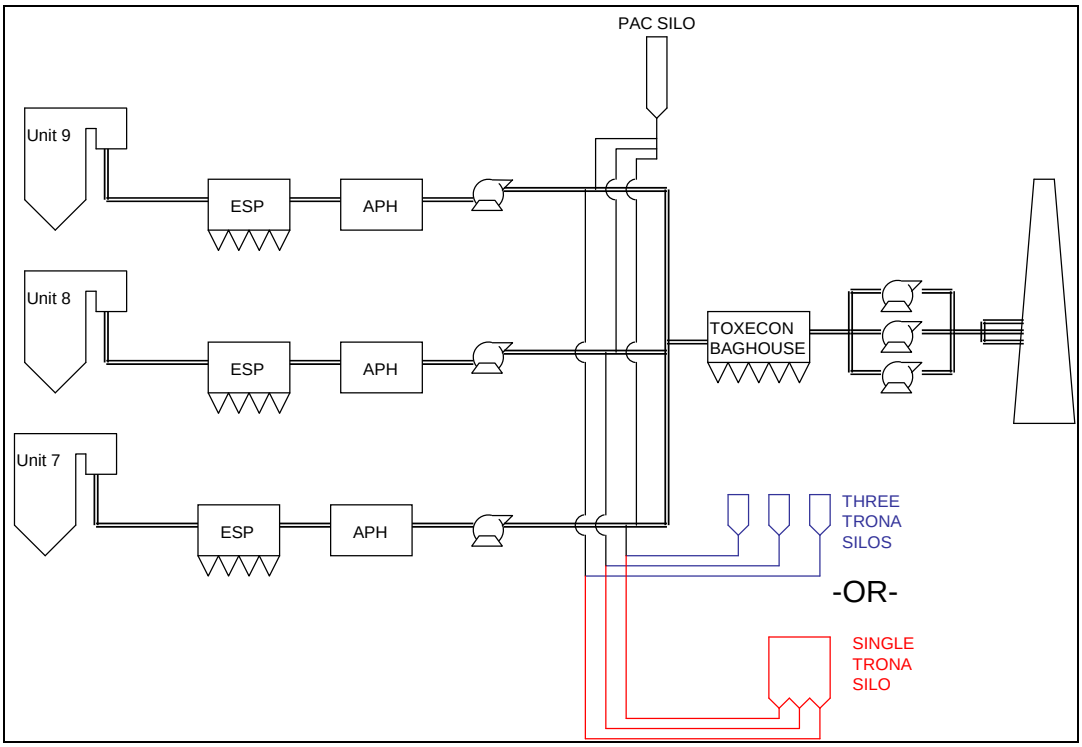


Figure 12: Schematic of the Trona Injection Equipment at Presque Isle Units 7, 8 and 9

Ash Handling System

Some modifications and upgrades to the existing plant equipment would be required to accommodate a full-scale trona injection system. These include upgrades to the electrical supply to provide new service to the injection system as well as intercom phones and area lighting.

The spent trona/ash/PAC mixture will be collected in the baghouse, conveyed to the ash silo and unloaded into ash trucks that dispose of the material in the landfill as is the current operating procedure. The ash handling capacity will need to be increased to accommodate the higher loading of material. The existing 4 in. conveyor piping system is adequate although a new mechanical exhauster capable of up to 15 in Hg will need to be installed. The new mechanical exhauster motor size would need to be increased from 10 HP to 20-25 HP.

The increased vacuum level produced by a new mechanical exhauster increases the gas flow rate in the ash system and therefore creates a larger air-to-cloth ratio in the filter separator. An air-to-cloth ratio of 4:1 is desirable so an increased filter area would be required with trona injection. To achieve this ratio the existing filter/separators could be operated in parallel, however this leaves the system without a redundant filter/separator. Another option is to replace the existing filter/separator with two larger capacity, continuous operating, filter/separators. Modifications to the ash silo building would be necessary, such as extending the bin roof and modifying the bin structure to support the higher loadings of the bigger filter/separators. An alternative would be to install pleated bags in the existing system.

Cost Estimates and Results

Costs for capital equipment, operations, maintenance, and power were provided by vendors as well as estimated using the economic basis provided in EPRI's *Economic Evaluation of Dry-Injection Flue Gas Desulfurization Technology*[6]. The capital and fixed and variable O&M costs were then converted into and combined as 20-year levelized costs using the traditional EPRI *Levelized Cost* or *Uniform Annual Cost* analysis typical of historical EPRI studies and as used in Reference 6. This methodology provides a suitable first-cut approximation and comparison of the time-value of money over the 20-year estimated life of the trona injection system options considered.

Different scenarios of equipment set-up and injection rates were priced and compared. These scenarios and the economic analysis results are summarized below. A more-detailed description of the analysis is presented in Appendix A.

Capital Costs

The costs of equipment and installation for the trona injection system and balance-of-plant systems are shown in Table 4. This table compares the capital cost elements for the one-silo vs. three-silo systems. Capital costs for a permanent trona injection system include the storage silo(s), blowers, conveyor piping, dehumidifiers, and modifications to the ash handling system. Bulk Conveyor Specialist, Inc provided the cost estimates for the trona storage and injection equipment and installation. The required capital equipment is summarized below. A more-detailed description of these capital cost elements is presented in Appendix A.

- **Storage Silo**: Skirted, carbon steel shell with cone. Storage capacity of 75 tons. Includes bin vent collector, bin discharger, discharge valve, bin indicators, weigh hopper, rotary valves, control panel, blowers, dehumidifiers.
- **Blowers**.
- **Conveyor Piping**.
- **Lances**.
- **Housing for Redundant Blowers and Dehumidifiers**.
- **Mechanical Exhauster Package**
- **Larger Capacity Filter/Separator**

Table 4: Summary of Equipment, Balance-of-Plant, and Engineering Costs

Trona Injection System and Balance-of-Plant Equipment and Installation Costs Presque Isle Power Plant Units 7, 8, and 9		
CAPITAL COST ELEMENT DESCRIPTION	**COST**	
	1 Silo	**3 Silos**
Trona Storage/Injection System (Equipment Cost)		
• Silo (s) - Including: 75 ton Capacity Storage Silo, 1 Hopper Below Silo, 1 Blower, 1 Dehumidifier Pkg, Conveyor Piping (300 ft)	$ 595,000	$ 1,785,000
• Lances (*Injection lances from test can be used in permanent system; additional lances are optional at $5,000 per lance)	$ 5,000*	$ 5,000*
• Redundancy (equipment added for 3 injection lines per 1 silo), Including: Splitter Valve, 2 Hoppers, 2 Rotary Valves, 2 Blowers, 2 Dehumidifier Packages, Housing for Blowers and dehumidifiers	$ 98,500	$ -
Installation of Trona Storage/Injection Equipment Includes civil, electrical, mechanical and piping	$ 580,000	$ 580,000
TOTAL PROCESS EQUIPMENT	$ 1,273,500	$ 2,365,000
Increase In Ash Handling Capabilities		
• 2 Mechanical Exhauster Packages	$ 15,000	$ 15,000
• Larger Capacity Filter/Separator (Design and Supply)	$ 200,000	$ 200,000
TOTAL ASH HANDLING EQUIPMENT UPGRADES	$ 215,000	$ 215,000
TOTAL EQUIPMENT COSTS (Installed Cost, TEC)	**$ 1,488,500**	**$ 2,580,000**
General Facilities **(10% of TEC)**	$148,850	$258,000
Engineering and Home office Fees **(12.5% of TEC)**	$186,062	$322,500
Project Contingency **(25% of Process Equip. + 20% of Ash Handling Equip.)**	$361,375	$634,250
Process Contingency **(7.5% of Process Equip. + 5% of Ash Handling Equip.)**	$106,262	$188,125
TOTAL PLANT COST (TPC)	**$2,291,050**	**$3,982,875**
Preproduction Costs **(=(1/12)*(Fixed O&M + Var O&M)+.02*TPC)**	$397,921	$431,757
TOTAL CAPITAL REQUIREMENT (TCR)	**$2,688,971**	**$4,414,632**

As shown in Table 4, the total capital requirement (TCR) for a project includes not only the capital cost estimates provided by the vendor, but also such factored estimates as funds for general facilities, engineering and home office fees, project and process contingencies, and preproduction costs. These factored estimates were calculated in accordance with EPRI guidelines and are consistent with those factors used in the analysis in Reference 6 as shown in the table. The TCR for a three-silo system is about 1.6 times that for a one-silo system.

Operating and Maintenance Costs

The operating and maintenance (O&M) costs associated with trona injection for SO_2 control include fixed and variable costs. Fixed O&M costs include labor, maintenance materials, and administrative and support labor. The variable O&M costs vary depending on unit and other capacity factors and include sorbent, power, and waste disposal.

Fixed O&M Costs

The fixed O&M costs include:

- labor costs for ash handling
- operating and maintenance labor costs for the silo and injection equipment
- maintenance materials
- administrative and support labor

The maintenance labor, materials and support labor are estimated using known costs for the TOXECON system installed and operating at Presque Isle.

Applicable labor rates, maintenance, and operating materials costs were determined for three SO_2 removal rates (45%, 64%, and 70%). For example, the ash handling system labor costs increase as SO_2 removal rates increase due to the need for more frequent ash unloading and disposal because of the increased sorbent injection rates. Operating labor costs also vary slightly depending on the type of PAC used due to slight differences in injection rate.

The operating labor costs for the silo and injection equipment are constant for different SO_2 removal rates as well as constant with either one-silo or three-silo systems. The operating, maintenance and project overhead costs are estimated from the annual costs associated with the TOXECON system currently at Presque Isle. The maintenance materials are estimated in the same manner.

Table 5 summarizes the first-year fixed O&M costs calculated for this analysis. As seen, the Fixed O&M costs do not vary depending on whether a one- or three-silo system is used. However, costs do vary depending upon the type of sorbent used and on the SO_2 removal rate. Table 5 shows the total first year fixed O&M costs comparing costs at different SO_2 removal rates.

Note that these first-year O&M costs in Table 5 can also be expressed in terms of $/yr, although such numbers do not reflect the application of levelization factors to reflect the time-value of money. Levelized O&M and capital costs are discussed below. The development of these fixed O&M costs and the assumptions made are described in more detail in Appendix A.

Table 5. Total First-Year Fixed Operating & Maintenance Costs

Total First Year Fixed O&M Cost			
1 or 3 Silos	**SO_2 Removal Rate**		
O&M Labor & Material Costs*	**45%**	**64%**	**70%**
• Labor Costs for Ash Handling			
Trona + DARCO® Hg + Ash	$132,740	$265,880	$357,860
Trona + DARCO® Hg-LH + Ash	$126,470	$256,800	$345,500
• O&M Labor & Materials & Support Labor for Silo & Injection Equipment			
O&M Labor Costs	$360,000	$360,000	$360,000
Maintenance Materials	$108,000	$108,000	$108,000
Total First Year Operating, Maintenance, & Support Costs (Silo & Injection)	$468,000	$468,000	$468,000
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg + Ash)	**$600,740**	**$733,880**	**$825,860**
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg-LH + Ash)	**$594,470**	**$724,800**	**$813,500**

*PAC injection rate varied for each SO2 removal rate.

Variable O&M Costs

The variable O&M costs vary depending on unit and other capacity factors and include estimates for:

- Power Costs
- Sorbent Costs
- Landfill Costs

The sorbent costs include trona as well as the increased PAC needed to keep the mercury removal at 90%. Power costs were estimated from the equipment power requirements and the current busbar cost of power production as obtained from the utility.

Power Costs

The electrical requirements for the trona injection system include power for blowers, rotary valve motors, bin discharger, and dehumidifiers. Each injection system requires power for one blower, one dehumidifier, and one rotary valve. There is one bin discharger per silo. Therefore, for a one-silo system with one large silo, power for one discharger is needed. For a three-silo system, power for 3 dischargers is needed. The long-term running power required is roughly half of the power required for start-up (connected load). The system power in kW is calculated knowing the amperage and voltage needed for the different components, along with a power factor and knowledge of the estimated time that each component operates.

Table 6 summarizes the estimated variable first-year operating cost for power estimated for one- and three-silo injection systems by summing the power usage requirements for each component and using an assumed busbar cost to produce power of $0.03/kWh as estimated by the utility. The calculations and intermediate steps used to determine the power cost estimate are presented in more detail in Appendix A.

Table 6. Variable First-Year Operating & Maintenance Costs for Power

Variable O&M Costs: Power		
	1 –Silo System	3-Silo System
Power Usage, in kW	42.35	127.05
Unit Power Cost, in $/kWh	$0.03	$0.03
Power Cost, in $/yr	$11,125	$33,375

Sorbent Costs

Sorbent costs vary depending on the desired SO_2 removal percentage and on the delivery method. Costs for trona and PAC increase as SO_2 removal levels increase due to the need for higher sorbent injection rates; this includes the increased trona injection rate as well as the increased PAC injection rate to maintain mercury removal levels. The cost for trona to be railed directly to the plant is $140/ton assuming the costs to install a rail spur is picked up under another project. If a rail spur is not installed to the plant, the trona can be railed to Ishpeming, then loaded into a truck from there and delivered to the plant by truck. Using a combination of rail and truck would cost $155/ton.

The amount of PAC needed to maintain 90% mercury control increases as trona injection increases due to the interference of trona injection with the PAC's ability to capture mercury. Table 7 summarizes the sorbent costs for the two delivery methods for the three SO_2 removal rates of 45, 64 and 70%. Also reflected in the table are the effects on first-year sorbent costs of different unit costs, and injection rates for trona and the PAC mercury sorbent, whether DARCO® Hg or DARCO® Hg-LH. The unit costs and injection rates assumed for each sorbent, delivery method and for each SO_2 removal rate as well as the steps taken to arrive at the total values summarized in Table 7. Additional details are provided in Appendix A.

Table 7. First-Year Variable Operating & Maintenance Costs for Sorbent Delivered by Rail and by Rail/Truck Combination to the Plant

Variable O&M Costs: Sorbent Delivered By Rail* or Combination to Plant			
Sorbent Costs in $/yr**	SO_2 Removal Rate		
	45%	64%	70%
Delivered by Rail* to Plant			
Trona + DARCO® Hg	$1,405,651	$2,836,597	$3,887,797
Trona + DARCO® Hg-LH	$1,460,182	$2,934,162	$3,920,647
Delivered by Rail† and Truck†			
Trona + DARCO® Hg	$1,514,056	$3,053,407	$4,178,520
Trona + DARCO® Hg-LH	$1,568,587	$3,150,972	$4,211,370

* Trona rail spur assumed to be installed under separate project
** Minus PAC that would already be injected
† Trona railed to Ishpeming and trucked to plant

Waste Disposal Costs

The variable O&M costs for waste disposal are the costs required to landfill the spent sorbent captured in the baghouse. The 2007 unit cost to landfill material was $44.40. The unit cost for

landfill along with the waste production rates for each sorbent was used to calculate the total cost to landfill the waste for both PAC sorbents for each of the three SO_2 reduction rates as summarized in Table 8. Since this is a differential cost estimate that considers only the effect of adding a trona injection system, the costs do not reflect the ash and PAC waste that is disposed of while running at full load with no trona injection. The waste production rates and steps used in calculating the waste disposal costs summarized in Table 8 are shown in more detail in Appendix A.

Table 8. First-Year Variable Operating & Maintenance Costs for Landfill Waste Disposal

Variable O&M Costs: Waste Disposal			
Waste Disposal Costs, in $/yr**	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
Trona + DARCO® Hg	$336,780	$674,575	$907,940
Trona + DARCO® Hg-LH	$330,360	$661,010	$886,060
**minus PAC/Ash waste that would already be disposed of			

Total Variable O&M Costs

Table 9 shows the total variable O&M costs at the three different SO_2 removal rates and for the different delivery methods. The total O&M costs include costs for power, sorbent usage, and disposal costs.

Table 9. First-Year Total Variable Operating & Maintenance Costs

Total Variable O&M Costs			
Total Variable O&M Costs, $/yr	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,775,800	$3,544,550	$4,829,115
Trona + DARCO® Hg-LH	$1,823,915	$3,628,550	$4,840,085
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,884,210	$3,761,360	$5,119,840
Trona + DARCO® Hg-LH	$1,932,320	$3,845,360	$5,130,810

Levelized Costs

Levelized costs were computed to represent a constant cost value for the operating and capital costs over the lifetime of the equipment and project. In other words, the levelized costs take the present value of the net costs and spread them evenly over a period of time. This makes it possible to compare costs looking into the future. For this assessment levelized costs are presented in units of mills/kWh, where a mill is 1/1000 of a dollar.

The key economic parameters and factors used in this analysis are summarized in Table 10. The calculations to determine levelized costs assumed a discount rate of 7.5% and a 20-year levelization factor was used. The capital costs are converted using a fixed charge rate of 15.0%

and the O&M costs are converted using levelization factors of 1.29 for all costs including power and consumables.

Table 10. Economic Factors and Parameters

Economic Factors & Parameters	
Year of Estimate	2007
Plant Life	20 Years
Capital Recovery Factor	0.15
Fixed Charge Rate	15%
O&M Levelization Factor	1.29
Normal Capacity Factor	0.75
Power Capacity Factor	0.85

This methodology is consistent with typical historical EPRI studies, and in particular, the factors used here reflect those used in Reference 6. The use of a 15% *Fixed Charge Rate* is consistent with using a *Capital Recovery Factor* of 0.15, a typical approximation currently used by EPRI and utilities today for levelizing capital costs. Although the factors used here are generalizations, their use is a reasonable approximation for a first-cut economic evaluation for the rough comparison of these similar options. Should any utility desire to pursue these options more seriously for a given plant, a detailed economic analysis using economic factors and a methodology specific to the utility's current normal practice would be advised to confirm the economic viability of each option.

Levelized Capital Costs

The calculations used to determine levelized capital costs are shown in detail in Appendix A. Table 11 summarizes the levelized total capital requirement for the one- and three-silo options. The total capital requirement for three silos is less than double the requirement for one silo.

Table 11. Levelized Capital Costs

Levelized Capital Costs (20 yr, Current $ Basis)		
LEVELIZED TOTAL CAPITAL REQUIREMENT	1-Silo System	3-Silo System
Levelized $/yr	$403,345	$662,195
Levelized $/kW	$1.49	$2.45
mills/kWh	0.23	0.37

By comparison, the total capital requirement for a green-field installation of a pulse-jet baghouse on a 250 MW unit might cost approximately 50 $/kW as suggested by an EPRI study published in 1992.[7]

Levelized O&M Costs

The detailed steps in calculating levelized fixed and variable O&M costs are discussed in Appendix A. Tables 12 and 13 summarize the levelized fixed and variable O&M costs, respectively, resulting from this analysis. These tables summarize the levelized costs for the two PAC sorbents versus the three SO_2 removal rates.

Table 12. Total Levelized Fixed Operating & Maintenance Costs

Levelized Total Fixed O&M Cost			
Levelized Total Fixed O&M Costs	**SO_2 Removal Rates**		
	45%	**64%**	**70%**
Trona + DARCO® Hg + Ash			
Levelized $/yr	$774,950	$946,705	$1,065,360
Levelized mills/kWh	0.44	0.53	0.60
Trona + DARCO® Hg-LH + Ash			
Levelized $/yr	$766,870	$934,990	$1,049,415
Levelized mills/kWh	0.43	0.53	0.59

Recall that the variable O&M costs are dependent not only on the SO_2 removal rate and type of PAC sorbent used, but also on the transportation mode to the plant; i.e., whether the sorbent is taken to the plant directly by rail or whether the Rail/Truck combination is used. This is reflected in the levelized total variable O&M costs given in Table 13.

Table 13. Levelized Total Variable Operating & Maintenance Costs

Levelized Total Variable O&M Costs			
Levelized Total Variable O&M Cost	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
Levelized $/yr	$2,290,785	$4,572,465	$6,229,555
Levelized mills/kWh	1.29	2.58	3.51
Trona + DARCO® Hg-LH			
Levelized $/yr	$2,352,850	$4,680,825	$6,243,710
Levelized mills/kWh	1.33	2.64	3.52
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
Levelized $/yr	$2,430,630	$4,852,150	$6,604,590
Levelized mills/kWh	1.37	2.74	3.72
Trona + DARCO® Hg-LH			
Levelized $/yr	$2,492,695	$4,960,510	$6,618,740
Levelized mills/kWh	1.41	80	3.73

Total Levelized Costs

Table 14 shows the total levelized costs, which includes the total variable O&M costs, total fixed O&M costs and total capital costs at three removal rates and for the two PAC sorbents for the two sorbent delivery methods. This is presented for the both the one- and three-silo systems.

Table 14. Total Levelized Costs (Capital and Fixed & Variable O&M Costs)

TOTAL Levelized Costs			
Total Levelized Cost (Capital and Fixed & Variable O&M Costs)	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
1-SILO SYSTEM			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
mills/kWh	1.96	3.34	4.34
Trona + DARCO® Hg-LH			
mills/kWh	1.99	3.39	4.34
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
mills/kWh	2.03	3.50	4.55
Trona + DARCO® Hg-LH			
mills/kWh	2.06	3.55	4.55
3-SILO SYSTEM			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
mills/kWh	2.10	3.48	4.49
Trona + DARCO® Hg-LH			
mills/kWh	2.13	3.54	4.48
Trona Delivered by Rail/Truck			
mills/kWh	2.18	3.64	4.70
Trona + DARCO® Hg-LH			
mills/kWh	2.21	3.70	4.70

Removal Cost per Ton of SO_2 Removed

The best way to compare SO_2 removal technologies is on the basis of \$/ton of SO_2 removed. Table 15 shows the cost per ton of SO_2 removed using trona at full scale for the three SO_2 removal rates considered as compared for the two PAC sorbent options and the two sorbent delivery options. These values are levelized over 20 years.

Table 15. Removal Cost per Ton of SO_2

Levelized Total Cost per Ton of SO_2 Removed ($/ton)			
No. of Silos, Delivery Method, and Sorbent	**SO_2 Removal Rate**		
	45%	**64%**	**70%**
1 SILO			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,483	$1,780	$2,116
Trona + DARCO® Hg-LH	$1,506	$1,809	$2,115
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,543	$1,864	$2,219
Trona + DARCO® Hg-LH	$1,566	$1,893	$2,218
3 SILOS			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,594	$1,858	$2,187
Trona + DARCO® Hg-LH	$1,617	$1,887	$2,186
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,654	$1,942	$2,290
Trona + DARCO® Hg-LH	$1,677	$1,971	$2,290

Inspection of Table 15 reveals that the greatest impact on the cost per ton of SO_2 removal is primarily due to the rate of sorbent injection. Note that in a one-silo system for both sorbents and both delivery methods, the cost typically increases by a factor of about 1.4 to increase SO_2 removal from 45% to 70%. For a three-silo system, the capital required for the larger system becomes a more significant in total cost. However, the sorbent cost still dominates and the total cost per ton of SO_2 removed increases by a factor of about 1.35.

Conclusions

The goal of 70% SO_2 removal was achieved during this two week test period when injecting 5926 lb/hr of trona. This corresponds to an average NSR of 1.02. The inlet concentration of SO_2 varied from 0.48-0.64 lb/MBtu. The highest removal was 74.1% with PAC injection at 3.8 lb/MMacf.

There was very little reduction in NO_x during the test period. In addition, the effect of a side reaction, where NO is oxidized to produce NO_2, was observed on one test day when PAC injection was turned off. This indicates that there is some conversion of NO to NO_2, but not enough to measure on the stack NO_x CEMs and considerably below the target of 30% reduction. The NO_2 level was high enough to be visible and cause an increase in opacity of almost 3%. On days when PAC injection was occurring, the opacity increased by a maximum of 0.75% but there was no visible plume.

Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. This effect was seen every day that trona was injected. The mercury removal slowly recovered overnight to the pre-test level of >90%. On the last two days of testing, PAC injection was increased to regain the >90% removal rate. Test conditions did not allow sufficient time to achieve this target rate while injecting trona. An estimate of the required PAC is 3X the pre-trona test rate.

Baghouse and tube sheet pressure drop increased during trona injection, causing an increase in cleaning frequency from 0.18 p/b/hr to 0.22 p/b/hr.

Plant operators kept the three units at full, steady load during testing. The boiler soot blowers were used every hour on a staggered schedule to keep the flue gas temperature from fluctuating during testing. Trona was injected near the PAC injection port, which should have resulted in excellent mixing with the flue gas before reaching the baghouse. The trona injection had no effect on boiler operations.

The reacted trona, PAC, and ash were unloaded from the ash silo using a wet unloading system. Because sodium carbonate will react with water to form solid hydrates, an anti-setup chemical was initially used with the water during unloading. No setup of the baghouse mixture was seen either in the mixer or in the transport truck. During the first week, an unloading during the morning occurred without the chemical, also resulting in no setup in the mixer or truck. The material may have been forming hydrates during mixing, preventing a hard setup. The use of the anti-setup chemical should be considered in future tests unless it can be shown that the mixing system prevents a solid setup in the mixer or truck.

An economic assessment of a full-scale trona injection system included equipment and other capital costs along with sorbent cost (trona and increased amount of PAC to maintain 90% removal) and O&M costs. The cost to remove SO_2 varied from $1,483/ton at 45% removal and one silo to $2,290/ton SO_2 at 70% removal with 3 silos.

References

1. EPRI Project Report number ADA4352002F01, March 1994.

2. EPRI Project RP 3083-05 Final Report (Mohave Pilot Tests), April 1996.

3. EPRI Project #TR-110867, "Assessing Air Pollution Control Options at the Hudson Station of Public Service Electric and Gas," August 1998.

4. Standards of Performance for New Stationary Sources National Emission Standards for Hazardous Air Pollutants Addition of Method 29 to Appendix A of Part 60 and Amendments to Method 101A of Appendix B of Part 61 | Federal Register | USEPA03-08-2007
    a. Federal Register document
    b. **URL:**http://www.epa.gov/EPA-AIR/1996/April/Day-25/pr-23270.html

5. Mirant Corporation, "Trona Injection Tests Mirant Potomac River Station Unit 1 November 12 to December 23, 2005", January 16, 2006.

6. *Economic Evaluation of Dry-Injection Flue gas Desulfurization Technology*, EPRI CS-4373, EPRI Project 1682-1, January 1986.

7. *Economic Evaluation of Particulate Control Technologies, Volume 1: New Units*, EPRI TR-100748, EPRI Project 3083-04-1, September 1992.

APPENDIX A – Cost Estimates and Results – Details

Costs for capital equipment, operations, maintenance, and power were provided by vendors as well as estimated using the economic basis provided in EPRI's "Economic Evaluation of Dry-Injection Flue Gas Desulfurization Technology." The costs are broken into sections of capital costs, operating and maintenance costs, and all are converted to 20-year levelized costs. Different scenarios of equipment set-up and injection rates were priced and compared.

The capital costs assumed an availability of 100% until these costs were levelized where a capacity factor of 75% was used. The fixed and variable operating and maintenance costs used a capacity factor of 75% throughout both the first year and levelized estimations with an exception of power which used an 85% capacity factor.

Capital Costs

The costs of equipment and installation for the trona injection system and balance-of-plant systems are shown in Table 16. This table compares the cost for one-silo and three-silo systems. Capital costs for a permanent trona injection system include the storage silo(s), blowers, conveyor piping, dehumidifiers, and modifications to the ash handling system. Cost estimates for the trona storage and injection equipment and installation costs were provided by Bulk Conveyor Specialist, Inc. A description of capital equipment is shown below.

- **Storage Silo**: Skirted, carbon steel shell with cone. Storage capacity of 75 tons. Includes bin vent collector, bin discharger, discharge valve, bin indicators, weigh hopper, rotary valves, control panel, blowers, dehumidifiers. Bin Vent Collector: Shaker type, 280 sq. ft. cloth, air-to-cloth ratio of 3:1.
  - Bin Discharger: 8 in. diameter, 1 Hp motor.
  - Discharge Valve: pneumatic knife gate.
  - Bin Indicators: (3) paddle type.
  - Weigh Hopper: 2000 lb capacity with load cells, 1.5 Hp rotary valve feeders, and one level indicator.
  - Control Panel: Allen Bradley, PLC Logic.

- **Blowers**: 350 CFM, 8-10 psi with in-and-out silencers.

- **Conveyor Piping**: 3" schedule 80, estimated length of 300'.

- **Lances**: 2" schedule 80 pipe, 304 stainless steel, 5'2" in length from flange to tip with 45 degree beveled tip.

- **Housing for Redundant Blowers and Dehumidifiers**: Skirted silo does not have sufficient space available for redundant blowers and dehumidifiers, a small building would be required.

- **Mechanical Exhauster Package**: Exhauster motor size increased from 10 Hp to 20-25 Hp, capable of pulling 15 inHg (14 inHg at full load).

- **Larger Capacity Filter/Separator**: Two larger, continuous operating filter/separators. Modifications to bin roof by extending 14' and bin structure by modifying support steel frame across bin roof to accept higher loads.

Table 16. Summary of Equipment, Balance-of-Plant, and Engineering Costs

Trona Injection System and Balance-of-Plant Equipment and Installation Costs		
Presque Isle Power Plant Units 7, 8, and 9		
Budget Item Description	**Cost**	
	1 SILO	**3 SILOS**
Trona Storage/Injection System		
Silo	$ 595,000	$ 1,785,000
Equipment Included		
75 ton Capacity Storage Silo		
1 Hopper Below Silo		
1 Blower		
1 Dehumidifier Package		
Conveyor Piping (300 ft)		
Lances (*Injection lances from test can be used in permanent system; additional lances are optional at $5,000 per lance)	$ 5,000*	$ 5,000*
Redundancy (equipment added for 3 injection lines per 1 silo)	$ 98,500	$ -
Splitter Valve		
2 Hoppers		
2 Rotary Valves		
2 Blowers		
2 Dehumidifier Packages		
Housing for Blowers and dehumidifiers		
Installation of Trona Storage/Injection Equipment	$ 580,000	$ 580,000
Includes civil, electrical, mechanical and piping		
TOTAL PROCESS EQUIPMENT	$ 1,273,500	$ 2,365,000
Increase In Ash Handling Capabilities		
2 Mechanical Exhauster Packages	$ 15,000	$ 15,000
Exhauster motor size increase (10 Hp to 20-25 Hp)		
Larger Capacity Filter/Separator	$ 200,000	$ 200,000
Design and Supply		
TOTAL ASH HANDLING EQUIPMENT UPGRADES	$ 215,000	$ 215,000
TOTAL EQUIPMENT COSTS (TEC)	$ 1,488,500	$ 2,580,000
General Facilities **(10% of TEC)**	$148,850	$258,000
Engineering and Home office Fees **(12.5% of TEC)**	$186,062	$322,500
Project Contingency **(25% of Process Equip. + 20% of Ash Handling Equip.)**	$361,375	$634,250
Process Contingency **(7.5% of Process Equip. + 5% of Ash Handling Equip.)**	$106,262	$188,125
TOTAL PLANT COST (TPC)	$2,291,050	$3,982,875
Preproduction Costs **(=(1/12)*(Fixed O&M + Var O&M)+.02*TPC)**	$397,921	$431,757
TOTAL CAPITAL REQUIREMENT (TCR)	$2,688,971	$4,414,632

Operating and Maintenance Costs

The operating and maintenance (O&M) costs associated with trona injection for SO_2 control include fixed and variable costs. Fixed O&M costs include labor, maintenance materials, and administrative and support labor. The variable O&M costs vary depending on unit and other capacity factors and include sorbent, power, and waste disposal.

Fixed O&M Costs

The fixed O&M costs include estimates of labor costs for ash handling and costs for operating and maintenance of the silo and injection equipment. It also includes estimates for maintenance materials and for administrative and support labor. The maintenance labor, materials and support labor are estimated using known costs for the TOXECON system installed and operating at Presque Isle.

Table 17 shows the operating labor cost parameters assumed for this cost analysis.

Table 17. Fixed O & M Costs – Ash Handling Labor Cost Parameters

Ash Handling Operating Labor Cost Parameters	
Operating Labor Cost Parameter	
Ash Handling	
rate $/hr (truck+ driver)	$70
ton/load (tons)	20
time/load (hrs)	5
Normal Capacity Factor	0.75

Table 18 indicates how the Ash Handling Labor cost estimates were determined using the labor parameters indicated in Table 17 along with the number of loads of trona/ash/PAC required for the three SO_2 removal rates of 45%, 64% and 70%. The labor costs increase as SO_2 removal rates increase due to the need for more frequent ash unloading and disposal. The 2007 rate for an ash truck and driver is about $70/hr with each truck-load capable of hauling 40,000 lbs or 20 tons. It takes roughly 5 hours to unload the ash and dispose of it in the landfill.

The number of loads of trona/ash/PAC to be disposed of assumes 100% material injected will be captured and disposed of and also incorporates a capacity factor of 75%. The equation below was used to determine the number of loads per year:

$$\text{\# Loads/Year} = (((WPR_{trona} + WPR_{PAC})*NCF) - ((WPR_{PAC,no\ trona\ inj.})*NCF)) / (\text{Tons per load})$$

WPR: Waste Production Rate (tons/hour)
NCF: Normal Capacity Factor

Table 18. Fixed O & M Costs – Ash Handling Labor Costs for Three SO_2 Removal Rates

Fixed O&M Cost: Ash Handling Operating Labor			
	SO_2 Removal Rate		
	45%	64%	70%
# of Loads Per Year			
Trona + DARCO® Hg + Ash	379	760	1022
Trona + DARCO® Hg-LH + Ash	361	734	987
Man-hours Per Year			
Trona + DARCO® Hg + Ash	1896	3798	5112
Trona + DARCO® Hg-LH + Ash	1807	3669	4936
Labor Costs for Ash Handling ($/yr)			
Trona + DARCO® Hg + Ash	$132,739	$265,880	$357,860
Trona + DARCO® Hg-LH + Ash	$126,473	$256,797	$345,500

The operating labor costs for the silo and injection equipment are constant for different SO_2 removal rates as well as constant with either one-silo or three-silo systems. The operating, maintenance and project overhead costs are estimated from the annual costs associated with the TOXECON system currently at Presque Isle. The maintenance materials are estimated in the same manner. The first year labor costs on projects such as this are usually higher than the following years due to the first year start-up issues and optimization of long-term operation. Table 19 shows the fixed costs of equipment operating, maintenance and support labor.

Table 19. Fixed Operating & Maintenance Costs for Equipment Operating, Maintenance and Support Labor

Fixed O&M Cost: Equipment Operating, Maintenance, and Support Labor		
	1st Year	
Operating Labor Costs	**1 SILO**	**3 SILOS**
Operating & Maintenance Labor Costs, in $/yr*	$360,000	$360,000
*Includes operating labor, maintenance labor, project overhead costs		
Maintenance Materials, in $/yr	$108,000	$108,000
TOTAL FIRST YEAR OPERATING, MAINTENANCE, AND SUPPORT COSTS	$468,000	$468,000

.

Table 20. Total First Year Fixed Operating & Maintenance Costs

Total First Year Fixed O&M Cost			
1 or 3 Silos	**SO_2 Removal Rate**		
O&M Labor & Material Costs*	**45%**	**64%**	**70%**
Labor Costs for Ash Handling			
Trona + DARCO® Hg + Ash	$132,740	$265,880	$357,860
Trona + DARCO® Hg-LH + Ash	$126,470	$256,800	$345,500
Labor Costs for Silo and Injection Equipment			
Total First Year Operating, Maintenance, & Support Costs	$468,000	$468,000	$468,000
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg + Ash)	**$600,740**	**$733,880**	**$825,860**
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg-LH + Ash)	**$594,470**	**$724,800**	**$813,500**

Variable O&M Costs

The variable O&M costs include estimates for sorbent costs, landfill costs and power costs. The sorbent costs include trona as well as the increased PAC needed to keep the mercury removal at 90%. Power costs were estimated from the equipment's power requirements and the current cost of power production.

Power Costs

The electrical requirements for the trona injection system include power for blowers, rotary valve motors, bin discharger, and dehumidifiers. Each injection system requires power for one blower, one dehumidifier, and one rotary valve. There is one bin discharger per silo, therefore, if there is one large silo power for one discharger is needed, but with 3 silos power for 3 dischargers is needed. The long-term running power required is roughly half of the power required for start-up. Table 21 shows the amperage needed for the different components and the conversion to kilowatts. Table 22 shows the estimated costs required for long-term running of the injection system using an assumed cost to produce power of $0.03/kWh. The power cost estimations use a Power Capacity Factor of 85%.

Table 21. Power Requirements to Run Trona Injection System

Power Requirements, 1 Injection System (Amps)		
Item	**Motor Description**	**Amps Required**
Blowers:	30 Hp, 480 Vac, 3 phase	40 amps at full load
Rotary Valve:	1 Hp each (2)	1.6 amps each (2)
Bin Discharger:	1.5 Hp	3.0 amps
TOTAL AMPS AT FULL LOAD		46.2 amps
TOTAL AMPS WHILE RUNNING (~1/2 Full Load)		20 amps
Dehumidifiers:		40 amps
TOTAL (amps)		60 amps
Power Requirements, 1 Injection System (kW)		
TOTAL in kW, 3 phase (kW=(1.73*Volts*Current*Power Factor)/1000)		42.35
Power Capacity Factor		0.85
Volts		480
Power Requirements, 3 Injection Systems (kW)		
TOTAL in kW, 3 phase		127.05

Table 22. Variable Operating & Maintenance Costs for Power

Variable O&M Costs: Power		
	1 Injection System	**3 Injection Systems**
Power Usage, in kW	42.35	127.05
Unit Power Cost, in $/kWh	$0.03	$0.03
Power Cost, in $/yr	$11,125	$33,375

Sorbent Costs

Sorbent costs vary depending on the SO_2 removal percentage desired and on the delivery method. Cost for both trona and PAC increase as SO_2 removal percentages increase. The cost for trona to be railed directly to the plant is $140/ton assuming the costs to install a rail spur is picked up under another project. If a rail spur is not installed to the plant the trona can be railed to Ishpeming then loaded into a truck from there and delivered to the plant by truck. Using a combination of rail and truck would cost $155/ton.

The amount of PAC needed to maintain 90% mercury control increases as trona injection increases due to trona interfering with the PAC's ability to capture mercury. Table 23 shows the sorbent costs for trona being delivered directly to the plant by rail and Table 24 shows the sorbent costs for trona being delivered by a combination of rail and truck. Both tables have unit costs for trona, DARCO® Hg, and DARCO® Hg-LH and display the injection rates required for different SO_2 removals. The sorbent cost estimations use a capacity factor of 75%

Table 23. Variable Operating & Maintenance Costs for Sorbent Delivered by Rail to the Plant

Variable O&M Costs: Sorbent Delivered By Rail to Plant			
Sorbent Unit Cost, FOB PIPP , in $/ton	Rail*		
Trona	$140		
DARCO® Hg	$1,100		
DARCO® Hg-LH	$2,100		
*Trona rail spur assumed to be installed under separate project			
	Injection Rates (ton/hr)		
Sorbent	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona	1.1	2.2	2.95
DARCO® Hg	0.142	0.20	0.25
DARCO® Hg-LH	0.085	0.1185	0.14
Sorbent Costs, in $/yr**			
Trona + DARCO® Hg	$1,405,651	$2,836,597	$3,887,797
Trona + DARCO® Hg-LH	$1,460,182	$2,934,162	$3,920,647
**minus PAC that would already be injected			

Table 24. Variable Operating & Maintenance Costs for Sorbent Delivered by a Combination of Rail and Truck to the Plant

Variable O&M Costs: Sorbent Delivered By Rail and Trucked To Plant			
Sorbent Unit Cost, FOB PIPP , in $/ton	Rail + Truck*		
Trona	$155		
DARCO® Hg	$1,100		
DARCO® Hg-LH	$2,100		
*Trona railed to Ishpeming and trucked to plant			
	Injection Rates (ton/hr)		
Sorbent	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona	1.1	2.2	2.95
DARCO® Hg	0.142	0.20	0.25
DARCO® Hg-LH	0.085	0.1185	0.14
Sorbent Costs, in $/yr**			
Trona + DARCO® Hg	$1,514,056	$3,053,407	$4,178,520
Trona + DARCO® Hg-LH	$1,568,587	$3,150,972	$4,211,370
**minus PAC that would already be injected			

Waste Disposal Costs

The variable O&M costs for waste disposal are the costs required to landfill the spent sorbent captured in the baghouse. The 2007 unit cost to landfill material was $44.40. Table 25 shows the waste produced for the different SO_2 removal rates and the costs required to landfill the waste. The costs do not include the ash and PAC waste that is disposed of while running at full load with no trona injected. The waste disposal cost estimations use a capacity factor of 75%.

Table 25. Variable Operating & Maintenance Costs for Disposing the Waste to the Landfill

Variable O&M Costs: Waste Disposal			
Landfill Cost, in $/ton	$ 44.40		
Waste Product	Waste Production Rates (ton/hr)		
	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona	1.1	2.2	2.95
Hg	0.142	0.20	0.25
Hg-LH	0.085	0.1185	0.14
Ash (110 lb/hr)	0.055	0.055	0.055
Waste Disposal Costs, in $/yr**			
Trona + DARCO® Hg	$336,777	$674,575	$907,941
Trona + DARCO® Hg-LH	$330,560	$661,010	$886,063
**minus PAC/Ash waste that would already be disposed of			

Table 26 shows the total variable O&M costs at different SO_2 removal rates and at different delivery methods. The total O&M costs include costs for power, sorbent usage, and disposal costs.

Table 26. Total Variable Operating & Maintenance Costs

Total Variable O&M Costs			
	Removal Rates		
Total Variable O&M Costs, in $/yr	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,775,803	$3,544,547	$4,829,114
Trona + DARCO® Hg-LH	$1,823,917	$3,628,547	$4,840,085
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,884,208	$3,761,357	$5,119,836
Trona + DARCO® Hg-LH	$1,932,322	$3,845,357	$5,130,808

Levelized Costs

Levelized costs were computed to represent a constant cost value for the operating and capital costs over the lifetime of the equipment and project. In other words, the levelized costs take the present value of the net costs and spread them evenly over a period of time. This makes it possible to compare costs looking into the future. For this assessment levelized costs are presented in units of mills/kWh, where a mill is 1/1000 of a dollar.

The calculations to determine levelized costs assumed a discount rate of 7.5% and a 20-year levelization factor was used. The capital costs are converted using a fixed charge rate of 15.0% and the O&M costs are converted using levelization factors of 1.29 for all costs including power and consumables.

Levelized Capital Costs

The capital costs are converted to levelized capital costs using a fixed charge rate of 15.0%. The levelized capital costs for $/year are calculated by multiplying the capital costs by the fixed charge rate of 15.0%. The levelized capital costs in $/kW are calculated by dividing the $/year amount by the nominal kilowatts produced by the plant, 270000kW for Presque Isle Power Plant. The levelized costs represented by mills/kWh are calculated using the following formula and a capacity factor (NCF) of 75%.

LCC (mills/kWh) = ((1000) * (CC) * (LFCR)) / ((NCF) * (8760 hr/yr))

LCC: Levelized Capital Costs
CC: Capital Costs ($/kW)
LFCR: Levelized Fixed Charge Rate
NCF: Normalized Capacity Factor

Table 27 shows the levelized capital costs and compares costs for a one-silo system versus a three-silo system. The total capital requirement for three silos is less than double the requirement for one silo.

Table 27. Levelized Capital Costs

Levelized Capital Costs (20 yr, Current $ Basis)		
Levelized Fixed Charge Rate	**15%**	
	1 SILO	**3 SILOS**
TOTAL LEVELIZED EQUIPMENT COST (Installed)		
Levelized $/yr (TEC * LFCR)	$223,275	$387,000
Levelized $/kW (TEC * LFCR / 270000 kW)	$0.83	$1.43
mills/kWh (1000* TEC*LFCR)/(270000kW*(8760 hrs/yr)*NCF))	0.13	0.22
TOTAL LEVELIZED PLANT COST		
Levelized $/yr (TPC * LFCR)	$343,657	$597,431
Levelized $/kW (TPC * LFCR / 270000 kW)	$1.27	$2.21
mills/kWh (1000* TPC*LFCR)/(270000kW*(8760 hrs/yr)*NCF))	0.19	0.34
TOTAL LEVELIZED CAPITAL REQUIREMENT		
Levelized $/yr (TCR * LFCR)	**$403,345**	**$662,195**
Levelized $/kW (TCR * LFCR / 270000 kW)	**$1.49**	**$2.45**
mills/kWh (1000* TCR*LFCR)/(270000kW*(8760 hrs/yr)*NCF))	**0.23**	**0.37**

Levelized Fixed O&M Costs

Tables 28 and 29 show the fixed operating and maintenance levelized costs for ash handling labor and equipment operating, maintenance, and support labor. These tables are summarized in Table 30. The calculations for the levelized fixed O&M costs are done in the same manner as the levelized capital costs but use a levelization factor of 1.29 in accordance with the EPRI Economic Analysis rather than the 15% fixed charge rate.

Table 28. Levelized Fixed Operating & Maintenance Costs for Ash Handling Labor

Levelized Fixed O&M Cost: Ash Handling Operating Labor			
Operating Labor Levelization Factors			
Ash Handling			
Capacity Factor	75%		
O&M Levelization Factor	1.29		
	Removal Rates		
	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Levelized Labor Costs for Ash Handling			
Trona + DARCO® Hg + Ash			
$/yr	$171,233	$342,985	$461,639
$/kW	$0.63	$1.27	$1.71
mills/kWh	0.10	0.19	0.26
Trona + DARCO® Hg-LH + Ash			
$/yr	$163,150	$331,268	$445,695
$/kW	$0.60	$1.23	$1.65
mills/kWh	0.09	0.19	0.25

Table 29. Levelized Fixed Operating & Maintenance Costs for Equipment Operating, Maintenance, and Support Labor

Levelized Fixed O&M COST: Equipment Operating, Maintenance, and Support Labor	
Operating Labor Levelization Factors	
Equipment Operating, Maintenance, and Support Labor	
Capacity Factor	75%
O&M Levelization Factor	1.29
	1 or 3 Silo(s)
Levelized Operating & Maintenance Labor Costs *	
$/yr	$464,400
$/kW	$1.72
mills/kWh	0.26
*Includes operating labor, maintenance labor, project overhead costs	
Levelized Maintenance Materials	
$/yr	$139,320
$/kW	$0.52
mills/kWh	0.08
TOTAL LEVELIZED OPERATING, MAINTENANCE, AND SUPPORT COSTS	
$/yr	$603,720
$/kW	$2.24
mills/kWh	0.34

Table 30. Levelized Total Operating & Maintenance Costs

Levelized Total Fixed O&M Cost			
Operating Labor Levelization Factors			
Capacity Factor	75%		
O&M Levelization Factor	1.29		
	Removal Rates		
	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Levelized Total Fixed O&M Costs			
Trona + DARCO® Hg + Ash			
$/yr	$774,953	$946,705	$1,065,360
$/kW	$2.87	$3.51	$3.95
mills/kWh	0.44	0.53	0.60
Trona + DARCO® Hg-LH + Ash			
$/yr	$766,870	$934,990	$1,049,415
$/kW	$2.84	$3.46	$3.89
mills/kWh	0.43	0.53	0.59

Levelized Fixed O&M Costs

Tables 31 through 34 show the variable operating and maintenance levelized costs for power, sorbents, and waste disposal. These tables are summarized in Table 35. The calculations for the levelized variable O&M costs are done in the same manner as the levelized fixed O&M costs and use a levelization factor of 1.29 in accordance with the EPRI Economic Analysis.

Levelized Power Costs

Table 31 shows the levelized power costs. A capacity factor of 75% is assumed and a levelization factor of 1.29 is used for power in accordance with the EPRI Economic Analysis.

Table 31. Levelized Variable Operating & Maintenance Costs for Power

Levelized Variable O&M Costs: Power		
Capacity Factor	0.75	
Levelization Factor	1.29	
	1 Injection System	**3 Injection Systems**
Power Usage, in kW	42.35	127.05
Levelized Power Cost		
$/yr	$14,351	$43,054
$/kW	0.05	0.16
mills/kWh	0.008	0.024

Levelized Sorbent Costs

Table 32 shows the levelized costs for sorbent delivered to the plant by rail. Table 33 shows the levelized costs for sorbent delivered to the plant by rail/truck. The levelized costs for trona and DARCO® Hg are compared to the levelized costs of trona and DARCO® Hg-LH at three

different SO_2 removal rates. A capacity factor of 75% is assumed and a levelization factor of 1.29 was used in accordance with the EPRI Economic Analysis.

Table 32. Levelized Variable Operating & Maintenance Costs for Sorbent Delivered by Rail to the Plant

Levelized Variable O&M Costs: Sorbent Delivered By Rail to Plant			
Capacity Factor	75%		
Levelization Factor	1.29		
	Removal Rates		
Levelized Sorbent Costs	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona + DARCO® Hg*			
$/yr	$1,813,290	$3,659,211	$5,015,259
$/kW	$6.72	$13.55	$18.58
mills/kWh	1.02	2.06	2.83
Trona + DARCO® Hg-LH*			
$/yr	$1,883,635	$3,785,069	$5,057,635
$/kW	$6.98	$14.02	$18.73
mills/kWh	1.06	2.13	2.85
*minus PAC that would already be injected			

Table 33. Levelized Variable Operating & Maintenance Costs for Sorbent Delivered by a Combination of Rail and Truck to the Plant

Levelized Variable O&M Costs: Sorbent Delivered By Rail and Trucked to Plant			
Capacity Factor	75%		
Levelization Factor	1.29		
	Removal Rates		
Levelized Sorbent Costs	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona + DARCO® Hg*			
$/yr	$1,953,133	$3,938,896	$5,390,291
$/kW	$7.23	$14.59	$19.96
mills/kWh	1.10	2.22	3.04
Trona + DARCO® Hg-LH*			
$/yr	$2,023,478	$4,064,754	$5,432,667
$/kW	$7.49	$15.05	$20.12
mills/kWh	1.14	2.29	3.06
*minus PAC that would already be injected			

Levelized Waste Disposal Costs

Table 34 shows the levelized waste disposal costs. The levelized costs for landfilling a combination of trona, DARCO® Hg and ash are compared to levelized costs for landfilling trona, DARCO® Hg-LH and ash at three different SO_2 removal rates. A capacity factor of 75% was assumed and a levelization factor of 1.29 was used in accordance with the EPRI Economic Analysis.

Table 34. Levelized Variable Operating & Maintenance Costs for Waste Disposal

Levelized Variable O&M Costs: Waste Disposal			
Capacity Factor	75%		
Levelization Factor	1.29		
	Removal Rates		
Levelized Waste Disposal Costs	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona + DARCO® Hg*			
$/yr	$434,422	$870,200	$1,171,244
$/kW	$1.61	$3.22	$4.34
mills/kWh	0.24	0.49	0.66
Trona + DARCO® Hg-LH*			
$/yr	$426,164	$852,703	$1,143,021
$/kW	$1.58	$3.16	$4.23
mills/kWh	0.24	0.48	0.64
*minus PAC that would already be injected			

Total Levelized Variable O&M Costs

Table 35 shows the total levelized variable operating and maintenance costs. The levelized costs for power, sorbent, and waste disposal are added up and can be compared as one silo versus three silos at three different SO_2 removal rates.

Table 35. Levelized Total Variable Operating & Maintenance Costs

Levelized Total Variable O&M Costs			
	Removal Rates		
Levelized Total Variable O&M Cost	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
$/yr	$2,290,786	$4,572,466	$6,229,557
$/kW	$8.48	$16.94	$23.07
mills/kWh	1.29	2.58	3.51
Trona + DARCO® Hg-LH			
$/yr	$2,352,853	$4,680,826	$6,243,710
$/kW	$8.71	$17.34	$23.12
mills/kWh	1.33	2.64	3.52
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
$/yr	$2,430,629	$4,852,150	$6,604,588
$/kW	$9.00	$17.97	$24.46
mills/kWh	1.37	2.74	3.72
Trona + DARCO® Hg-LH			
$/yr	$2,492,695	$4,960,510	$6,618,742
$/kW	$9.23	$18.37	$24.51
mills/kWh	1.41	2.80	3.72

Total Levelized Costs

Table 36 shows the total levelized costs, which includes the total variable O&M costs, total fixed O&M costs and total capital costs at three removal rates.

Table 36. Levelized Costs (Capital, Fixed, and Variable Levelized Costs)

Levelized Total Costs			
Total Levelized Cost (Capital, Fixed, and Variable Costs)	Removal Rates		
	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
1 SILO			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
$/yr	$3,469,084.86	$5,922,516.40	$7,698,261.25
$/kW	$12.85	$21.94	$28.51
mills/kWh	1.96	3.34	4.34
Trona + DARCO® Hg -LH			
$/yr	$3,523,067.86	$6,019,159.39	$7,696,470.85
$/kW	$13.05	$22.29	$28.51
mills/kWh	1.99	3.39	4.34
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
$/yr	$3,608,927.31	$6,202,201.30	$8,073,293.28
$/kW	$13.37	$22.97	$29.90
mills/kWh	2.03	3.50	4.55
Trona + DARCO® Hg -LH			
$/yr	$3,662,910.31	$6,298,844.29	$8,071,502.87
$/kW	$13.57	$23.33	$29.89
mills/kWh	2.06	3.55	4.55
3 SILOS			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
$/yr	$3,727,934.08	$6,181,365.62	$7,957,110.48
$/kW	$13.81	$22.89	$29.47
mills/kWh	2.10	3.48	4.49
Trona + DARCO® Hg -LH			
$/yr	$3,781,917.08	$6,278,008.62	$7,955,320.07
$/kW	$14.01	$23.25	$29.46
mills/kWh	2.13	3.54	4.48
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
$/yr	$3,867,776.53	$6,461,050.52	$8,332,142.50
$/kW	$14.33	$23.93	$30.86
mills/kWh	2.18	3.64	4.70
Trona + DARCO® Hg -LH			
$/yr	$3,921,759.53	$6,557,693.52	$8,330,352.10
$/kW	$14.53	$24.29	$30.85
mills/kWh	2.21	3.70	4.70

Removal Cost per Ton of SO_2 Removed

Table 37 shows the cost per ton of SO_2 removed using trona at full scale. These values are levelized over 20 years. The amount of SO_2 removed is based on the baseline emission rate of 5,200 tons per year for all three units combined. The cost per ton of SO_2 removed is calculated by dividing the levelized total costs ($/yr) given in table 36 by the amount removed from the baseline for each removal rate. The cost per ton of SO_2 removed varied from $1,483 to $2,290.

Table 37. Removal Costs per Ton SO_2 Removed

Levelized Total Cost per Ton of SO_2 Removed ($/ton)			
No. of Silos, Delivery Method, and Sorbent	**SO_2 Removal Rate**		
*	**45%**	**64%**	**70%**
1 SILO			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,483	$1,780	$2,116
Trona + DARCO® Hg-LH	$1,506	$1,809	$2,115
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,543	$1,864	$2,219
Trona + DARCO® Hg-LH	$1,566	$1,893	$2,218
3 SILOS			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,594	$1,858	$2,187
Trona + DARCO® Hg-LH	$1,617	$1,887	$2,186
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,654	$1,942	$2,290
Trona + DARCO® Hg-LH	$1,677	$1,971	$2,290

Appendix CC. SO_2 NO_x Economics

Appendix A. Cost Estimates and Results for Trona Injection – Details

Costs for capital equipment, operations, maintenance, and power were provided by vendors as well as estimated using the economic basis provided in EPRI's "Economic Evaluation of Dry-Injection Flue Gas Desulfurization Technology." The costs were broken into sections of capital costs, operating and maintenance costs, and all were converted to 20-year levelized costs. Different scenarios of equipment set-up and injection rates were priced and compared.

The capital costs assumed an availability of 100% until these costs were levelized where a capacity factor of 75% was used. The fixed and variable operating and maintenance costs used a capacity factor of 75% throughout both the first year and levelized estimations with an exception of power which used an 85% capacity factor.

1.0 CAPITAL COSTS

The costs of equipment and installation for the trona injection system and balance-of-plant systems are shown in Table 1. This table compares the cost for one-silo and three-silo systems. Capital costs for a permanent trona injection system include the storage silo(s), blowers, conveyor piping, dehumidifiers, and modifications to the ash handling system. Cost estimates for the trona storage and injection equipment and installation costs were provided by Bulk Conveyor Specialist, Inc. A description of capital equipment is shown below.

- Storage Silo: Skirted, carbon steel shell with cone. Storage capacity of 75 tons. Includes bin vent collector, bin discharger, discharge valve, bin indicators, weigh hopper, rotary valves, control panel, blowers, dehumidifiers. Bin Vent Collector: Shaker type, 280 sq. ft. cloth, air-to-cloth ratio of 3:1.
  - Bin Discharger: 8 in. diameter, 1 Hp motor.
  - Discharge Valve: pneumatic knife gate.
  - Bin Indicators: (3) paddle type.
  - Weigh Hopper: 2000 lb capacity with load cells, 1.5 Hp rotary valve feeders, and one level indicator.
  - Control Panel: Allen Bradley, PLC Logic.
- Blowers: 350 CFM, 8-10 psi with in-and-out silencers.
- Conveyor Piping: 3” schedule 80, estimated length of 300’.
- Lances: 2” schedule 80 pipe, 304 stainless steel, 5’2” in length from flange to tip with 45 degree beveled tip.
- Housing for Redundant Blowers and Dehumidifiers: Skirted silo does not have sufficient space available for redundant blowers and dehumidifiers, a small building would be required.

- Mechanical Exhauster Package: Exhauster motor size increased from 10 Hp to 20-25 Hp, capable of pulling 15 inHg (14 inHg at full load).
- Larger Capacity Filter/Separator: Two larger, continuous operating filter/separators. Modifications to bin roof by extending 14’ and bin structure by modifying support steel frame across bin roof to accept higher loads.

Table 1. Summary of Equipment, Balance-of-Plant, and Engineering Costs.

Trona Injection System and Balance-of-Plant Equipment and Installation Costs		
Presque Isle Power Plant Units 7, 8, and 9		
Budget Item Description	**Cost**	
	1 SILO	**3 SILOS**
Trona Storage/Injection System		
Silo	$ 595,000	$ 1,785,000
Equipment Included		
75 ton Capacity Storage Silo		
1 Hopper Below Silo		
1 Blower		
1 Dehumidifier Package		
Conveyor Piping (300 ft)		
Lances (*Injection lances from test can be used in permanent system; additional lances are optional at $5,000 per lance)	$ 5,000*	$ 5,000*
Redundancy (equipment added for 3 injection lines per 1 silo)	$ 98,500	$ -
Splitter Valve		
2 Hoppers		
2 Rotary Valves		
2 Blowers		
2 Dehumidifier Packages		
Housing for Blowers and dehumidifiers		
Installation of Trona Storage/Injection Equipment	$ 580,000	$ 580,000
Includes civil, electrical, mechanical and piping		
TOTAL PROCESS EQUIPMENT	**$ 1,273,500**	**$ 2,365,000**
Increase In Ash Handling Capabilities		
2 Mechanical Exhauster Packages	$ 15,000	$ 15,000
Exhauster motor size increase (10 Hp to 20-25 Hp)		
Larger Capacity Filter/Separator	$ 200,000	$ 200,000
Design and Supply		
TOTAL ASH HANDLING EQUIPMENT UPGRADES	**$ 215,000**	**$ 215,000**
TOTAL EQUIPMENT COSTS (TEC)	**$ 1,488,500**	**$ 2,580,000**
General Facilities (10% of TEC)	$148,850	$258,000
Engineering and Home office Fees (12.5% of TEC)	$186,062	$322,500
Project Contingency (25% of Process Equip. + 20% of Ash Handling Equip.)	$361,375	$634,250
Process Contingency (7.5% of Process Equip. + 5% of Ash Handling Equip.)	$106,262	$188,125
TOTAL PLANT COST (TPC)	**$2,291,050**	**$3,982,875**
Preproduction Costs (=(1/12)*(Fixed O&M + Var O&M)+.02*TPC)	$397,921	$431,757
TOTAL CAPITAL REQUIREMENT (TCR)	**$2,688,971**	**$4,414,632**

2.0 OPERATING AND MAINTENANCE COSTS

The operating and maintenance (O&M) costs associated with trona injection for SO_2 control include fixed and variable costs. Fixed O&M costs include labor, maintenance materials, and administrative and support labor. The variable O&M costs vary depending on unit and other capacity factors and include sorbent, power, and waste disposal.

2.1 Fixed O&M Costs

The fixed O&M costs include estimates of labor costs for ash handling and costs for operating and maintenance of the silo and injection equipment. It also includes estimates for maintenance materials and for administrative and support labor. The maintenance labor, materials and support labor are estimated using known costs for the TOXECON™ system installed and operating at Presque Isle.

Table 2 shows the operating labor cost parameters assumed for this cost analysis.

Table 2. Fixed O & M Costs – Ash Handling Labor Cost Parameters.

Ash Handling Operating Labor Cost Parameters	
Operating Labor Cost Parameter	
Ash Handling	
rate $/hr (truck+ driver)	$70
ton/load (tons)	20
time/load (hrs)	5
Normal Capacity Factor	0.75

Table 3 indicates how the Ash Handling Labor cost estimates were determined using the labor parameters along with the number of loads of trona/ash/PAC required for the three SO_2 removal rates of 45%, 64% and 70%. The labor costs increased as SO_2 removal rates increased due to the need for more frequent ash unloading and disposal. The 2007 rate for an ash truck and driver was about $70/hr with each truck-load capable of hauling 40,000 lbs or 20 tons. It took roughly 5 hours to unload the ash and dispose of it in the landfill.

The number of loads of trona/ash/PAC disposed of assumes 100% material injected was captured and disposed of and also incorporates a capacity factor of 75%. The equation below was used to determine the number of loads per year:

$$\text{\# Loads/Year} = (((WPR_{trona} + WPR_{PAC})*NCF) - ((WPR_{PAC,no\ trona\ inj.})*NCF)) / (\text{Tons per load})$$

WPR: Waste Production Rate (tons/hour)

NCF: Normal Capacity Factor

Table 3. Fixed O & M Costs – Ash Handling Labor Costs for Three SO2 Removal Rates.

Fixed O&M Cost: Ash Handling Operating Labor			
	SO_2 Removal Rate		
	45%	**64%**	**70%**
# of Loads Per Year			
Trona + DARCO® Hg + Ash	379	760	1022
Trona + DARCO® Hg-LH + Ash	361	734	987
Man-hours Per Year			
Trona + DARCO® Hg + Ash	1896	3798	5112
Trona + DARCO® Hg-LH + Ash	1807	3669	4936
Labor Costs for Ash Handling ($/yr)			
Trona + DARCO® Hg + Ash	$132,739	$265,880	$357,860
Trona + DARCO® Hg-LH + Ash	$126,473	$256,797	$345,500

The operating labor costs for the silo and injection equipment were constant for different SO_2 removal rates as well as constant with either one-silo or three-silo systems. The operating, maintenance and project overhead costs were estimated from the annual costs associated with the TOXECON™ system currently at Presque Isle. The maintenance materials were estimated in the same manner. The first year labor costs on projects such as this were usually higher than the following years due to the first year start-up issues and optimization of long-term operation. Table 4shows the fixed costs of equipment operating, maintenance and support labor.

Table 4. Fixed Operating & Maintenance Costs for Equipment Operating, Maintenance and Support Labor.

Fixed O&M Cost: Equipment Operating, Maintenance, and Support Labor		
	1st Year	
Operating Labor Costs	**1 SILO**	**3 SILOS**
Operating & Maintenance Labor Costs, in $/yr*	$360,000	$360,000
*Includes operating labor, maintenance labor, project overhead costs		
Maintenance Materials, in $/yr	$108,000	$108,000
TOTAL FIRST YEAR OPERATING, MAINTENANCE, AND SUPPORT COSTS	$468,000	$468,000

Table 5. Total First Year Fixed Operating & Maintenance Costs.

Total First Year Fixed O&M Cost			
1 or 3 Silos	**SO_2 Removal Rate**		
O&M Labor & Material Costs*	**45%**	**64%**	**70%**
Labor Costs for Ash Handling			
Trona + DARCO® Hg + Ash	$132,740	$265,880	$357,860
Trona + DARCO® Hg-LH + Ash	$126,470	$256,800	$345,500
Labor Costs for Silo and Injection Equipment			
Total First Year Operating, Maintenance, & Support Costs	$468,000	$468,000	$468,000
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg + Ash)	**$600,740**	**$733,880**	**$825,860**
TOTAL O&M COSTS, 1 or 3 SILOS (Trona + DARCO® Hg-LH + Ash)	**$594,470**	**$724,800**	**$813,500**

2.2 Variable O&M Costs

The variable O&M costs included estimates for sorbent costs, landfill costs and power costs. The sorbent costs included trona as well as the increased PAC needed to keep the mercury removal at 90%. Power costs were estimated from the equipment's power requirements and the current cost of power production.

2.2.1 Power Costs

The electrical requirements for the trona injection system included power for blowers, rotary valve motors, bin discharger, and dehumidifiers. Each injection system required power for one blower, one dehumidifier, and one rotary valve. There was one bin discharger per silo, therefore, if there was one large silo power for one discharger was needed, but with 3 silos power for 3 dischargers was needed. The long-term running power required was roughly half of the power required for start-up. Table 6 shows the amperage needed for the different components and the conversion to kilowatts. Table 7 shows the estimated costs required for long-term running of the injection system using an assumed cost to produce power of $0.03/kWh. The power cost estimations use a Power Capacity Factor of 85%.

Table 6. Power Requirements to Run Trona Injection System.

Power Requirements, 1 Injection System (Amps)		
Item	**Motor Description**	**Amps Required**
Blowers:	**30 Hp, 480 Vac, 3 phase**	**40 amps at full load**
Rotary Valve:	1 Hp each (2)	1.6 amps each (2)
Bin Discharger:	1.5 Hp	3.0 amps
TOTAL AMPS AT FULL LOAD		46.2 amps
TOTAL AMPS WHILE RUNNING (~1/2 Full Load)		20 amps
Dehumidifiers:		40 amps
TOTAL (amps)		60 amps
Power Requirements, 1 Injection System (kW)		
TOTAL in kW, 3 phase (kW=(1.73*Volts*Current*Power Factor)/1000)		42.35
Power Capacity Factor		0.85
Volts		480
Power Requirements, 3 Injection Systems (kW)		
TOTAL in kW, 3 phase		**127.05**

Table 7. Variable O & M Costs for Power.

Variable O&M Costs: Power		
	1 Injection System	**3 Injection Systems**
Power Usage, in kW	42.35	127.05
Unit Power Cost, in $/kWh	$0.03	$0.03
Power Cost, in $/yr	$11,125	$33,375

2.2.2 Sorbent Costs

Sorbent costs varied depending on the SO_2 removal percentage desired and on the delivery method. Cost for both trona and PAC increased as SO_2 removal percentages increased. The cost for trona to be railed directly to the plant was $140/ton assuming the costs to install a rail spur was picked up under another project. If a rail spur was not installed to the plant the trona could be railed to Ishpeming then loaded into a truck from there and delivered to the plant by truck. Using a combination of rail and truck would cost $155/ton.

The amount of PAC needed to maintain 90% mercury control increased as trona injection increased due to trona interfering with the PAC's ability to capture mercury. Table 8 shows the sorbent costs for trona being delivered directly to the plant by rail and Table 9 shows the sorbent costs for trona being delivered by a combination of rail and truck. Both tables have unit costs for trona, DARCO® Hg, and DARCO® Hg-LH and display the injection rates required for different SO_2 removals. The sorbent cost estimations use a capacity factor of 75%

Table 8. Variable O & M Costs for Sorbent Delivered by Rail to the Plant.

Variable O&M Costs: Sorbent Delivered By Rail to Plant			
Sorbent Unit Cost, FOB PIPP , in $/ton	**Rail***		
Trona	$140		
DARCO® Hg	$1,100		
DARCO® Hg-LH	$2,100		
*Trona rail spur assumed to be installed under separate project			
	Injection Rates (ton/hr)		
Sorbent	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Trona	1.1	2.2	2.95
DARCO® Hg	0.142	0.20	0.25
DARCO® Hg-LH	0.085	0.1185	0.14
Sorbent Costs, in $/yr**			
Trona + DARCO® Hg	$1,405,651	$2,836,597	$3,887,797
Trona + DARCO® Hg-LH	$1,460,182	$2,934,162	$3,920,647
**minus PAC that would already be injected			

Table 9. Variable O & M Costs for Sorbent Delivered by Rail and Truck to the Plant.

Variable O&M Costs: Sorbent Delivered By Rail and Trucked To Plant			
Sorbent Unit Cost, FOB PIPP , in $/ton	**Rail + Truck***		
Trona	$155		
DARCO® Hg	$1,100		
DARCO® Hg-LH	$2,100		
*Trona railed to Ishpeming and trucked to plant			
	Injection Rates (ton/hr)		
Sorbent	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Trona	1.1	2.2	2.95
DARCO® Hg	0.142	0.20	0.25
DARCO® Hg-LH	0.085	0.1185	0.14
Sorbent Costs, in $/yr**			
Trona + DARCO® Hg	$1,514,056	$3,053,407	$4,178,520
Trona + DARCO® Hg-LH	$1,568,587	$3,150,972	$4,211,370
**minus PAC that would already be injected			

2.2.3 Waste Disposal Costs

The variable O&M costs for waste disposal were the costs required to landfill the spent sorbent captured in the baghouse. The 2007 unit cost to landfill material was $44.40. Table 10 shows the waste produced for the different SO_2 removal rates and the costs required to landfill the waste. The costs do not include the ash and PAC waste that is disposed of while

running at full load with no trona injected. The waste disposal cost estimations use a capacity factor of 75%.

Table 10. Variable O & M Costs for Disposing the Waste to the Landfill.

Variable O&M Costs: Waste Disposal			
Landfill Cost, in $/ton	$ 44.40		
Waste Product	**Waste Production Rates (ton/hr)**		
	SO2 Removal of 45%	SO2 Removal of 64%	SO2 Removal of 70%
Trona	1.1	2.2	2.95
Hg	0.142	0.20	0.25
Hg-LH	0.085	0.1185	0.14
Ash (110 lb/hr)	0.055	0.055	0.055
Waste Disposal Costs, in $/yr**			
Trona + DARCO® Hg	$336,777	$674,575	$907,941
Trona + DARCO® Hg-LH	$330,560	$661,010	$886,063
**minus PAC/Ash waste that would already be disposed of			

Table 11 shows the total variable O&M costs at different SO_2 removal rates and at different delivery methods. The total O&M costs include costs for power, sorbent usage, and disposal costs.

Table 11. Total Variable O & M Costs.

Total Variable O&M Costs			
Total Variable O&M Costs, in $/yr	**Removal Rates**		
	SO_2 Removal of 45%	**SO_2 Removal of 64%**	**SO_2 Removal of 70%**
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,775,803	$3,544,547	$4,829,114
Trona + DARCO® Hg-LH	$1,823,917	$3,628,547	$4,840,085
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,884,208	$3,761,357	$5,119,836
Trona + DARCO® Hg-LH	$1,932,322	$3,845,357	$5,130,808

3.0 LEVELIZED COSTS

Levelized costs were computed to represent a constant cost value for the operating and capital costs over the lifetime of the equipment and project. In other words, the levelized costs take the present value of the net costs and spread them evenly over a period of time. This makes it possible to compare costs looking into the future. For this assessment levelized costs are presented in units of mills/kWh, where a mill is 1/1000 of a dollar.

The calculations to determine levelized costs assumed a discount rate of 7.5% and a 20-year levelization factor was used. The capital costs are converted using a fixed charge rate of 15.0% and the O&M costs were converted using levelization factors of 1.29 for all costs including power and consumables.

3.1 Levelized Capital Costs

The capital costs were converted to levelized capital costs using a fixed charge rate of 15.0%. The levelized capital costs for $/year were calculated by multiplying the capital costs by the fixed charge rate of 15.0%. The levelized capital costs in $/kW were calculated by dividing the $/year amount by the nominal kilowatts produced by the plant; 270,000kW for Presque Isle Power Plant. The levelized costs represented by mills/kWh were calculated using the following formula and a capacity factor (NCF) of 75%.

LCC (mills/kWh) = ((1000) * (CC) * (LFCR)) / ((NCF) * (8760 hr/yr))

LCC: Levelized Capital Costs
CC: Capital Costs ($/kW)
LFCR: Levelized Fixed Charge Rate
NCF: Normalized Capacity Factor

Table 12 shows the levelized capital costs and compares costs for a one-silo system versus a three-silo system. The total capital requirement for three silos is less than double the requirement for one silo.

Table 12. Levelized Capital Costs.

Levelized Capital Costs (20 yr, Current $ Basis)		
Levelized Fixed Charge Rate	15%	
	1 SILO	**3 SILOS**
TOTAL LEVELIZED EQUIPMENT COST (Installed)		
Levelized $/yr (TEC * LFCR)	$223,275	$387,000
Levelized $/kW (TEC * LFCR / 270000 kW)	$0.83	$1.43
mills/kWh (1000* TEC*LFCR)/(270000kW*(8760 hrs/yr)*NCF))	0.13	0.22
TOTAL LEVELIZED PLANT COST		
Levelized $/yr (TPC * LFCR)	$343,657	$597,431
Levelized $/kW (TPC * LFCR / 270000 kW)	$1.27	$2.21
mills/kWh (1000* TPC*LFCR)/(270000kW*(8760 hrs/yr)*NCF))	0.19	0.34
TOTAL LEVELIZED CAPITAL REQUIREMENT		
Levelized $/yr (TCR * LFCR)	$403,345	$662,195
Levelized $/kW (TCR * LFCR / 270000 kW)	$1.49	$2.45
mills/kWh (1000* TCR*LFCR)/(270000kW*(8760 hrs/yr)*NCF))	0.23	0.37

3.2 Levelized Fixed O&M Costs

Table 13 and Table 14 show the fixed operating and maintenance levelized costs for ash handling labor and equipment operating, maintenance, and support labor. The calculations for the levelized fixed O&M costs are done in the same manner as the levelized capital costs but use a levelization factor of 1.29 in accordance with the EPRI Economic Analysis rather than the 15% fixed charge rate.

Table 13. Levelized Fixed Operating & Maintenance Costs for Ash Handling Labor.

Levelized Fixed O&M Cost: Ash Handling Operating Labor			
Operating Labor Levelization Factors			
Ash Handling			
Capacity Factor	75%		
O&M Levelization Factor	1.29		
	Removal Rates		
	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Levelized Labor Costs for Ash Handling			
Trona + DARCO® Hg + Ash			
$/yr	$171,233	$342,985	$461,639
$/kW	$0.63	$1.27	$1.71
mills/kWh	0.10	0.19	0.26
Trona + DARCO® Hg-LH + Ash			
$/yr	$163,150	$331,268	$445,695
$/kW	$0.60	$1.23	$1.65
mills/kWh	0.09	0.19	0.25

Table 14. Levelized Fixed O & M Costs for Equipment Operating, Maintenance, and Support Labor.

Levelized Fixed O&M COST: Equipment Operating, Maintenance, and Support Labor	
Operating Labor Levelization Factors	
Equipment Operating, Maintenance, and Support Labor	
Capacity Factor	75%
O&M Levelization Factor	1.29
	1 or 3 Silo(s)
Levelized Operating & Maintenance Labor Costs *	
$/yr	$464,400
$/kW	$1.72
mills/kWh	0.26
*Includes operating labor, maintenance labor, project overhead costs	
Levelized Maintenance Materials	
$/yr	$139,320
$/kW	$0.52
mills/kWh	0.08
TOTAL LEVELIZED OPERATING, MAINTENANCE, AND SUPPORT COSTS	
$/yr	$603,720
$/kW	$2.24
mills/kWh	0.34

Table 15. Levelized Total Operating & Maintenance Costs.

Levelized Total Fixed O&M Cost			
Operating Labor Levelization Factors			
Capacity Factor	75%		
O&M Levelization Factor	1.29		
	Removal Rates		
	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Levelized Total Fixed O&M Costs			
Trona + DARCO® Hg + Ash			
$/yr	$774,953	$946,705	$1,065,360
$/kW	$2.87	$3.51	$3.95
mills/kWh	0.44	0.53	0.60
Trona + DARCO® Hg-LH + Ash			
$/yr	$766,870	$934,990	$1,049,415
$/kW	$2.84	$3.46	$3.89
mills/kWh	0.43	0.53	0.59

3.3 Levelized Variable O&M Costs

Table 16 through Table 19 show the variable operating and maintenance levelized costs for power, sorbents, and waste disposal. These tables are summarized in Table 35. The calculations for the levelized variable O&M costs are done in the same manner as the levelized fixed O&M costs and use a levelization factor of 1.29 in accordance with the EPRI Economic Analysis.

3.3.1 Levelized Power Costs

Table 16 shows the levelized power costs. A capacity factor of 75% is assumed and a levelization factor of 1.29 is used for power in accordance with the EPRI Economic Analysis.

Table 16. Levelized Variable O & M Costs for Power.

Levelized Variable O&M Costs: Power		
Capacity Factor	0.75	
Levelization Factor	1.29	
	1 Injection System	3 Injection Systems
Power Usage, in kW	42.35	127.05
Levelized Power Cost		
$/yr	$14,351	$43,054
$/kW	0.05	0.16
mills/kWh	0.008	0.024

3.3.2 Levelized Sorbent Costs

Table 17 shows the levelized costs for sorbent delivered to the plant by rail. Table 18 shows the levelized costs for sorbent delivered to the plant by rail/truck. The levelized costs for trona and DARCO® Hg are compared to the levelized costs of trona and DARCO® Hg-LH at three different SO_2 removal rates. A capacity factor of 75% is assumed and a levelization factor of 1.29 was used in accordance with the EPRI Economic Analysis.

Table 17. Levelized Variable O & M Costs for Sorbent Delivered by Rail to the Plant.

Levelized Variable O&M Costs: Sorbent Delivered By Rail to Plant			
Capacity Factor	75%		
Levelization Factor	1.29		
	Removal Rates		
Levelized Sorbent Costs	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Trona + DARCO® Hg*			
$/yr	$1,813,290	$3,659,211	$5,015,259
$/kW	$6.72	$13.55	$18.58
mills/kWh	1.02	2.06	2.83
Trona + DARCO® Hg-LH*			
$/yr	$1,883,635	$3,785,069	$5,057,635
$/kW	$6.98	$14.02	$18.73
mills/kWh	1.06	2.13	2.85
*minus PAC that would already be injected			

Table 18. Levelized Variable O & M Costs for Sorbent Delivered by a Combination of Rail and Truck to the Plant.

Levelized Variable O&M Costs: Sorbent Delivered By Rail and Trucked to Plant			
Capacity Factor	75%		
Levelization Factor	1.29		
	Removal Rates		
Levelized Sorbent Costs	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Trona + DARCO® Hg*			
$/yr	$1,953,133	$3,938,896	$5,390,291
$/kW	$7.23	$14.59	$19.96
mills/kWh	1.10	2.22	3.04
Trona + DARCO® Hg-LH*			
$/yr	$2,023,478	$4,064,754	$5,432,667
$/kW	$7.49	$15.05	$20.12
mills/kWh	1.14	2.29	3.06
*minus PAC that would already be injected			

3.3.3 Levelized Waste Disposal Costs

Table 19 shows the levelized waste disposal costs. The levelized costs for landfilling a combination of trona, DARCO® Hg and ash were compared to levelized costs for landfilling trona, DARCO® Hg-LH and ash at three different SO_2 removal rates. A capacity factor of 75% was assumed and a levelization factor of 1.29 was used.

Table 19. Levelized Variable O & M Costs for Waste Disposal.

Levelized Variable O&M Costs: Waste Disposal			
Capacity Factor	75%		
Levelization Factor	1.29		
	Removal Rates		
Levelized Waste Disposal Costs	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Trona + DARCO® Hg*			
$/yr	$434,422	$870,200	$1,171,244
$/kW	$1.61	$3.22	$4.34
mills/kWh	0.24	0.49	0.66
Trona + DARCO® Hg-LH*			
$/yr	$426,164	$852,703	$1,143,021
$/kW	$1.58	$3.16	$4.23
mills/kWh	0.24	0.48	0.64
*minus PAC that would already be injected			

3.3.4 Total Levelized Variable O&M Costs

Table 20 shows the total levelized variable operating and maintenance costs. The levelized costs for power, sorbent, and waste disposal are added up and can be compared as one silo versus three silos at three different SO_2 removal rates.

Table 20. Levelized Total Variable O & M Costs.

Levelized Total Variable O&M Costs			
	Removal Rates		
Levelized Total Variable O&M Cost	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
$/yr	$2,290,786	$4,572,466	$6,229,557
$/kW	$8.48	$16.94	$23.07
mills/kWh	1.29	2.58	3.51
Trona + DARCO® Hg-LH			
$/yr	$2,352,853	$4,680,826	$6,243,710
$/kW	$8.71	$17.34	$23.12
mills/kWh	1.33	2.64	3.52
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
$/yr	$2,430,629	$4,852,150	$6,604,588
$/kW	$9.00	$17.97	$24.46
mills/kWh	1.37	2.74	3.72
Trona + DARCO® Hg-LH			
$/yr	$2,492,695	$4,960,510	$6,618,742
$/kW	$9.23	$18.37	$24.51
mills/kWh	1.41	2.80	3.72

3.4 Total Levelized Costs

Table 21 shows the total levelized costs, which includes the total variable O&M costs, total fixed O&M costs and total capital costs at three removal rates.

Table 21. Levelized Costs (Capital, Fixed, and Variable Levelized Costs).

Levelized Total Costs			
	Removal Rates		
Total Levelized Cost (Capital, Fixed, and Variable Costs)	SO_2 Removal of 45%	SO_2 Removal of 64%	SO_2 Removal of 70%
1 SILO			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
$/yr	$3,469,084.86	$5,922,516.40	$7,698,261.25
$/kW	$12.85	$21.94	$28.51
mills/kWh	1.96	3.34	4.34
Trona + DARCO® Hg -LH			
$/yr	$3,523,067.86	$6,019,159.39	$7,696,470.85
$/kW	$13.05	$22.29	$28.51
mills/kWh	1.99	3.39	4.34
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
$/yr	$3,608,927.31	$6,202,201.30	$8,073,293.28
$/kW	$13.37	$22.97	$29.90
mills/kWh	2.03	3.50	4.55
Trona + DARCO® Hg -LH			
$/yr	$3,662,910.31	$6,298,844.29	$8,071,502.87
$/kW	$13.57	$23.33	$29.89
mills/kWh	2.06	3.55	4.55
3 SILOS			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg			
$/yr	$3,727,934.08	$6,181,365.62	$7,957,110.48
$/kW	$13.81	$22.89	$29.47
mills/kWh	2.10	3.48	4.49
Trona + DARCO® Hg -LH			
$/yr	$3,781,917.08	$6,278,008.62	$7,955,320.07
$/kW	$14.01	$23.25	$29.46
mills/kWh	2.13	3.54	4.48
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg			
$/yr	$3,867,776.53	$6,461,050.52	$8,332,142.50
$/kW	$14.33	$23.93	$30.86
mills/kWh	2.18	3.64	4.70
Trona + DARCO® Hg -LH			
$/yr	$3,921,759.53	$6,557,693.52	$8,330,352.10
$/kW	$14.53	$24.29	$30.85
mills/kWh	2.21	3.70	4.70

4.0 REMOVAL COST PER TON OF SO_2 REMOVED

Table 22 shows the cost per ton of SO_2 removed using trona at full scale. These values are levelized over 20 years. The amount of SO_2 removed is based on the baseline emission rate of 5,200 tons per year for all three units combined. The cost per ton of SO_2 removed is calculated by dividing the levelized total costs ($/yr) given in table 36 by the amount removed from the baseline for each removal rate. The cost per ton of SO_2 removed varied from $1,483 to $2,290.

Table 22. Removal Costs per Ton SO_2 Removed.

Levelized Total Cost per Ton of SO_2 Removed ($/ton)			
No. of Silos, Delivery Method, and Sorbent	**SO_2 Removal Rate**		
*****	**45%**	**64%**	**70%**
1 SILO			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,483	$1,780	$2,116
Trona + DARCO® Hg-LH	$1,506	$1,809	$2,115
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,543	$1,864	$2,219
Trona + DARCO® Hg-LH	$1,566	$1,893	$2,218
3 SILOS			
Trona Delivered by Rail to Plant			
Trona + DARCO® Hg	$1,594	$1,858	$2,187
Trona + DARCO® Hg-LH	$1,617	$1,887	$2,186
Trona Delivered by Rail/Truck			
Trona + DARCO® Hg	$1,654	$1,942	$2,290
Trona + DARCO® Hg-LH	$1,677	$1,971	$2,290