DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

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

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DISCLAIMER

ABSTRACT

With the Nation's coal-burning utilities facing the possibility of tighter controls on mercury pollutants, the U.S. Department of Energy is funding projects that could offer power plant operators better ways to reduce these emissions at much lower costs.

Mercury is known to have toxic effects on the nervous system of humans and wildlife. Although it exists only in trace amounts in coal, mercury is released when coal burns and can accumulate on land and in water. In water, bacteria transform the metal into methylmercury, the most hazardous form of the metal. Methylmercury can collect in fish and marine mammals in concentrations hundreds of thousands times higher than the levels in surrounding waters.

One of the goals of DOE is to develop technologies by 2005 that will be capable of cutting mercury emissions 50 to 70 percent at well under one-half of today's costs. ADA Environmental Solutions (ADA-ES) is managing a project to test mercury control technologies at full scale at four different power plants from 2000 – 2003. The ADA-ES project is focused on those power plants that are not equipped with wet flue gas desulfurization systems.

ADA-ES has developed a portable system that will be tested at four different utility power plants. Each of the plants is equipped with either electrostatic precipitators or fabric filters to remove solid particles from the plant's flue gas.

ADA-ES's technology will inject a dry sorbent, such as activated carbon, which removes the mercury and makes it more susceptible to capture by the particulate control devices. A fine water mist may be sprayed into the flue gas to cool its temperature to the range where the dry sorbent is most effective.

PG&E National Energy Group is providing two test sites that fire bituminous coals and both are equipped with electrostatic precipitators and carbon/ash separation systems. Wisconsin Electric Power Company is providing a third test site that burns Powder River Basin (PRB) coal and has an electrostatic precipitator for particulate control. Alabama Power Company will host a fourth test at its Plant Gaston, which is equipped with a hot-side electrostatic precipitator and a downstream fabric filter.

EXPERIMENTAL

All field-testing has been completed at Pleasant Prairie Unit 2 and all data and samples have been analyzed.

RESULTS AND DISCUSSIONS

This Topical Report is issued as complete detailed results of data and sample analysis. These results are for tests that were conducted at We Energies' Pleasant Prairie Power Plant Unit 2.

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EXECUTIVE SUMMARY

Pleasant Prairie Unit 2 was successfully tested for applicability of activated carbon injection as a mercury control technology. Test results from this site have enabled a thorough evaluation of the impacts of future mercury regulations to Pleasant Prairie Unit 2, including performance, estimated cost, and operation data. Directly as a result of this work, options and alternatives for an optimized design can be evaluated.

The team responsible for executing this program included plant and Wisconsin Electric headquarters personnel, EPRI and several of its member companies, DOE, ADA-ES, Norit Americas, Inc., Apogee Scientific, Environmental Elements Corporation, GE Mostardi Platt, URS Corporation, Reaction Engineering, as well as other laboratories. The technical support of all of these entities came together to make this program achieve its goals.

Overall the objectives of this field test program were to determine the mercury control and balance-of-plant impacts resulting from activated carbon injection into a full-scale ESP on Pleasant Prairie Unit 2, a Powder River Basin subbituminous-coal-fired 600 MW unit. One-quarter of the gas stream was used for these tests, or 150 MWe. Five carbon-based sorbents, one lime, three lime-carbon combinations, and three flyashes were tested in a slipstream of flue gas via a field packed-bed apparatus for mercury adsorption. Four carbon-based sorbents were tested full-scale by injection into one of the four ESPs on Pleasant Prairie Unit 2 (150 MW nominal). Sorbents were injected in the duct downstream of the SO_3 injection system, allowing about one second of residence time prior to the ESP. Conditions tested included spray cooling and SO_3 off. Baseline tests confirmed prior results, showing that there is little to no native mercury removal at Pleasant Prairie.

Mercury control as a function of sorbent injection was found in practice to vary significantly from theory. The minimum planned injection rate of 10 lb/MMacf yielded a higher-than-expected mercury removal of 60-65%. Increasing the injection rate did not improve mercury control, rather it appeared that a ceiling was reached, approaching 70% control. Reducing the injection rate by half impaired the removal rate by only about 10%. At 1 lb/MMacf mercury control efficiency averaging 46% over a five-day period was achieved.

Spray cooling from 300 to 250º F did not improve mercury control by carbon injection. The spray cooling limits were pushed in terms of ash deposition, with no impact on mercury control.

Coal measurements agreed well with both Ontario Hydro and S-CEM measurements used throughout the test program. Ash analyes yielded a problematic result. Even at the minimum injection rate tested (1 lb/MMacf for a mercury control of 40-50%), the ash was rendered unsalable as measured by a foam index test. Since Pleasant Prairie currently sells all of its high-quality, Class C flyash for use in concrete, this is a significant economic and environmental impact of carbon injection. Further evaluation of a TOXECON configuration is recommended based on the high cost of ACI into the ESP.

INTRODUCTION

In December 2000 EPA announced the intent to regulate mercury emissions from the nation's coal-fired power plants. In anticipation of these regulations, a great deal of research has been conducted during the past decade to characterize the emission and control of mercury compounds from the combustion of coal. Much of this research was funded by the Department of Energy, EPA, and EPRI. The results are summarized in the comprehensive AWMA Critical Review Article[1]. As a result of these efforts, the following was determined:

1. Trace concentrations of mercury in flue gas can be measured relatively accurately;
2. Mercury is emitted in a variety of forms;
3. Mercury species vary with fuel source and combustion conditions; and
4. Control of mercury from utility boilers will be both difficult and expensive.

This latter point is one of the most important and dramatic findings from the research conducted to date. Because of the large volumes of gas to be treated, low concentrations of mercury, and presence of difficult to capture species such as elemental mercury, some estimates show that 90% mercury reduction for utilities could cost the industry as much as $5 billion per year[1]. Most of these costs will be borne by power plants that burn low-sulfur coal and do not have wet scrubbers as part of the air pollution equipment.

With regulations rapidly approaching, it is important to concentrate efforts on the most mature retrofit control technologies. Injection of dry sorbents such as powdered activated carbon (PAC) into the flue gas and further collection of the sorbent by ESPs and fabric filters represents the most mature and potentially most cost-effective control technology for power plants. However, all of the work to date has been conducted using bench-scale and pilot experiments. Although these reduced-scale programs provide valuable insight into many important issues, they cannot fully account for impacts of additional control technology on plant-wide equipment.

Therefore, it is necessary to scale-up the technology and perform full-scale field tests to document actual performance levels and determine accurate cost information. Under a DOE/NETL cooperative agreement, ADA-ES is working in partnership with PG&E National Energy Group (NEG), We-Energies, a subsidiary of Wisconsin Energy Corp. (also referred to interchangeably as Wisconsin Electric or Wisconsin Electric Power Company), Alabama Power Company, a subsidiary of Southern Company, and EPRI on a field evaluation program of sorbent injection upstream of existing particulate control devices for mercury control[2-4]. Other organizations providing cost share to this program are Ontario Power Generation, First Energy, Hamon-Research Cottrell, TVA, Kennecott Energy, and Arch Coal. Team members include EPRI, Apogee Scientific, URS Corporation, Energy & Environmental Strategies, Reaction Engineering, Southern Research Institute, Hamon Research-Cottrell, Environmental Elements Corporation, Norit Americas, and EnviroCare International.

This report is the Final Report presenting results from the second of these field test programs, conducted at Wisconsin Electric's Pleasant Prairie Power Plant in the fall of 2001.

DESCRIPTION OF OVERALL PROGRAM

The Department of Energy's National Energy Technology Laboratory (NETL) is the primary funding agency on an industry cost-shared test program to obtain the necessary information to assess the costs of controlling mercury from coal-fired utility plants that do not have scrubbers for SO_2 control. The method for mercury control evaluated in this program is the injection of dry sorbents, such as activated carbon, upstream of the existing particulate control device on a full-scale system. The economics are developed based on various levels of mercury control at four different host sites. The four sites, shown below, fire a coal type and have particulate control equipment that are representative of 75% of the coal-fired generation in the United States.

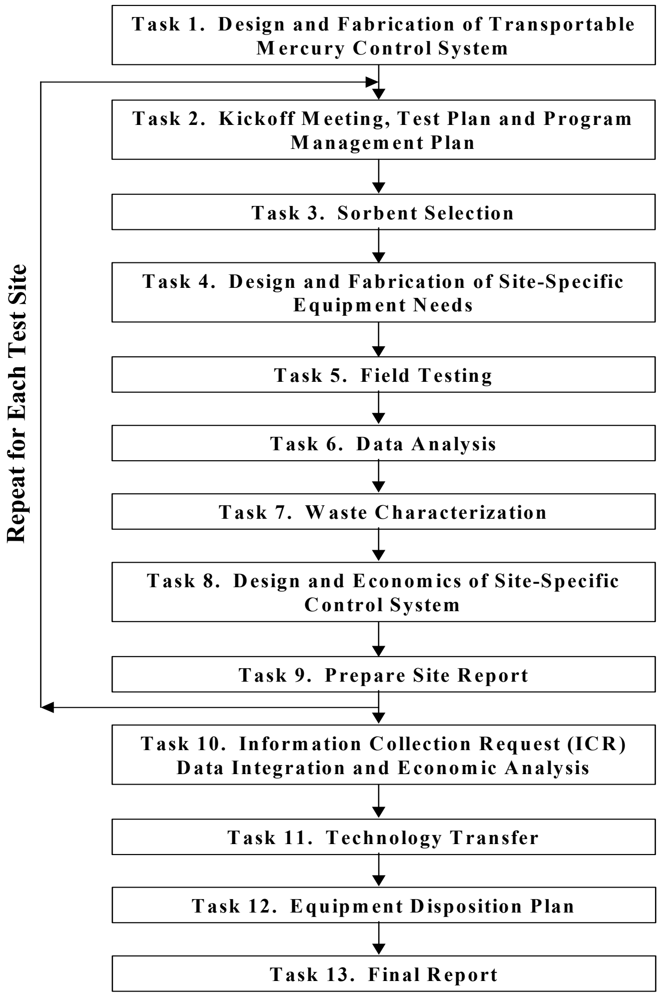
Test Site	Coal	Particulate Control
PG&E NEG Salem Harbor	Low S. Bituminous	Cold-Side ESP
PG&E NEG Brayton Point	Low S. Bituminous	Cold-Side ESP
We-Energies Pleasant Prairie	PRB (Subbituminous)	Cold-Side ESP
Alabama Power Gaston	Low S. Bituminous	Hot-Side ESP COHPAC FF

Pleasant Prairie Unit 2 is of key interest because it was the only plant included in the NETL program that burns western, low-sulfur sub-bituminous coal. The particulate collection device (PCD) is a cold-side ESP, which represents the PCD of choice at over 90% of nation's coal-fired boilers. Other attractive features of this test site for this program include:

1. The ability to isolate one ESP chamber (1/4 of the unit, ~150 MW);
2. The challenge of implementing mercury control at a site where baseline mercury measurements (1999) showed no significant mercury removal and a flue gas mercury dominated by the elemental species;
3. A duct configuration with long, unobstructed runs that allowed adequate space for the installation of water injection lances upstream of the sorbent injection lances so that the effects of spray cooling (to achieve lower flue gas lower temperatures) on mercury control could be evaluated; and
4. A keen interest in the impact of activated carbon on fly ash sold for use in concrete. The ash is currently sold as a valuable commodity. Impacts on ash re-use are important to evaluate in determining the real costs of mercury control

The overall program has 12 technical tasks. Tasks 2 through 9 are specific for each of the field evaluations and Tasks 1, 10, 11 and 12 are common tasks in support of all the test sites. The technical tasks are shown on Figure 1.

Figure 1: Outline of Overall Program Technical Tasks



This program is funded through a cooperative agreement between the Department of Energy National Energy Technology Laboratory (NETL) and ADA Environmental Solutions, LLC (ADA-ES). The agreement includes a requirement that industry cost share this program at a minimum of 33%. Under the DOE/NETL cooperative agreement, ADA-ES is working in partnership with PG&E National Energy Group (NEG), Wisconsin Electric, a subsidiary of Wisconsin Energy Corp., Alabama Power Company, a subsidiary of Southern Company, and EPRI. Significant cost share was provide by industry for the Pleasant Prairie tests. Cost share partners were:

Wisconsin Electric Company	**EPRI**
First Energy	**TVA**
EnviroCare	**Ontario Power**
Kennecott Energy	**Southern Company**
PG&E NEG	
Norit Americas, Inc.	**ADA-ES**

PLEASANT PRAIRIE PROJECT OBJECTIVE AND TECHNICAL APPROACH

The overall objectives of testing at Pleasant Prairie Unit 2 are to determine the cost and impacts of sorbent injection into the cold side ESP for mercury control. Impacts that were evaluated include ESP performance and ash marketability. The evaluation was conducted on ¼ of the gas stream, nominally 150 MW.

To achieve the overall objective, the program was designed with an extensive field evaluation, laboratory testing, and analysis effort. This report presents the results of these efforts.

SITE DESCRIPTION

Wisconsin Electric Company, a subsidiary of Wisconsin Energy, owns and operates Pleasant Prairie Power Plant located in Kenosha, Wisconsin. The plant has two (2) 600 MW balanced-draft coal-fired boilers. Unit 2 was the test unit. The units fire a variety of Powder River Basin low sulfur, sub-bituminous coals.

The primary particulate control equipment consists of cold-side ESP's, of weighted wire design with liquid sulfur SO_3 flue gas conditioning. The precipitators were designed and built by Research-Cottrell and the flue gas conditioning system was supplied by Wahlco. They were originally designed to collect fly ash from the Riley Stoker turbo-fired boiler with design superheated steam conditions of 1905 PSIA/995^o F. The boiler was designed to burn low sulfur coal at a gross nominal generating capacity of 616 MW (580 MW net). The design ACFM was 2,610,000 at 280^{o}F and an inlet pressure of $^+/_-$ 30" H_2O. The design collection efficiency was 99.72%. There is a common stack supporting sister units.

Precipitator #2 was commissioned and put into service in 1985. The installation is comprised of four (4) electrostatic precipitators that are arranged piggyback style and designated 2-1,2-2,2-3, and 2-4. Each of the four precipitators is two (2) chambers wide and four (4) mechanical fields deep with eight (8) electrical fields in direction of gas flow. The unit employs sixty-four (64) T/R's, sixteen (16) on each precipitator. The T/R's are capable of double half wave or full wave operation. At this time, the T/R's are in full wave operation.

Opacity is measured at the stack, but there is the capability of measuring opacity in the common ductwork for each of the two (2) piggyback units.

Hopper ash is combined between all four precipitators in the dry ash-pull system. The ash is sold as base for concrete and is considered a valuable product of the Pleasant Prairie Power Plant. One precipitator's ash can be isolated from the balance of the unit, and was for the duration of carbon injection tests.

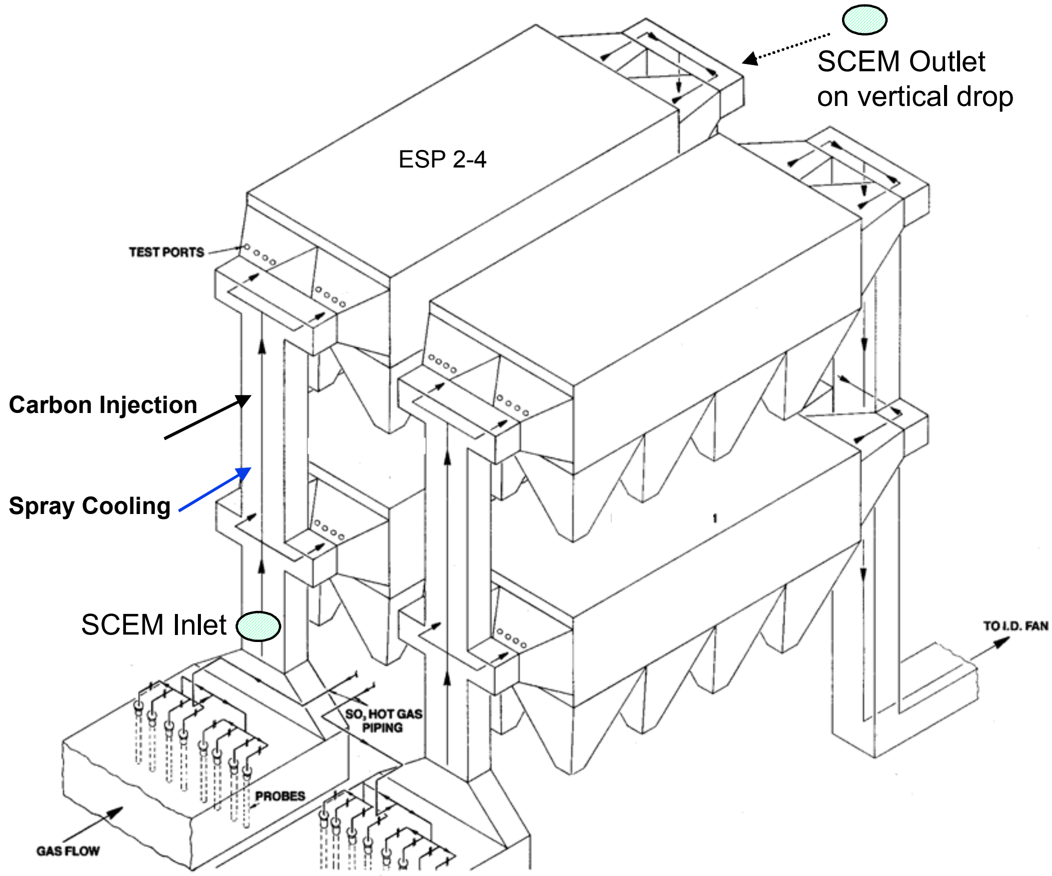
A summary of important descriptive parameters for Pleasant Prairie Unit 2 is presented in Table 1.

Table 1. Site Description Summary, Pleasant Prairie Unit 2.

PARAMETER IDENTIFICATION	DESCRIPTION
Process	
Boiler Manufacturer	Riley Stoker Turbo-Fired
Burner Type	Riley Stoker – Direction Flame
Low NOx Burners	No
Steam Coils	No
Over Fire Air	No (glycol preheater)
NOx Control (Post Combustion)	None
Temperature (APH Outlet)	280^{o}F
Coal (Typical during test period)	
Type	Powder River Basin
Heating Value (Btu/lb)	~8,300
Moisture (%)	30
Sulfur (%)	.35
Ash (%)	5
Hg (μg/g)	0.1
Cl (%)	0.001
Control Device	
Type	Cold-Side ESP
ESP Manufacturer	Research Cottrell
Design	Weighted Wire
Specific Collection Area (ft^2/1000afcm)	468
Flue Gas Conditioning	Wahlco SO_3 Injection

Figure 2 shows an isometric view of the Unit 1 ESPs at Pleasant Prairie. Unit 2 is identical to Unit 1. One of the four ESPs was treated, representing nominally 150 MW of the unit's total capacity. This met DOE’s requirement to evaluate units no larger than 150 MW and also provided the opportunity to compare ESP performance and mercury removal on parallel ESPs, one treated with sorbent injection and one untreated. The injection tests were conducted across the 2-4 ESP, which is the north side.

Figure 2. Isometric View of Precipitator Arrangement at Pleasant Prairie.



The 2-4 ESP is the top box of the piggyback-configuration and therefore had a long duct run which could accommodate both sorbent injection and spray cooling, and still have adequate residence time for both.

Sorbent for mercury control was injected into the ductwork downstream of the SO_3 injection grid. The sorbent had approximately 0.75 seconds of residence time in the duct before entering the ESP.

FIELD EVALUATION

The critical elements of the site evaluation were the actual field tests and measurements, which relied upon accurate, rapid measurements of mercury concentration and an injection system that realistically represented commercially-available technology.

Near real-time, vapor-phase mercury measurements were made using a Semi-Continuous Emissions Monitors (S-CEM) designed and operated by Apogee Scientific. This instrument was developed with EPRI funding to facilitate EPRI research and development efforts[5]. Multiple S-CEMs were used. The locations of the analyzers are shown on Figure 2. The S-CEMs operated continuously for over seven weeks, providing speciated, vapor-phase mercury concentrations at the inlet and outlet of COHPAC.

Norit Americas supplied a portable, dilute-phase pneumatic injection system that is typical of those used at Municipal Solid Waste (MSW) facilities for mercury control with activated carbon. ADA-ES designed the distribution and injection components of the system.

A Test Plan for this program at Pleasant Prairie was developed prior to commencing testing, it is included in Appendix A. Meetings were held with plant, project and environmental personnel to finalize the scope and logistics of the test program. Testing that had been performed at Pleasant Prairie in 1999 and 2000 provided the basis for development of this test plan. The flue gas at Pleasant Prairie does not remove mercury in the existing configuration. Prior work performed by the team members at the site assisted in streamlining test selection and sorbent screening.

The overall schedule for equipment installation and tests conducted for the Pleasant Prairie Unit 2 evaluation is shown in Table 2.

Table 2. Schedule of Pleasant Prairie Unit 2 Mercury Control Evaluation

Test Description	Dates (2001)
Sorbent Screening Tests (field)	June
Equipment Installation	July-August
Preliminary S-CEM measure	August 19-20
Baseline Tests	Sept 10-12
Check-out and initial sorbent inj.	Sept 22
Parametric Test Week 1	Sept 24-28
Parametric Test Week 2	Oct 1-5
Parametric Test Week 3	Oct 8-12
Long Term Test (Darco FGD)	Oct 29-Nov 9
Ash / sample and data analyses	Sept 2001 – Jan 2002

The following sections describe each component of the program; laboratory and field test results are presented under the appropriate subsections below.

Site-Specific Equipment Description

Sorbent requirements for various levels of mercury control were predicted based on empirical models developed through EPRI funding[6]. The values used were based on an in-flight model with one second residence time and uniform sorbent size of 15 microns (size of commercially available PAC). Practical limits associated with bulk handling of sorbents, storage requirements and increased loading to the ESP were also considered. Rates used to design equipment for the Pleasant Prairie test are presented in Table 3. The system was sized for a maximum injection rate of 1500 lb/h.

Table 3. Predicted Injection Rates for FGD Carbon on 1/4 of Pleasant Prairie ESP.

Target Hg Removal Efficiency (%)	**Predicted Injection Concentration (lbs/MMacf)**	**Predicted Injection Rate[a] (lb/h)**
20	10	360
40	20	720
50	30	1080

Note a: Injection rate based on nominal flow at full load of 600,000 acfm.

The transportable sorbent injection system was provided by Norit Americas and consisted of a bulk-storage silo and twin blower/feeder trains each rated at 750 lb/hr. Sorbents were delivered in bulk pneumatic trucks and loaded into the silo, which was equipped with a bin vent bag filter. From the two discharge legs of the silo, the reagent was metered by variable speed screw feeders into eductors that provided the motive force to carry the reagent to the injection point. Regenerative blowers provided the conveying air. A PLC system was used to control system operation and adjust injection rates. Figure 3 is a photograph of the sorbent silo and feed train installed at Pleasant Prairie. Flexible hoses carried the reagent from the feeders to distribution manifolds located on the ESP inlet duct, feeding the injection probes. Each manifold supplied up to six injectors.

EnviroCare International provided the spray cooling system used to cool the flue gas temperature. The spray cooling system was comprised of a valve rack skid, air and water headers, and spray lances. Compressed air and supply water from the plant was provided to the valve rack skid where controls regulated the air and water to obtain proper flows and pressures at the spray lances. Since the volume and temperature of the gases varied across the ESP inlet duct, the spray cooling system was engineered with two control zones.

Figure 3. Carbon Injection Storage Silo and Feeder Trains Installed at Pleasant Prairie.

In preparation for the field test at Pleasant Prairie, the internal duct bracing within 40 feet downstream of the spray lances was removed. Feedback thermocouples were located 40 feet downstream of the spray lances and used to regulate water flow and air pressure to the spray lances to maintain a predetermined temperature setpoint. The spray cooling system was designed to maintain a temperature difference of 50 °F between the inlet and outlet thermocouples. An in-duct camera monitored the internal supports 40 feet downstream from water injection to provide immediate indication of any ash buildup.

Description of Field Tests

The field tests were separated into four different test phases:

- Sorbent Screening;
- Baseline;
- Parametric Tests; and
- Long-Term Tests.

Test methods are described first, and then each of these phases of testing is described in the subsections below. Results from the laboratory and field tests are presented in the separate "Pleasant Prairie Test Results" Section that follows.

1. Test Methods used in Field Testing at Pleasant Prairie

For testing at Pleasant Prairie Unit 2 the team generated a comprehensive test plan (Appendix A). This document includes the test methodology and quality control procedures used. Detailed descriptions of the Ontario-Hydro method field sampling and laboratory analyses were provided by the test company, Mostardi-Platt, prior to testing[7]. Also included in Appendix C of the test plan is a detailed description of the S-CEM method used for continuous mercury monitoring. These were the two primary methods used to measure mercury during the field tests. Two additional mercury measurement methods were used selectively. Durag provided their Verewa instrument, a real-time mercury analyzer, at the ESP outlet. This instrument provided data during baseline testing, but once sorbent injection began, the measurements were inconclusive. Frontier Geosciences' MESA (iodine-impregnated carbon trap) method was also used for total mercury measurements during long-term tests.

Mostardi-Platt also ran EPA Method 29 to quantify multi-metals at the outlet of the 2-4 ESP during the baseline and long-term tests.

EPA Method 5 was used to determine particulate loading at the outlet to the ESP during baseline and long-term testing. Total particulate was also measured in real-time using an MSI Beta Gauge. This instrument was the best performer of several that were tested by the plant for a long-term installation. MSI maintained the instrument throughout the test period.

Impactor tests to determine particle size and the carbon content of each stage were also conducted, during long-term tests only. These test results were not quantitative, but rather showed that the fine particulate level was below the detection limit of the impactor test method.

During spray cooling tests instrumentation including an in-duct camera and an extensive thermocouple array downstream of injection were relied upon to ensure that buildup of ash in the duct did not become a problem. Dew point was measured periodically using a Land Combustion Dew Point Analyzer.

Sample locations were at the inlet and/or outlet of the 2-4 ESP. A complete list of parameters measured and their sample locations during long-term tests is provided in Table 1 of the long term test memo of November 16, 2001 in Appendix D.

2. Sorbent Selection and Screening

Because of the economic impact of sorbent cost on the overall cost of mercury control, it is desirable to find less expensive sorbents. Many groups, including team members EPRI, URS Corporation (URS), and Apogee, have conducted extensive studies on this issue and have developed methods to quickly and economically screen potential sorbents.

The test plan included time to evaluate several sorbents. Alternative sorbents were chosen from several different potential sorbent types and suppliers. In some cases it is of interest to consider using ash with high LOI from plants within the host sites' system. This was of particular interest for Pleasant Prairie, since both Valley and Presque Isle flyashes contain high levels of carbon.

The procedure for sorbent screening was first to assess whether a sorbent meets the economic and availability criteria below, then to include the sorbent in laboratory screening and/or slipstream screening tests to determine its capacity. If initial screening shows good results and the sorbent is available, more extensive field testing, including duct injection, may be performed.

Sorbent Selection Criteria

The future market for mercury sorbents is potentially very large and this program provides the first opportunity for suppliers to have sorbents evaluated full-scale. To follow the intent of NETL in choosing sorbents (to test commercially- or near commercially-available products), a sorbent selection criteria was developed so that sorbent vendors/developers could clearly understand the needs and requirements of this program. A draft of the sorbent selection criteria is included in the Pleasant Prairie Test Plan (Appendix A). In summary an alternative sorbent supplier must show that the sorbent will:

1. Cost at least 25% less to use than FGD carbon;
2. Be available in quantities of at least 15,000 lb and 250,000 lb for site tests;
3. Be available in sufficient quantities to supply at least 1000 tons per year by 2007; and
4. Have a capacity of at least 100 μg/g as measured in the laboratory by URS Corporation.

URS Corporation conducted both the laboratory and slip-stream measurements of sorbent adsorption capacity and provided technical expertise in results interpretation. URS has determined the equilibrium adsorption capacity for a variety of sorbents as a function of mercury concentration, mercury type, flue gas temperature, and flue gas composition. Results from these tests and a description of the test device and procedures have been published previously[8].

Sorbents Screened and Selected

Prior testing that had been done under EPRI and WE projects had evaluated the mercury control effectiveness of several sorbents in Pleasant Prairie flue gas. During this program that data was built upon by performing new tests to add to the knowledge base. Table 4 shows the sorbent tests that were performed in the field to investigate sorbent options for Pleasant Prairie. Five carbon-based sorbents, one lime, three lime-carbon combinations, and three flyashes were tested in URS Corporation's packed-bed slipstream screening device.

A major influence on sorbent effectiveness and performance is the size of the sorbent. Therefore it was of interest to test smaller size sorbents. Darco Insul is a fine carbon of limited availability, which is used in another industry. It is based on Darco FGD but is chemically treated and size-separated for a smaller average size of 6-8 micrometers MMD. Smaller sizes are of interest in sorbent testing because of typically higher capacity, reactivity, and the potential for increased utilization predicted by mass transfer theory. Norit also provided "Ground FGD" which is smaller than FGD but not as small as Insul. As the name implies, "Ground FGD" is Darco FGD that has been processed by mechanical grinding.

Table 4 summarizes the sorbents tested in the field slipstream device under this program.

Table 4. Sorbent Screening Tests at Pleasant Prairie.

Sorbent Description	Supplier	Field slipstream downstream of SO3	Field slipstream upstream of SO3
Darco FGD, Insul, Fine FGD	Norit Americas	FGD, FGD-lime, Insul	FGD, Insul, Fine FGD
Nuchar-1, Nuchar-DC	Westvaco	X	
Lime		X	
SorbTech	Sorbent Technologies	X	
Sorbalit	Dravo		X
Pleasant Prairie flyash	Unit 2 ESP hopper	X	X
Ground Valley flyash [+100]	Baghouse hopper, ground	X	
Hand-ground Valley flyash [+100]	Baghouse hopper, hand ground	X	

3. Baseline Testing

After equipment installation and checkout, a set of baseline tests was conducted the week of September 9-12, 2001. During this test boiler load was held steady at "full-load" conditions during testing hours, nominally 7:00 am to 7:00 pm. Both the S-CEMs and the modified Ontario Hydro Method were used to measure mercury across the 2-4 ESP. Prior tests had shown little to no removal of mercury across Pleasant Prairie's ESP.

In addition to monitoring mercury removal, it was also important to document the performance of the ESP with and without sorbent injection. This is critical to the success of sorbent injection for mercury control at Pleasant Prairie. All tests, including baseline, parametric, and long-term tests, included monitoring of ESP performance. The primary performance indicator for an ESP is power level. The higher the power level, the better the performance. Power is measured in kW and was monitored throughout all testing. Changes in particulate matter characteristics such as resistivity can affect ESP performance. Opacity was also monitored, as well as Beta Gauge measurements for total particulate using a plant-installed instrument.

During the baseline tests, daily samples of coal and ESP ash were collected. Methods 5 and 29 were also run to obtain multi-metal and particulate levels at the ESP outlet for comparison with sorbent injection results.

4. Parametric Testing

A series of parametric tests was conducted to determine the optimum operating conditions for several levels of mercury control. Primary variables were:

- Injection concentration,

- Carbon type (four types were tested),
- SO_3 flue gas conditioning on/off, and
- Spray cooling to 250 °F.

In all, 16 different parametric conditions were tested. A summary of the parametric tests is presented in Table 5. "Standard" conditions were with the boiler at full load operation, SO_3 conditioning on, and no spray cooling. Exceptions to the standard conditions are noted in the table. Each condition was run for a minimum of six hours, except for Test Series 13-16 where the small particle size distribution of the Insul sorbent caused feeding problems.

During the parametric tests, the S-CEMs were used to quantify mercury control effectiveness of each tested condition. In addition, the impact of sorbent injection on the performance of the ESP was monitored.

Table 5. Summary of Parametric Test Conditions.

Test Series	Carbon Name	Target Injection Concentration (lbs/MMacf)	Non Standard Conditions
1	Darco FGD	10	SO_3 Conditioning Off
2, 3, 5	Darco FGD	10, 20, 30	Standard
4	Darco FGD	10	Spray Cooling to 250°F
6, 8, 9, 10	Ground FGD	1, 2, 5, 10	Standard
7	Ground FGD	10	SO_3 Conditioning Off
11&12	FGL	5 & 10	Standard
13 - 16	Insul	0.5, 1, 2, 3	Standard

5. Long-Term Performance Tests

Long-term testing under optimum conditions, as determined from the parametric tests, was performed to gather data on:

- Mercury removal efficiency over time;
- The effects of sorbent injection on ESP performance, ash quality, and balance of plant equipment; and
- Operation of the injection equipment to determine the viability and economics of the process.

The original test plan called for injecting sorbents at one condition, 24 hours/day, for up to two weeks to obtain the highest mercury removal rates possible within equipment limitations. However, results from the parametric tests showed significant mercury removal at low injection rates. This raised interest in the long-term performance under these conditions. The long-term test was divided into three injection periods, each lasting five days, to determine:

1. The ability to achieve significant mercury removal (40 –50%) at a low sorbent injection concentration. The interest here was to obtain representative ash samples at this low rate to determine the impact on existing, valuable reuse of the Pleasant Prairie fly ash. At 1 lb/MMacf the estimated increase in ash LOI was 0.5%.
2. Mercury removal and impact on ESP performance at a high sorbent injection concentration. An injection concentration of 10 lb/MMacf was chosen because no additional mercury removal was measured at injection rates >10; and
3. Whether the relationship between mercury removal and sorbent injection concentration obtained during the parametric tests would remain the same with long-term operation. An intermediate sorbent injection concentration of 3 lb/MMacf was chosen.

Darco FGD activated carbon was chosen as the sorbent for these tests. Similar to the baseline test series, mercury was measured by both the S-CEMs and Ontario Hydro. The Ontario Hydro measurements were performed only once during the long-term tests at the highest injection concentration, 10 lb/MMacf. ESP performance, coal and fly ash samples, and plant CEM data were collected. Full load boiler conditions were held between the hours of 7:00 am to 8:00 p.m., with load under dispatch control at other times, except for the three days when the Ontario Hydro tests were conducted and full load was maintained 24 hours/day. Table 6 presents the schedule for the long-term tests and the goals associated with each condition.

Table 6. Long-Term Test Conditions and Goals.

Dates	**Target Injection Concentration**	**Test Goals**
10/31/01 – 11/4/01	1 lb/MMacf	1. Minimize impact on ash 2. Measure mercury removal at low injection rate
11/5/01 – 11/9/01	3 lb/MMacf	1. Measure mercury removal at logarithmic "middle" point
11/10/01 – 11/14/01	10 lb/MMacf	1. Measure mercury removal at high injection rate 2. Determine impact on ESP 3. Conduct Ontario Hydro mercury measurements

PLEASANT PRAIRIE TEST RESULTS

Field testing on Pleasant Prairie Unit 2 was concluded on November 14, 2001. The test series and dates of testing were summarized in Table 2.

Results are presented separately for each of the series of tests in the subsections below. Results from coal and ash analyses for all test series are presented and discussed together under "Coal and Ash Characterization." Cost data is provided in the final subsection "Economic Analysis." Conclusions are summarized in the final Section.

SORBENT SCREENING TEST RESULTS

At Pleasant Prairie, mercury adsorption tests were carried out on a slip-stream of flue gas extracted from two locations upstream of the ESP; before and after SO_3 injection. Eight carbon-based and three fly ash-based sorbents were tested at 250 or 300°F, with and without SO_3 conditioning. The major conclusions from the fixed-bed tests were:

- Carbons are capable of achieving high mercury capacities in Pleasant Prairie flue gas;
- SO_3 appears to inhibit carbon adsorption, but not to the extent that capacity is decreased below the threshold capacity (nominally 150 µg/g for an ESP) and therefore performance should not be impacted[9];and
- Flue gas cooling significantly increased the adsorption capacity of some of the carbon-based sorbents.

The results of all field sorbent screening tests are shown in Table 7. Sorbent capacities are normalized to 50 µg/Nm^3 mercury concentration. Since capacity is dependent on mercury concentration, the capacities in Pleasant Prairie flue gas would be about one-third those shown. Three major categories of sorbents were tested: carbon-based, ash-based, and carbon-lime combinations. Observations from these results are:

- The Norit carbons displayed very high adsorption capacities;
- FGD and Insul looked very similar;
- The presence of SO_3 from flue gas conditioning inhibited adsorption;
- The capacity of the Fine FGD sample was high, but lower than regular FGD;
- Ground VAPP ash showed improvement as temperature decreased from 300 to 250°F;
- The higher capacity of the hand-ground Valley flyash sample was surprising because this sample appeared to have larger particles than the "ground" Valley ash (processed with a shatterbox grinder). Differences may be due to how these samples pack and possible channeling of the flow (this may also be the reason for lower capacity of the Fine FGD);
- The Sorbent Technology (SorbTech) sample looked good (near 1900µg/g) downstream of SO_3 conditioning, this compares favorable with FGD results from 2000 (425 µg/g) at these conditions;
- The two Nuchar samples showed no capacity;
- The P4 ash shows no appreciable adsorption, even at 250 ºF.

Carbon/Lime Tests:

- Adsorption capacities of FGD+Lime were no better than FGD alone.
- Sorbalit (lime-carbon mixture produced by Dravo) showed high adsorption upstream of SO_3. This sample had a lime/carbon ratio of 20:1.

Table 7. Results of fixed bed screening tests by URS at Pleasant Prairie. Adsorption capacities are normalized to 50 µg/Nm^3 mercury concentration.

Sample Name	Field Location	Sorbent Concentration (mg/g)	Field Temperature (^oF)	Field Equilibrium Adsorption Capacity (µg/g)
FGD Carbon	Upstream of SO_3	0.166	250	8823
FGD Carbon	Downstream of SO_3	0.33	250	3355
Fine FGD Carbon	Upstream of SO_3	0.166	250	4032
VAPP[+100]-ground	Downstream of SO_3	2.5	300	18
VAPP[+100]-ground	Downstream of SO_3	5	250	82
VAPP[+100]-hand ground	Downstream of SO_3	5	300	402
Nuchar Carbon	Downstream of SO_3	0.165	300	0
Nuchar DC	Downstream of SO_3	0.33	300	0
Norit Insul Carbon	Upstream of SO_3	0.111	250	8754
Norit Insul Carbon	Downstream of SO_3	0.33	250	1069
SorbTech-2	Downstream of SO_3	0.33	300	1889
P4 Ash	Upstream of SO_3	10	250	0.15
P4 Ash	Downstream of SO_3	10	250	3
FGD+Lime	Downstream of SO_3	0.166/10	250	2091
FGD+Lime	Downstream of SO_3	0.166/10	300	>1504
Sorbalit	Upstream of SO_3	0.166*	250	>10261
Lime	Downstream of SO_3	10	250	0.13

*note: adsorption capacity was 513 µg/g with respect to entire carbon/lime mass

Sorbents for the full-scale evaluation were selected based on several factors, including results from these fixed bed screening tests for mercury adsorption capacity, price, and availability of bulk delivered sorbent at quantities up to 100,000 lbs. Norit Americas lignite-based PAC, Darco FGD, was chosen as the benchmark sorbent.

Four sorbents were selected for full-scale evaluation in the parametric test series. All four sorbents were PACs because none of the ash-based sorbents met the established criteria. The alternate sorbents were chosen because they had potential advantages over the benchmark sorbent. Two sorbents had smaller size distributions, which according to theory should significantly improve mercury collection efficiency. The third sorbent was a lower capacity, lower cost PAC. A description of the four sorbents selected for the parametric test series is presented in Table 8.

Table 8. Description of Norit Carbons Selected for the Parametric Tests.

Name	**Description**	**Particle Size Distribution**[a]		
		D95	**D50**	**D5**
Darco FGD	Lignite AC	52	18	<3
Darco FGL	Lignite AC	52	18	<3
Darco Insul	Fine, chemically washed specialty product	25	6-7	<2
Ground FGD	Lignite AC	50	14	<3

Note a: Percent of particles less than size in microns

BASELINE TEST RESULTS

For Baseline tests both S-CEMs and Ontario-Hydro were used to make mercury measurements on September 10 and 11. In addition coal and ash analyses for mercury were made. These results are tabulated and discussed in the Section below entitled "Coal and Ash Characterization."

Preliminary results from Baseline tests were summarized in a memo dated September 20, 2001. This memo is included for reference in Appendix B. The S-CEM data in the memo and on Figures 4 and 5 shows that of the about 11-14 µg/g mercury at the inlet to the ESP, about 8-13 µg/g was emitted. Nominally 20% of the vapor-phase mercury was oxidized mercury at the inlet location. There was oxidation occurring across the ESP, with as much as 50% of the vapor-phase mercury in the oxidized form downstream from the ESP. These results can be seen on Figure 4. The S-CEM results were confirmed by the Ontario-Hydro tests, below.

Results from Ontario Hydro tests conducted by GE Mostardi Platt in September 2002 are presented in Table 9. All GE Mostardi-Platt test reports are included in Appendix E. The average flue gas temperature during this period was 290^{o}F. The data show minimal baseline mercury removal across the ESP. The predominant species of mercury, whether at the inlet or outlet of the ESP, was elemental. Similar to measurements conducted at Gaston, there was oxidation of mercury in the direction of flow, in this case, across the ESP.

Table 9. Speciated Mercury Measured by Ontario Hydro Method, Baseline Conditions. Average of Three Runs.

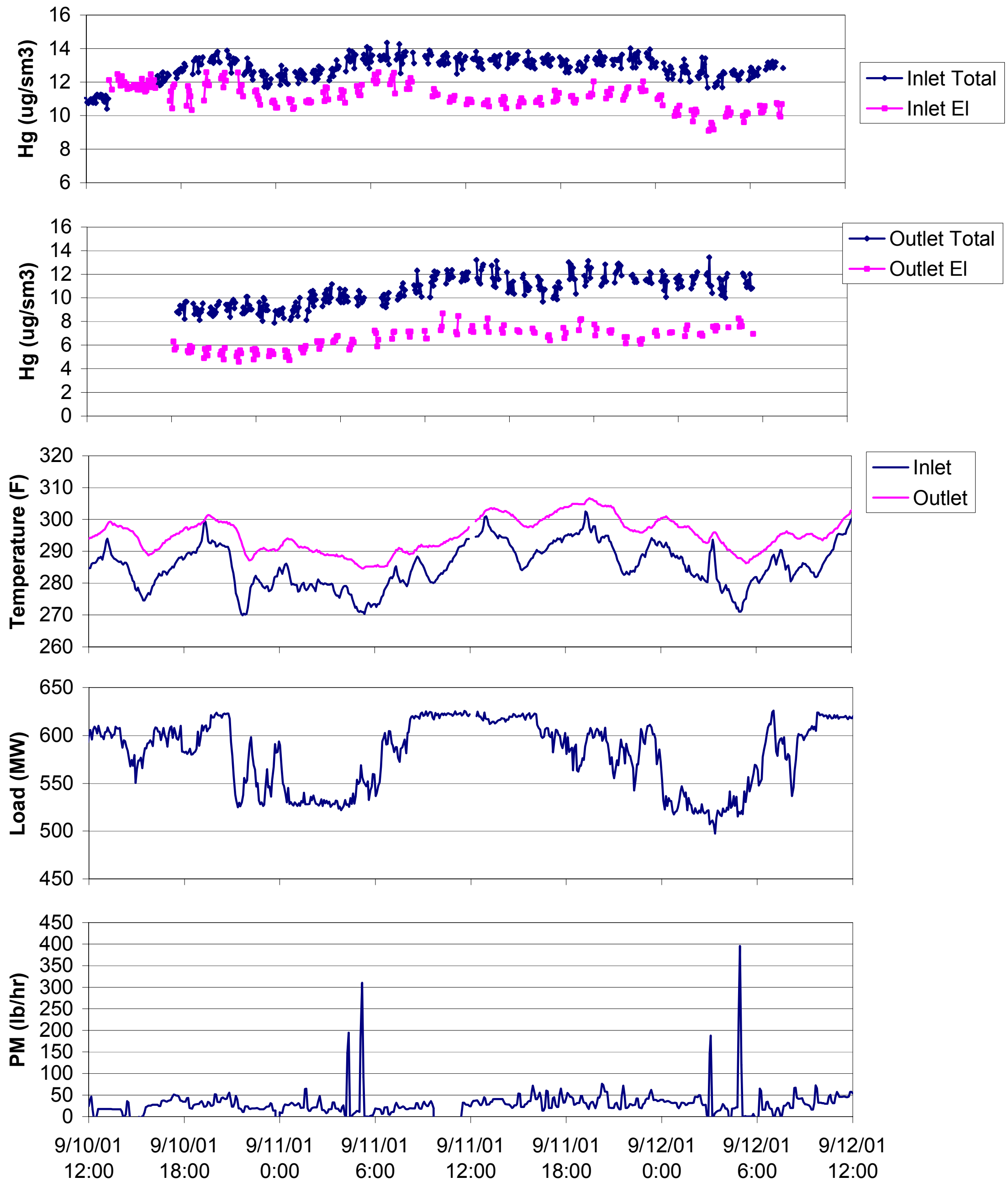
	Particulate (μg/dncm[a])	**Elemental (μg/dncm[a])**	**Oxidized (μg/dncm[a])**	**Total (μg/dncm[a])**
ESP Inlet	1.97	12.22	2.51	16.71
ESP Outlet	0.01	9.80	6.01	15.82
Removal Efficiency (%)	99.5	19.8	*	**5.3**
% of Total at Inlet	11.8	73.1	15.0	
% of Total at Outlet	**0**	**61.9**	**38.0**	

* mercury oxidizing , no removal

Coal samples collected during baseline tests and analyzed for mercury levels showed an average concentration of 0.1 μg/g. At Pleasant Prairie a coal mercury level of 0.1 μg/g is equivalent to a mercury concentration of about 16-17 μg/dncm @ 3% O_2 in the flue gas.

In addition to monitoring mercury removal, it was also important to document the performance of the ESP before and during sorbent injection. The primary ESP performance indicator at this site was power level, these data are presented under the Parametric Test section below for direct comparison between baseline and sorbent injection.

Figure 4. Baseline S-CEM Data from Pleasant Prairie.



Note a: Normal: T = 32°F

PARAMETRIC TEST RESULTS

Parametric testing showed mercury removal as a function of injection concentration, sorbent type, SO_3 conditioning, and spray cooling. The impact of sorbent injection on ESP performance was closely monitored.

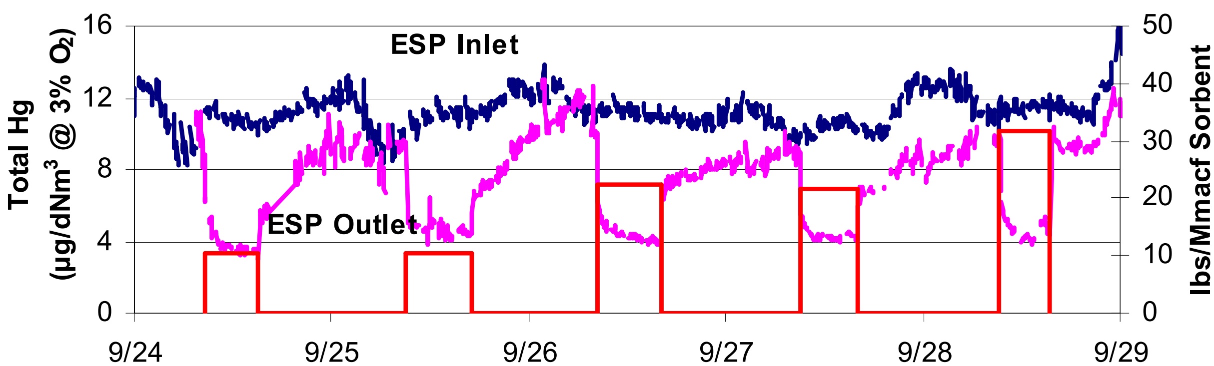
Results from parametric test series were summarized in memos dated October 2, October 8 and October 9, 2001. These memos are provided in Appendix C. Major results and observations are presented here.

The first week of parametric tests used Darco FGD as the sorbent, and tested several injection rates. In addition, spray cooling was tested with sorbent injection, the flue gas was cooled from an average temperature of 300 ºF (the temperature was stratified across the duct) to averages of 260 and 250 ºF.

An example of the data from the S-CEMs during the first week of parametric testing is presented in Figure 5. These five tests were conducted with Darco FGD. SO_3 conditioning was off on September 24 and spray cooling to 260 and 250ºF was evaluated on September 27. Reduction and recovery of outlet mercury concentration can be seen to correlate with periods of sorbent injection. Inlet mercury levels varied between nominally 9 and 13 µg/dncm. During sorbent injection, outlet mercury concentrations decreased to a minimum of about 4 µg/dncm. In most cases the outlet mercury levels recovered to baseline levels within 10 – 12 hours after sorbent injection was stopped.

As can be seen on Figure 5, the majority of the mercury control response was immediate upon starting injection. Recovery back to the inlet concentration after stopping sorbent injection was only partial immediately, with full recovery taking several hours.

Figure 5. S-CEM Mercury Measurements During the First Week of Parametric Tests with Norit Darco FGD PAC at Pleasant Prairie.



The early tests showed a couple of surprising trends. First, the mercury removal efficiencies were significantly higher than expected at the lower injection concentrations. The model predicted about 20% in-flight removal at a sorbent injection rate of 10 lb/MMacf. An actual mercury removal rate of between 60 and 65% was measured during the two 10 lb/MMacf test conditions. The in-flight model does not take into account mercury removal due to sorbent being deposited on internal structures, such as turning vanes, or on the ESP plates. It appears that the contribution from the carbon on the plates and other structures in the ESP to overall mercury removal was significant. The second unexpected trend was that mercury removal efficiencies did not increase significantly over 60% at higher injection concentrations of 20 and 30 lb/MMacf. Thus even doubling and tripling the injection rate yielded only a nominal improvement to mercury control. Over several hours of injection at 10 lb/MMacf, mercury control efficiency eventually approached 70%, the highest seen at Pleasant Prairie.

In response to the high removals rates measured with 10 lb/MMacf sorbent injection, the team tested still lower injection rates. Reducing the sorbent injection rate to as low as 1 lb/MMacf dropped the mercury control efficiency to 46%, much higher than would be predicted. Figure 6 depicts the trend of removal with injection rate, showing the diminishing returns as the injection is increased to about 10 lb/MMacf.

Spray Cooling Test

The testing also included an evaluation of spray cooling. Spray cooling was done in conjunction with injecting sorbent at 21.4 lb/MMacf. Flue gas temperature entering the 2-4 ESP was stratified from north to south by nominally 40^{o}F, based on air heater rotation. The north side average temperature was about 300^{o} F at the start of the spray cooling test. Water was injected so that the average temperature 40 ft downstream of the water injection lances, as measured by the thermocouple array, was 260 ^{o}F, or a 40 ^{o}F decrease on the north side and a 20 ^{o}F decrease on the south side. When no enhancement of mercury removal was seen after several hours, the water spray rate was increased to obtain a flue gas temperature of 250 ^{o}F. To achieve this level of cooling, 18 gpm of water was being injected. Because of the pozzalonic nature of the PRB ash, the internal ductwork and the sorbent injection lances (40 ft downstream of the spray lances) were monitored closely with an in-duct camera and by periodic manual inspection of the sorbent lances. No sign of deposition was seen at 260 ^{o}F. However, after less than 50 minutes of cooling to 250 ^{o}F, deposition was building on the sorbent lances on the north side. No improvement in mercury removal was measured at these lower temperatures and because deposition was noted, the spray cooling test was terminated. The total duration of spray cooling was 4.5 hours.

These results were not surprising because similar trends have been seen during slipstream testing by EPRI on PRB coal-derived flue gases. Based on work at other coal-fired units, lower temperatures increase the adsorption capacity of most sorbents. But as stated earlier, the PAC adsorption capacities are already much higher than the threshold capacity needed for effective mercury removal via in-duct injection. Increasing the capacity via flue gas cooling in this temperature range did not result in increased removal efficiency. However, operating in the ideal temperature range is still an important concept as it relates to the control of mercury. There are conditions where cooler temperatures may enhance or allow sorbents to be more effective for mercury control. Additional testing of spray cooling's effectiveness needs to be conducted at plants whose operating temperatures are above 300 ^{o}F.

Effect of SO_3 Conditioning

Sorbent screening tests using URS' packed-bed test fixture showed that SO_3 conditioning decreased the adsorption capacity of the carbon sorbents. This sparked interest in testing the impact of SO_3 full-scale. The difference in mercury removal during the first full-scale test with and without SO_3 conditioning was 60 versus 65%, respectively. This is almost a 10% difference, which is the level of accuracy we believe is repeatable in these tests. To confirm whether SO_3 conditioning really had an impact on sorbent effectiveness, it was tested again, using 10 lb/MMacf Ground FGD with and without SO_3 conditioning during the second week of parametric tests. The results were 60% removal with SO_3 and 63% removal without SO_3. Data from the two sets of tests indicate that there was no significant effect on mercury removal with PAC injection when SO_3 conditioning was in-service.

Parametric Test Summary

The supplied equipment: the sorbent injection system supplied by Norit Americas, as well as the spray cooling system supplied by EnviroCare; operated reliably during the parametric tests.

A summary of results from all the parametric tests is presented on Figure 6. This figure plots mercury removal efficiency as a function of sorbent injection concentration. The different symbols represent different test conditions including carbon type, SO_3 off, and spray cooling. This graph shows that there was a rapid increase in mercury removal with PAC injection up to an injection concentration of about 5 lbs/MMacf. Increasing the sorbent injection rate from 5 to 10 lbs/MMacf showed an incremental 10% increase in mercury removal. No significant additional removal was observed when the rate of sorbent injection was raised above 10 lbs/MMacf.

As stated above, this apparent ceiling of 70% removal was surprising. Poor sorbent distribution in the gas stream could contribute to this problem. To prove that distribution was not a problem, several tests were conducted with the injection lances in different configurations that would alter distribution patterns. No measurable change in mercury removal was noted.

There was no significant difference in performance among the four carbons, even with the finer grain carbons. The finest carbon, Insul with a D50 of 7µm, was difficult to feed because of bridging in the discharge legs of the silo. Design changes would have to be incorporated into this system to feed finer carbons.

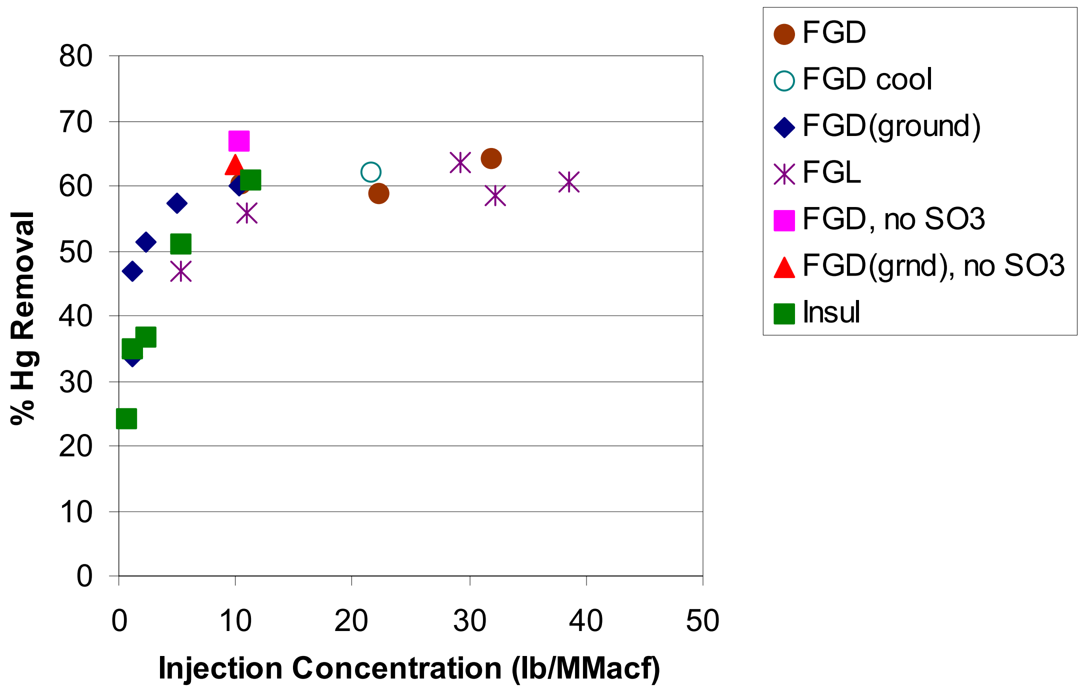
Since this is a PRB coal-fired site, some comparison with other PRB mercury tests may be appropriate. Public Service of Colorado's Comanche Station was the subject of a pilot-scale mercury test series in 1997-1999 under a DOE program. A quick review of those results shows a reasonably good match to the Pleasant Prairie results. Specifically, from the PRB-fired Comanche 600 acfm slipstream pilot data the following observations can be made[10]:

- Baseline mercury removal was low to moderate (usually 10-30% at temperatures from 260-300 ºF) in the ESP configuration;
- Sorbent injection in the range of 1 to 5 lb/MMacf provided increasing mercury removal up to a ceiling of about 70% removal in the ESP configuration;

- In the pulse-jet baghouse configuration, mercury removals greater than 80% were realized with 1 lb/MMacf carbon injection.

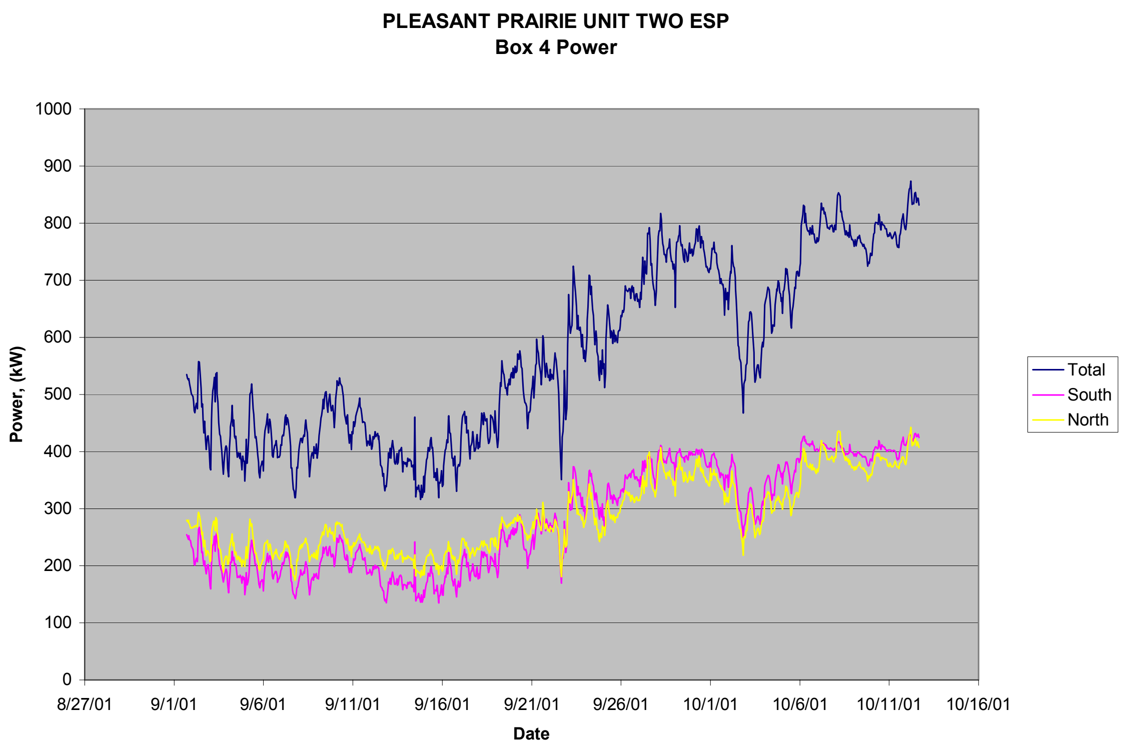
Another point of comparison for these results is tests performed at Pleasant Prairie in 2000 in the EPRI PoCT test chamber, a slipstream test device that can be configured as a baghouse or ESP. The baghouse tests showed that about 3 lb/MMacf carbon injection resulted in >90% mercury removal. This provides an estimate for the amount of sorbent that would be required for higher levels of removal full-scale.

Figure 6. Mercury Removal Trends Across ESP as a Function of PAC Injection Concentrations. Measurements Made During Parametric Tests, Sept-Oct 2001.



One of the significant observations made during the parametric testing was that carbon injection had no adverse impact on the performance of the ESP. Some improvements in power levels were seen during the spray cooling tests. There was no measurable increase in opacity or mass emissions as measured with the Beta monitor. Figure 7 below shows the ESP power levels on both the control side box and the tested box before and during the parametric testing period. If any trend can be noted, it is that power levels increased around the time carbon injection started on September 22, 2001.

Figure 7. ESP Power Levels for Control Side (South) and Test Side (North) Boxes During Baseline and Sorbent Injection Tests, Sept-Oct 2001.



LONG-TERM TEST RESULTS

A Memo summarizing long-term test results was issued November 16, 2001 and is included in Appendix D. The major results are presented and discussed here. Coal and ash analyses are presented in the following subsection. The test reports for Ontario-Hydro, Method 5, and Method 29 tests done by GE Mostardi Platt are included in Appendix E.

Removal Trends

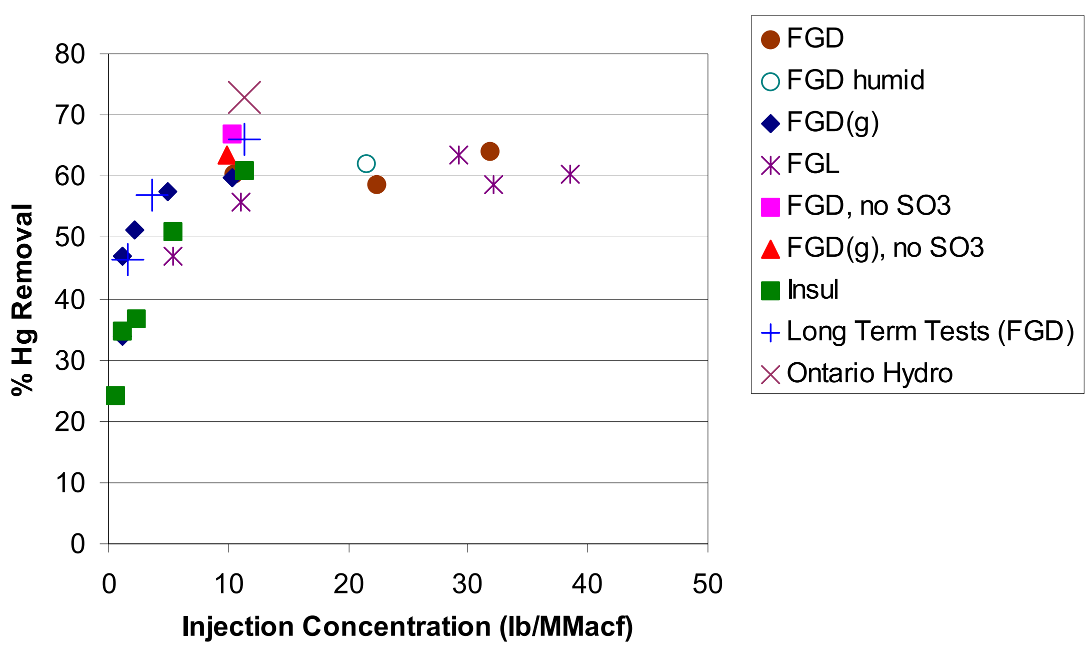
Three injection rates were tested during the long-term tests, and mercury was measured (at various times) using the S-CEMS, Ontario-Hydro, and MESA methods. Table 10 shows the daily average results at each injection rate. Figure 8 presents mercury removal with respect to PAC injection concentration for both the parametric and long-term tests. Mercury removal rates as measured with the S-CEMs for each of three long-term test conditions can be seen as the large crosses at 1.6, 3.7, and 11.3 lbs/MMacf. These data points represent the average over each 5-day period. The average mercury removal was 46% at 1.6, 57% at 3.7, and 66% at 11.3 lbs/MMacf. These results fall within the trends developed during the parametric tests, showing that no significant additional increase in mercury removal was achieved with longer run times.

Table 10. Daily average mercury removal measured by S-CEM during long-term test.

	Removal Efficiency (%)	Inlet microg/dscm	Outlet microg/dscm	Injection Conc. lbs/Mmacf
31-Oct	27*	10.5	7.6	1.2
1-Nov	43	11.6	6.5	1.5
2-Nov	48	12.8	6.6	1.8
3-Nov	49	13.1	6.6	1.8
4-Nov	Avg = 46	Change Injection Conc.		Avg = 1.6
5-Nov	61	15.2	6	3.5
6-Nov	59	14.3	5.8	3.4
7-Nov	52	12.5	6.1	3.8
8-Nov	54	13.6	6.1	3.9
9-Nov	Avg = 57	Change Injection Conc.		Avg = 3.7
10-Nov	70	13.9	4.1	11.6
11-Nov	70	12	3.7	11.8
12-Nov	66	13	4.5	11.4
13-Nov	65	14.2	5.1	11.3
14-Nov	65	14.7	5.1	10.3
	Avg = 66			Avg = 11.3

* not included in average

Figure 8. Mercury Removal Trends for Parametric and Long-Term Tests at Pleasant Prairie.



Triplicate Ontario Hydro measurements were made at the inlet and outlet of the 2-4 ESP. The average removal efficiency is shown in Figure 8 as the large X at 11 lbs/MMacf. Results from the Ontario Hydro measurements are presented in Table 11. The average inlet mercury concentration was 17.4 μg/dncm, with over 80% being measured as elemental mercury. Coal samples taken during this period had an average mercury level of 0.1 μg/g, or an equivalent flue gas concentration of 16-17 μg/g. The outlet mercury concentrations show the effect of carbon injection with lower mercury emissions for all species and 70.4% and 74.5% reduction of the elemental and oxidized species respectively. The average reduction in total mercury was 72.9%. At the outlet the predominant species of mercury is the elemental form; however, it is still 70% less than what was present upstream of PAC injection. Thus both elemental and oxidized mercury are removed with PAC injection.

Table 11. Speciated Mercury Measured by Ontario Hydro Method, Long-Term Tests at PAC Injection Concentration = 11 lbs/MMacf.

	Particulate (μg/dncm[a])	**Elemental (μg/dncm[a])**	**Oxidized (μg/dncm[a])**	**Total (μg/dncm[a])**
ESP Inlet	1.0	14.7	1.7	17.4
ESP Outlet	0	4.3	0.4	4.7
Removal Efficiency (%)	**100**	**70.7**	**74.5**	**72.9**
% of Total at Inlet	5.7	84.5	9.8	
% of Total at Outlet	0	91.5	8.5	

Note a. Normal: T = 32^{o}F

Table 12 shows the speciation of vapor-phase mercury for each long-term injection rate. 81-89% of the vapor-phase mercury was elemental at the ESP inlet, of which 54-71% was removed or oxidized. The balance of mercury (9-11%) was oxidized, of which up to 50% was removed.

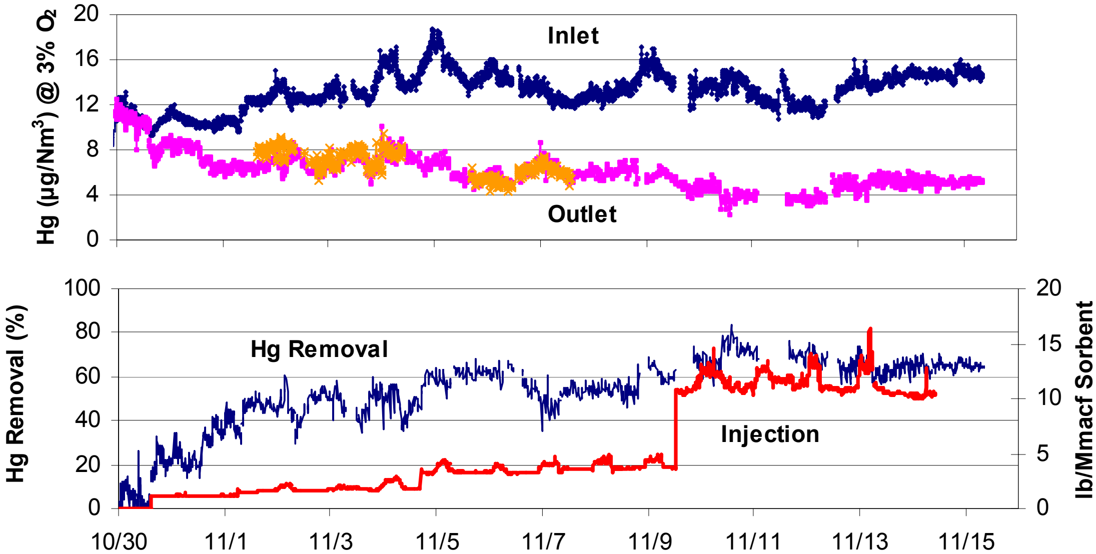
Table 12. Mercury Speciation as measured by S-CEM during each long-term test condition.

Injection Concentration	**Inlet Hg (microgram/dncm)**			**Outlet Hg (microgram/dncm)**		
	Hg^0	**Hg^{+2}**	**Total**	**Hg^0**	**Hg^{+2}**	**Total**
1 lb/Mmacf	**10.7 (89%)**	**1.3 (11%)**	**12.0**	**4.9 (72%)**	**1.9 (28%)**	**6.8**
3 lb/Mmacf	**11.7 (84%)**	**2.2 (16%)**	**13.9**	**4.5 (75%)**	**1.5 (25%)**	**6.0**
10 lb/Mmacf	**11.0 (81%)**	**2.6 (19%)**	**13.6**	**3.2 (72%)**	**1.3 (28%)**	**4.5**

Note: Total and elemental mercury measured directly, oxidized mercury calculated from the difference.

Figure 9 presents inlet and outlet mercury concentrations as measured by the S-CEMs, mercury removal across the ESP, and PAC injection concentration during the long-term test. Inlet mercury concentration varied between 10 and 17 μg/dncm. During the first two days of the long-term test at the low injection rate, outlet mercury levels slowly decreased to about 6.5 μg/dncm. Outlet mercury can be seen to trend well with inlet mercury levels, especially when mercury concentration increased on November 12, 2001. Daily load swings (the unit ramped down to a lower load most nights) do not have a noticeable imprint on mercury control effectiveness.

Figure 9. Inlet and Outlet Mercury Concentrations, Removal Efficiencies and PAC Injection During Long-Term Test at Pleasant Prairie, November 2001.



Mercury Test Method Comparisons

The S-CEM and Ontario Hydro removal efficiency results show good correlation, within 10%. This was the case even though the S-CEM measures only vapor phase mercury and the Ontario Hydro measurements showed nearly 6% particulate mercury at the inlet. Table 13 shows the direct comparison between these test methods. Coal analyses during this period confirmed that the flue gas mercury concentration should have been about 16 -17$\mu g/Nm^3$.

Table 13. Comparison of S-CEM and Ontario Hydro Mercury Measurements.

Total Mercury and Gaseous Mercury Meaurements From OH and S-CEM* During Long Term Tests
All concentrations reported as microgram/dscm

Run Number	Run 1		Run 2		Run 3		Average	
Date	11/12/2001		11/13/2001		11/13/2001			
	S-CEM*	OH	S-CEM*	OH	S-CEM*	OH	S-CEM*	OH
Inlet	12.6	13.9	12.8	14.3	13.3	16.2	12.9	16.2
Outlet	4.5	3.7	4.8	5.4	5	4.8	4.8	4.4
Removal Efficiency (%)	64.4%	73.4%	62.8%	62.2%	62.2%	70.4%	63.1%	72.8%

* S-CEM measures only gas phase mercury

Frontier Geosciences' MESA trap method was also used to measure mercury at each of the three injection rates during long-term tests. The sample was drawn from the S-CEM probe. The comparison between all three test methods for these runs is summarized in Table 14. The MESA test resulted in somewhat lower total mercury measurements, but agreed well in terms of removal efficiency with the other two methods, as seen in the table.

Table 14. Comparison of S-CEM, Ontario Hydro, and MESA Mercury Measurements at three injection rates.

	1 lb/MMacf			3 lb/MMacf			10 lb/MMacf		
	Mesa	S-CEM	OH	Mesa	S-CEM	OH	Mesa	S-CEM	OH
Removal Eff, %	51	50	NA	50	59	NA	69	63	73

Multi-Metals Test Results (Method 29)

Method 29 was run in triplicate during baseline and long-term tests. The long-term test runs were conducted the day after the Ontario-Hydro tests, but at the same condition of 10 lb/MMacf carbon injection. The results, shown in Table 15 below, show that trace metals are unaffected by sorbent injection. Results from individual runs are provided in Appendix E.

Mercury concentration as measured by Method 29 is slightly lower than that measured by the S-CEMS. Method 29 is not the preferred mercury measurement method and may have a negative bias.

Table 15. Method 29 Results from Pleasant Prairie Unit 2 with and without Sorbent Injection.

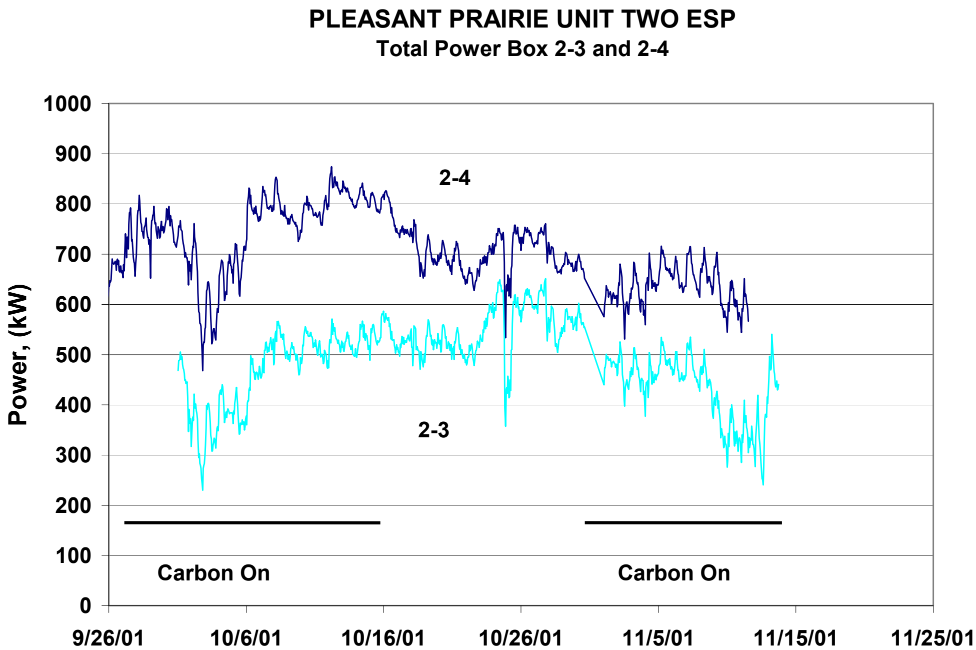
TRACE METALS TEST RESULTS SUMMARY		
Plant: WEPCO - Pleasant Prairie Power Plant		**Source: Unit No. 2**
Test Location	North Outlet Duct	
Test Condition	Baseline	Long-Term
Date	9/12/01	11/14/01
Analyte:	Average Concentration (ug/dscm)[See Note]	
Arsenic	ND<0.45	ND<2.28
Chromium	<3.75	ND<3.90
Lead	ND<2.27	ND<2.28
Mercury	10.97	3.44
Nickel	ND<2.27	<6.08
Selenium	ND<9.09	ND<22.76
	Emission Rate (lbs/hr)	
Arsenic	ND<0.001	ND<0.003
Chromium	<0.005	ND<0.005
Lead	ND<0.003	ND<0.003
Mercury	0.013	0.004
Nickel	ND<0.003	<0.008
Selenium	ND<0.011	ND<0.028
Dscfm	329,217	325,877

Note: Maximum Possible Concentrations based on detection limits. Triplicate runs. "ND<" indicates that the metal was not detected in any of three runs. "<" indicates that the metal was not detected in one or two of three runs.

ESP Performance

Figure 10 presents total power for the test ESP, 2-4, and the control ESP, 2-3, for the period starting September 26 through November 15. The data show that there was no negative impact on ESP performance when carbon was injected either during the parametric or long-term tests. Slight increases in power levels on the test side are within normal variation between the two units.

Figure 10. Comparison of Unit 2-4 (with PAC Injection) and 2-3 ESP Total Power Levels During Parametric and Long-Term Tests, September – November 2001.



Total particulate was also measured using EPA Method 5 during both baseline and long-term tests. These tests showed that the grain loading in the flue gas was somewhat lower during long-term tests (0.0016 gr/dscf) than during baseline (0.0027 gr/dscf). Triplicate runs were made in both cases. Test data is in Appendix E.

COAL AND ASH CHARACTERIZATION

Reaction Engineering managed the fly ash and coal sample analyses during this program. The full report from Dr. Connie Senior of Reaction Engineering is included in Appendix F, with highlights presented here. Most measurements were carried out by Microbeam Technologies except the leaching analyses, which were supervised by Dave Hassett at the University of North Dakota EERC. WE performed coal and ash analyses, including the foam index tests.

Ultimate, proximate, and Hg analyses were performed on coal samples collected during testing. These measurements were used to calculate expected mercury concentrations in the flue gas for comparison with flue gas measurements.

Wisconsin Electric has invested significant efforts to reach a 97% utilization of ash produced by its coal-fired boilers. The fly ash from Pleasant Prairie is a high-quality, Class C fly ash that is sold for use in concrete and is a cream colored, highly desirable product. The effects of carbon injection on the salability of this ash were of prime concern.

Ash analyses performed included:

- LOI;
- Mercury;
- Leaching (TCLP[11] and SGLP[12]);
- ASTM C618; and
- Foam index.

Results of Coal and Ash Analyses

Coal analyses showed good comparison with the Ontario Hydro tests performed during both baseline and long-term tests. Over the Ontario Hydro test periods coal analysis would indicate mercury concentrations of 16 to 17 $\mu g/Nm^3$, compared with Ontario-Hydro results of 15 to 17 $\mu g/Nm^3$. These results are within a ±10% variability.

Chlorine analysis of the coal showed 7 to 9 µg/g, which is a low level that corresponds to less than 1 ppm in the flue gas. HCl content in the flue gas has been suggested as an important parameter for effective mercury control via sorbent injection in other research programs.

Of the analyses performed on the ash, the most dramatic result was the foam index testing. When carbon was injected even at low levels of 1 lb/MMacf, the foam index test failed, rendering the Pleasant Prairie fly ash unusable. This impacts the cost of using carbon injection into the ESP for mercury control, as discussed in the following section, "Economic Analysis."

The major conclusions from analysis of the ash are:

- LOI increased from a baseline of 0.6% to 2.5 to 3.5% at an injection concentration of 10 lbs/MMacf. There was a linear increase in mercury content of the ash with PAC injection rate. For example, LOI was 1% at an injection concentration of 1 lb/MMacf.
- There was no systematic variation between LOI and mercury in the samples taken from the front and back of the ESP in the few samples taken.
- TCLP and SGLP showed no detectable leachable mercury. Long term SGLP (Synthetic Ground Water Leaching Protocol) was run for 60 and 90 days.
- Mercury in the ash increased from baseline levels of <0.2 µg/g up to individual samples as high as 5 µg/g during the long-term tests. Based on coal analyses, if all the mercury was in the ash, the ash would contain an average of about 2 µg/g mercury. Analyses performed by WE showed ash mercury content typically 0.8-1 µg/g with carbon injection, which is reasonable for the 50-70% control level.
- Fly ash from the long term tests conformed with ASTM C618, which is used to determine whether ash qualifies as "Class C" flyash. A critical parameter is that LOI is less than 6%. The other parameters were also all within required limits.
- Ash samples with carbon at any concentration failed foam index tests. These are field tests used to determine the amount of Air Entrainment Additives needed to meet freeze thaw requirements. Wisconsin Electric is contractually obligated to meet a criteria in this

test of "<25 drops". Even ash sampled during the 1 lb/MMacf injection rate, with an LOI of 1.1%, maxed out the test at 72 drops. This is a problem with activated carbon in the ash, which is highly reactive with the entraining agents, perhaps more so than combustion-derived LOI.

- Fly ash samples with even low concentrations of carbon were discolored. This is another parameter that can impair flyash sales.

The results from the foam index tests were the most important because failure of these tests prohibited Pleasant Prairie from selling this ash. In fact, the ash failed foam index tests for five weeks following the end of the carbon injection tests. This suggests that even trace levels of the PAC render the ash unsalable.

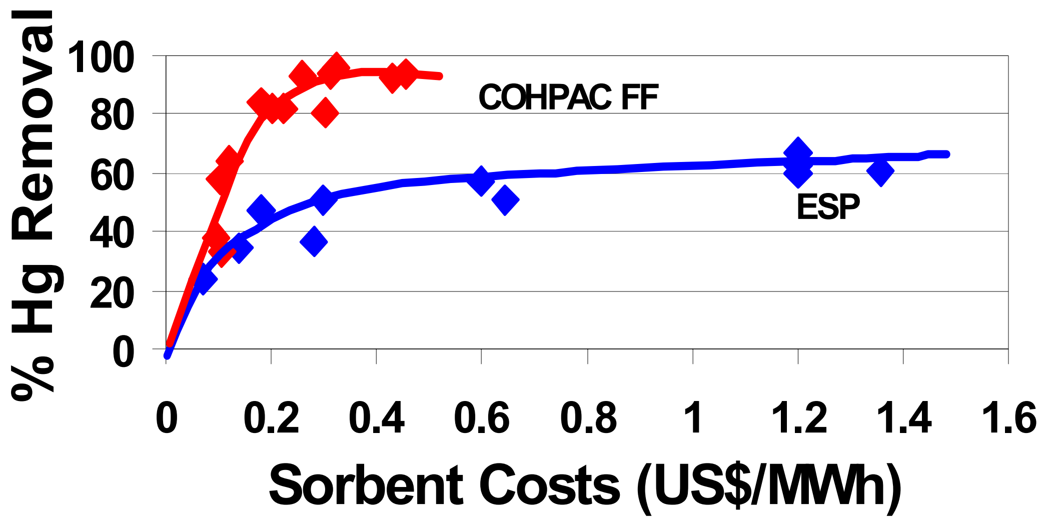
ECONOMIC ANALYSIS

After completion of testing and analysis of the data, the requirements and costs for full-scale, permanent commercial implementation of the necessary equipment for mercury control using sorbent injection technology at the 600 MW Pleasant Prairie Unit 2 have been determined. The cost of process equipment sized and designed based on the long-term test results for approximately 40-50% and 60-70% mercury control, and on the plant specific requirements (sorbent storage capacity, plant arrangement, retrofit issues, winterization, controls interface, etc.) has been estimated. In addition the comparative cost for the sorbent injection system requirements if a baghouse were retrofitted (in a COHPAC / TOXECON configuration) is presented.

While equipment capital costs are somewhat sensitive to injection rate because of the number and/or size of silos, feeders, and injection systems, the majority of the total costs to the owner are attributable to the quantity of sorbent consumed and the ash disposal, both of which are operating costs. The two scenarios presented in detail here are both ESP injection designs. The quantity of sorbent required is different (and therefore so is capital equipment sizing), but the waste disposal cost does not change between the two scenarios. A third scenario which is technically feasible but requires further cost analysis is the COHPAC or TOXECON configuration, in which a baghouse is retrofitted downstream of the existing ESPs.

Results from the field tests conducted to date indicate different levels of mercury removal can be achieved depending on the particulate control device. Data collected from the field test at Gaston indicate mercury removal levels of up to 90% were obtained with COHPAC (a baghouse). At Pleasant Prairie 50-70% control was the maximum achievable mercury control, with the configuration of an ESP collecting PRB ash. Figure 11 presents a summary of the mercury removal trends measured at both Gaston and Pleasant Prairie and the projected annual sorbent costs of PAC in $/MWh.

Figure 11. Comparison of Projected, Annual Sorbent Costs for an ESP (Pleasant Prairie) and COHPAC Fabric Filter (Gaston) Based on Results from NETL Full-Scale Tests, 2001.



The estimated uninstalled cost for a sorbent injection system and storage silo for 60-70% mercury control on the 612 MW Unit 2 is $695,000 ± 10%. Costs were estimated based on a long-term PAC injection concentration of 10 lbs/MMacf. For Pleasant Prairie Unit 2, this would require an injection rate of nominally 1,400 lbs/h. Assuming a unit capacity factor of 80% and a delivered cost for PAC of $0.50/lb, the annual sorbent cost for injecting PAC into the existing ESP would be about $5,000,000. Table 16 summarizes the design criteria used for the pricing for this scenario and for the smaller injection system discussed below.

As developed during these tests, the sorbent injection rate required for 40-50% mercury control is significantly less than the above scenario, consuming only about one-tenth of the sorbent. The estimated uninstalled capital cost for this design is $415,000 ± 10%. Equipment sizing here is designed for about 3 lb/MMacf, but capital costs cannot be significantly reduced below this size by reducing the sorbent consumption design point. The same capital costs are therefore presented for either 40-50% control with ESP injection, or for a TOXECON design (sorbent injection system costs only, not baghouse costs). PAC costs for 40-50% control at an injection concentration of 1 lb/MMacf would be about $525,000. PAC costs for TOXECON, at a control rate that is not established but that should be in the range of 80-90^{+}% control, are estimated at an injection concentration of 3 lb/MMacf, or $1,600,000 annually.

Table 16. System Design Criteria for Mercury Control System at Pleasant Prairie Unit 2.

	40-50% Mercury Control[1]	60-70% Mercury Control
Number of Silos	1	2
Number of injection trains	3	4
Design feed capacity/train	200	500
Operating feed capacity/train (lb/hr)	150	360
Sorbent storage capacity (lbs)	162,000	520,000
Conveying distance (ft)	200	200
Sorbent	Powdered Activated Carbon	Powdered Activated Carbon
Aerated Density (lb/ft3)	18	18
Settled Density (lb/ft3)	34	34
Particle MMD (microns)	18	18

[1]This smaller size sorbent injection system is the same design assumed for TOXECON operation.

Sorbent Injection System Description

The description and design data provided in detail here are for the 10 lb/MMacf system targeted at 60-70% mercury control via ESP injection. The smaller system has similar components but the quantity and size vary.

The permanent commercial Activated Carbon Injection (ACI) system will consist of two bulk storage silos and dilute phase pneumatic conveying systems. Norit Americas, Inc. provided a detailed quote for this equipment, the quote is included in Appendix G along with a piping and instrumentation diagram, a silo plan view, and a systems and services drawing.

PAC sorbent will be received in 40,000 lb batches delivered by self-unloading pneumatic bulk tanker trucks. The silo is equipped with a pulse jet type bin vent filter to contain dusting during the loading process. The silo is a shop-built, dry-welded tank with twin mass flow discharge cones equipped with air fluidizing pads and nozzles to promote powder flow. Point level probes and weigh cells monitor sorbent level and inventory. Silo sizing was based on the capacity to hold 13 truckloads of PAC which would be sufficient for 15 days of operation at the design injection rate.

The PAC is fed from the discharge cones by rotary valves into feeder hoppers. From the hoppers the PAC is metered into the conveying lines by volumetric feeders. Conveying air supplied by regenerative blowers passes thru a venturi eductor, which provides suction to draw the PAC into the conveying piping and carry it to distribution manifolds, where it splits equally to multiple injection lances. The blowers and feeder trains are contained beneath the silo within the skirted enclosure.

A programmable Logic Controller (PLC) is used to control all aspects of system operation. The PLC and other control components will be mounted in a NEMA4 control panel. The control panel, MCCs and disconnects will be housed in a pre-fabricated Power and control building located adjacent to the silos.

Balance of Plant Requirements

Some modifications and upgrades to the existing plant equipment will be required to accommodate the ACI system. These include upgrades to the electrical supply at Pleasant Prairie to provide new service to the ACI system. Instrument air, intercom phones and area lighting will also be required.

Cost and Economic Methodology

Costs for the Sorbent storage and injection equipment were provided by Norit-Americas (Norit) based on the design data in Table 16. Norit has built and installed dozens of similar systems at waste-to-energy and incineration plants. ADA-ES provided costs for the distribution manifold, piping and injection lances. Norit also provided an installation man-hour estimate and crane-hour estimate that were used to develop the installation costs for the Norit Equipment along with an estimate for foundations including pilings. These costs are presented only for the ESP injection scenarios since site-specific baghouse pricing was not obtained.

EPRI TAG methodology was used to determine the indirect costs. A project contingency of 15% was used. Since the technology is relatively simple and well-proven on similar scale, the process contingency was set at 5%. ACI equipment can be installed in a few months, therefore no adjustment was made for interest during construction, a significant cost factor for large construction projects lasting several years.

Operating costs include sorbent costs, electric power, operating labor, maintenance (labor and materials) and spare parts. An average incremental operating labor requirement of 6 hours per day was estimated to cover the incremental labor to operate and monitor the ACI system. The annual maintenance costs were based on 5% of the uninstalled equipment cost.

More detailed cost information in all categories, including labor rate assumptions, etc., are included in Appendix G.

Capital Costs

Assuming 60-70% target control of mercury, the uninstalled ACI storage and feed equipment costs are estimated at $695,000± 10%. The estimated cost for a sorbent injection system and storage silo installed on 600 MW Unit 2 is $1,518,000 and includes all process equipment, foundations, support steel, plant modifications utility interfaces, engineering, taxes, overhead and contingencies. Table 17 briefly summarizes the capital and O&M costs.

Assuming 40-50% control of mercury, the uninstalled ACI storage and feed equipment costs are estimated at $415,000± 10%. The estimated cost for a sorbent injection system and storage silo installed on 600 MW Unit 2 is $985,000 and includes the items as listed above.

Table 17. Capital and Operating & Maintenance Cost Estimate Summary for ACI Systems on Pleasant Prairie Unit 2. Annual Basis 2003.

CAPITAL COSTS SUMMARY		
	40-50% η	60-70% η
Equipment, FOB Pleasant Prairie	$415,000	$695,000
Site Integration (materials & labor)	$70,000	$85,000
Installation (ACI silo and process equipment, foundations)	$185,000	$ 250,000
Taxes	$35,000	$ 55,000
Indirects/Contingencies	$280,000	$434,000
Total Capital Required	**$985,000**	**$1,519,000**
OPERATING & MAINTENANCE COSTS SUMMARY		
Sorbent @ $.50/lb	$525,600	$5.05 MM
Other miscellaneous costs	110,000	$166,000
Waste Disposal (including lost revenue)	$3.8-6.2 MM	$3.8-6.2 MM
Annual O&M for 2003	**$4.4-6.8 MM**	**$ 9.0-11.4 MM**

Operating Costs

The most significant operational costs of ACI are the PAC sorbent and the waste disposal. Sorbent costs were estimated for nominally 60% mercury control based on the long-term PAC injection concentration of 10 lbs/MMacf, and for 40-50% control based on 1 lb/MMacf. For Pleasant Prairie Unit 2, this would require respective injection rates of nominally 1,400 lbs/h or 140 lb/hr. Assuming a unit capacity factor of 80% and a delivered cost of $0.50/lb for PAC, the annual sorbent cost for injecting PAC into the existing ESP would be about $5.0MM for 60% control. 40% control could be achieved for about $525,000 in sorbent each year. However, the waste disposal costs, including the lost revenue of not selling the ash and the cost to landfill the ash are incurred in both cases. These costs drive up the control cost significantly. Initial estimates, shown in Table 17, ranging from $3.8 to 6.2 MM per 600 MW unit, demonstrate the severity of this cost. Other annual operating costs including electric power, operating labor, and maintenance are estimated to be a fraction of this amount. The minimum waste disposal costs include a subsidy for low-end reuse of the carbon-containing ash. The maximum costs are based on actual landfill costs for disposal in high-grade (double-liner, with leachate collection) landfills.

As mentioned previously, a configuration in which sorbent is instead injected into a baghouse located downstream of the existing Pleasant Prairie ESP (a TOXECON configuration) would avoid certain costs and incur others. The capital requirement would increase to include the baghouse retrofit. The operating costs would decrease significantly since the disposal costs would be mostly avoided and the ESP ash sale could be retained. The carbon-enriched ash captured in TOXECON would be disposed at a cost. The amount of sorbent required for TOXECON would depend on the level of control required. A design effort would include projection of control levels and associated sorbent requirements. Initial projections of 3 lb/MMacf sorbent for 80-90% control of mercury in TOXECON result in an annual sorbent cost of $1.5 MM. Installed capital costs for a baghouse retrofit are in the range of $50-60/kW, depending on the project complexity.

Based on these test program results the option of TOXECON is worth further investigation. Even for moderate mercury control of 40%, the operational costs of ACI into the ESP may quickly justify the additional capital investment of a baghouse. Areas for further analysis include the actual retrofit costs of a baghouse, the level of mercury control that is required and the relative sorbent requirements, waste disposal costs for the TOXECON product, and other balance-of-plant impacts such as the design and control of the baghouse system, draft requirements, and auxiliary load burden.

Costs presented in this discussion and in Appendix G include the capital and operating costs of the sorbent injection system only.

CONCLUSIONS and RECOMMENDATIONS

A full-scale evaluation of mercury control using activated carbon injection upstream of a cold-side ESP was conducted at Wisconsin Electric's Pleasant Prairie Power Plant Unit 2. This comprehensive test program answered many questions about the potential for mercury control at Pleasant Prairie, and also pointed to several areas in which more information is needed. This section summarizes the test results and conclusions, as well as some recommendations for implementation of a permanent mercury control system for the unit, should this be deemed necessary.

Results and trends from these relatively short-term tests were encouraging, but identified a significant problem: the ash cannot be used in concrete. The overall test conclusions are:

- Mercury removal between 40 – 50% was obtained at 1 lb/MMacf PAC injection. This was a significantly higher removal than predicted at this low injection rate.
- Mercury removal between 50 – 60% was obtained at 3 lb/MMacf PAC injection.
- Mercury removal between 60 – 70% was obtained at 10 lb/MMacf PAC injection. No additional removal was seen at higher injection rates.
- PAC injection effectively reduced both elemental and oxidized mercury concentrations.
- No difference was noted in the effectiveness of the tested carbons, which included Darco FGD, Ground FGD, FGL and Insul. Products with a smaller size did not appear to improve performance.
- Fly ash could not be used for concrete even with the minimum level of PAC tested. The critical test that failed was the "foam index test," which maxed out at even the lowest carbon concentrations. This test indicates the amount of air entraining agent required for concrete manufacture. The test failed for five weeks following the conclusion of injection, which indicates that even trace amounts of PAC can render the ash unsalable.
- The ash showed no detectable leached mercury in TCLP and SGLP tests, and met the "Class C" flyash criteria as established by ASME C618. These tests indicate that the ash could be landfilled.
- There were no detrimental impacts with PAC injection on ESP performance as indicated by power level, opacity, or particulate emissions. However these were short-term tests on a large ESP (>450 SCA). The longer-term carbon migration through the ESP was not evaluated.
- Spray cooling by 30-50 ºF to an average flue gas temperature of 250 ºF did not impact mercury removal with 20 lb/MMacf PAC injection. Spray cooling of flue gas in this temperature range, which is lower than is practical because of deposition and possible corrosion impacts, still does not appear to improve sorbent injection effectiveness for PRB coals.
- Increasing injection concentration above 10 lbs/MMacf, even by factors of two and three, did not increase mercury removal above 65-70%.

- Similar results were noted at PSCo's Comanche Station (a PRB-fired site) in tests during 1998. When tested in a baghouse configuration, the Comanche 600 acfm pilot achieved 80% mercury control with 1 lb/MMacf carbon injection. PoCT tests in a Pleasant Prairie slipstream in 2000 yielded that about 3 lb/MMacf carbon injection into a baghouse (TOXECON) configuration obtained >90% mercury control.
- The possible configurations for mercury control at Pleasant Prairie include:
  - Direct sorbent injection into the ESP, as tested, which will require landfilling of the currently beneficially used ash. This configuration can obtain up to 60-70% mercury control but uses a large excess of sorbent if greater than 40-50% control is targeted;
  - COHPAC / TOXECON retrofit downstream of the ESP so that sorbent injection waste is collected separately from the majority of the ash. In this scenario the amount of sorbent required for a given mercury removal is not established. At the PRB-fired Comanche pilot, a baghouse configuration with about 1 lb/MMacf PAC injection obtained over 80% mercury control. In PoCT tests at Pleasant Prairie, about 3 lb/MMacf sorbent resulted in >90% control. This configuration would preserve the current ash utilization, since sorbent is injected downstream of the primary particulate collector, the ESP.
- The capital cost of an ACI system for Pleasant Prairie Unit 2 ranges from $985,000 to $1.52 MM (±10%)depending on the level of control required.
- The cost to obtain consistent removal of 60-70% at Pleasant Prairie (using 10 lb/MMacf PAC injection into the ESP) would incur, in 2003, sorbent costs of $5 MM. Ash disposal costs are estimated at $3.8-6.2 MM.
- The cost to obtain consistent removal of 40-50% at Pleasant Prairie (using 1 lb/MMacf PAC injection into the ESP) would incur, in 2003, sorbent costs of $525,000. Ash disposal costs are estimated at $3.8-6.2 MM.
- For greater than 50% mercury control, a baghouse is probably economically justified at Pleasant Prairie to avoid ash contamination and to minimize sorbent consumption. Detailed figures for a baghouse have not been developed, but are a recommended next step. Suggestions for further investigation of these costs include evaluation of the actual control level required and relative sorbent requirements, actual equipment and installation costs for a baghouse retrofit on the site, operating costs such as auxiliary load, detailed design such as draft and control requirements, and analysis of TOXECON byproduct disposal costs.

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APPENDIX A

TEST PLAN

DOE NATIONAL ENERGY TECHNOLOGY LABORATORY MERCURY FIELD EVALUATION

Wisconsin Electric Pleasant Prairie Power Plant
Sorbent Injection into Cold-Side ESP for Mercury Control

Test Plan Prepared for:
Wisconsin Electric Company
Wisconsin Energy
DOE NETL
EPRI

Test Plan Prepared by:
ADA-ES & Orion Power Holdings

July 19, 2001

PROJECT OBJECTIVES

The overall objective of this project is to determine the cost and impacts of sorbent injection into the cold side ESP for mercury control at Wisconsin Electric's Pleasant Prairie Power Plant Unit 2. Impacts that will be evaluated include ESP performance and ash marketability. The evaluation will be conducted on ¼ of the gas stream, nominally 150 MW.

PROJECT OVERVIEW

This test is part of an overall program funded by the Department of Energy's National Energy Technology Laboratory (NETL) to obtain the necessary information to assess the costs of controlling mercury from coal-fired utility plants that do not have scrubbers for SO_2 control. The economics will be developed based on various levels of mercury control at four different host sites. The four sites, shown below, burn coal and have particulate control equipment that are representative of 75% of the U.S. coal-fired generation.

Test Site	Coal	Particulate Control
PG&E NEG Salem Harbor	Low S. Bituminous	Cold Side ESP
PG&E NEG Brayton Point	Low S. Bituminous	Cold Side ESP
Wisconsin Electric Pleasant Prairie	PRB	Cold Side ESP
Alabama Power Gaston	Low S. Bituminous COHPAC FF	Hot Side ESP

Pleasant Prairie Unit 2 was chosen for this evaluation because of its combination of firing PRB coal with a cold-side ESP. This combination is increasingly common as many U.S. utilities are fuel switching to lower-sulfur western coals. It also provides unique challenges that must be evaluated to determine the true impacts of carbon injection. In this evaluation dry sorbents will be injected into the ductwork upstream of one (of four) ESPs. Operating conditions will be modified to optimize the performance in terms of both mercury capture and emissions compliance in short-term tests, followed by longer-term tests that will more thoroughly evaluate the operational impacts and costs at reasonable injection rates.

The advantages at Pleasant Prairie are:

1. One ESP chamber can be treated in isolation, and long duct runs provide good residence times for spray cooling and sorbent injection.
2. The baseline mercury removal as shown in ICR testing from 1999 shows no removal of mercury by the ash. The high level of elemental mercury at the site makes it a challenging application for carbon injection that will test the limit of the technology.

3. Capital costs for adding sorbent injection, with or without cooling the flue gas, are less than retrofitting a baghouse or scrubbing system.
4. The ash is currently sold as a valuable commodity. Impacts on ash re-use are important to evaluate in determining the real costs of mercury control.
5. Wisconsin Electric has another site, Valley Power Plant, which generates a high-LOI ash that can be tested for use as a sorbent at Pleasant Prairie.

General Technical Approach

Testing at Pleasant Prairie is part of a field evaluation program that will implement mercury control technologies on portions of full-scale particulate control to obtain performance and operational data, and gather samples to determine the impact of these technologies on waste disposal and byproduct reuse.

The method for controlling mercury will be sorbent injection. If required, mercury removal will be enhanced by temperature control through spray cooling or plant-specific equipment. This will be established by sorbent screening tests that will be conducted at Pleasant Prairie in spring of 2001, and based on further discussions with operations personnel, including a risk analysis.

A series of parametric tests will be conducted to determine the optimum operating conditions for several levels of mercury control. The maximum injection rate will be set based on practical limitations of ESP performance and ash impacts. At least two lower injection rates will also be tested so that a relationship between injection rate and removal can be established for each sorbent. Based on results from these tests, a two week test with activated carbon and optimized conditions will be conducted to assess longer term impact to ESP, ash and auxiliary equipment operation. To save costs during optimization, mercury levels will be measured with a semi-continuous emissions monitor (S-CEM). Verification of the S-CEM and mercury removal efficiencies in the long-term test will be measured by the draft Ontario Hydro method.

At each site, two sorbents will be evaluated during the parametric tests for one week each. A standard activated carbon will be included at each of the test sites. It is expected that the standard sorbent will be a lignite-derived activated carbon, supplied by American Norit. This is subject to change since Norit is providing some newly developed activated carbon sorbents, intended to be more cost-effective. Final sorbent selection will be determined by sorbent screening tests at the site. Given the large quantity of sorbent required for the long-term tests, it is necessary to select the sorbent well in advance to have the amount on hand. For these long-term tests, the Norit activated carbon determined to be most cost-effective will be used. The second sorbent tested at Pleasant Prairie will be processed Valley fly ash, sieved and ground. This sorbent was shown in earlier testing to have the potential for mercury capture, as well as to be economically attractive and available.

The economic analysis will include:

Capital costs	Waste disposal issues
Sorbent usage costs	Byproduct utilization issues
Impact on ESP operation	Enhancements, such as cooling
Balance of plant	O&M requirements

Injection equipment will be installed in July to September 2001. Testing will be conducted during the fall of 2001.

SITE DESCRIPTION

Wisconsin Electric Company, a subsidiary of Wisconsin Energy, owns and operates Pleasant Prairie Power Plant located in Kenosha, Wisconsin. The plant has two (2) 600 MW balanced-draft coal-fired boilers. Unit 2 is planned to be the test unit. The units fire a variety of Powder River Basin low sulfur, sub-bituminous coals.

The primary particulate control equipment consists of cold-side ESP's, of weighted wire design with liquid sulfur SO_3 flue gas conditioning. The precipitators were designed and built by Research-Cottrell and the flue gas conditioning system was supplied by Wahlco. They were originally designed to collect fly ash from the Riley Stoker turbo-fired boiler with design superheated steam conditions of 1905 PSIA/995^o F. The boiler was designed to burn low sulfur coal at a gross nominal generating capacity of 616 MW (580 MW net). The design ACFM was 2,610,000 at 280^{o}F and an inlet pressure of $^+/_-$ 30" H_2O. The design collection efficiency was 99.72%. There is a common stack supporting sister units.

Precipitator #2 was commissioned and put into service in 1985. The installation is comprised of four (4) electrostatic precipitators that are arranged piggyback style and designated 2-1,2-2,2-3, and 2-4. Each of the four precipitators is two (2) chambers wide and four (4) mechanical fields deep with eight (8) electrical fields in direction of gas flow. The unit employs sixty-four (64) T/R's, sixteen (16) on each precipitator. The T/R's are capable of double half wave or full wave operation. At this time, the T/R's are in full wave operation.

Opacity is measured at the stack, but there is the capability of measuring opacity in the common ductwork for each of the two (2) piggyback units.

Hopper ash is combined between all four precipitators in the dry ash-pull system. The ash is sold as base for concrete and is considered a valuable product of the Pleasant Prairie Power Plant. One precipitator's ash can be isolated from the balance of the unit.

A summary of important descriptive parameters for Pleasant Prairie Unit 2 is presented in Table 1.

Table 1
Site Description Summary, Pleasant Prairie Unit 2

PARAMETER IDENTIFICATION	DESCRIPTION
Process	
Boiler Manufacturer	Riley Stoker Turbo-Fired
Burner Type	Riley Stoker – Direction Flame
Low NOx Burners	Yes
Steam Coils	***No***
Over Fire Air	No (glycol preheater)
NOx Control (Post Combustion)	None
Temperature (APH Outlet)	280°F
Coal	
Type	Powder River Basin
Heating Value (Btu/lb)	11,897
Moisture (%)	20.1
Sulfur (%)	0.43
Ash (%)	7.5
Hg (μg/g)	0.1
Cl (%)	0.0015
Control Device	
Type	Cold-Side ESP
ESP Manufacturer	Research Cottrell
Design	Weighted Wire
Specific Collection Area (ft^2/1000afcm)	468
Flue Gas Conditioning	Wahlco SO_3 Injection

TECHNICAL APPROACH

Sorbent for mercury control will be injected into the ductwork downstream of the SO_3 injection grid. The long run of ducting between the injection grid and the ESP chamber will allow the sorbent to have a 1 to 2-second residence time in the duct, which has been shown in pilot-scale studies to be sufficient for moderate to high levels of mercury control. One of the four ESPs will be treated, nominally 150 MW. This meets DOE's requirement to evaluate units up to 150 MW and also provides the opportunity to compare ESP performance and mercury removal on parallel ESPs, one treated with sorbent injection and one untreated.

Figure 1 presents a diagram of the particulate control equipment at Pleasant Prairie. This figure shows that each unit has four double-chamber ESPs, oriented in a piggy-back fashion. Figure 3 shows an isometric view of Unit 1. Unit 2 is identical to Unit 1.

Figure 1. Schematic of Pleasant Prairie Unit 1 Precipitator Arrangement: Unit 2 is Similar.

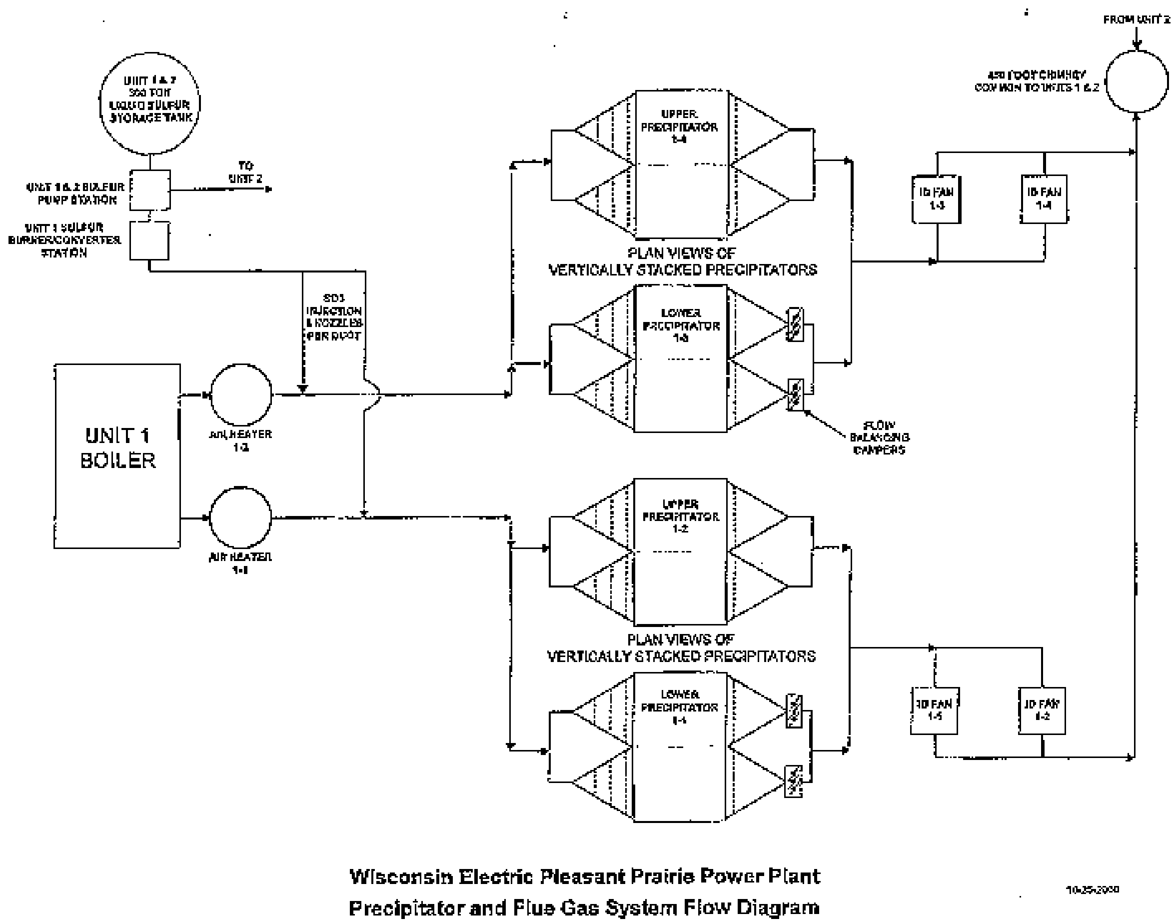
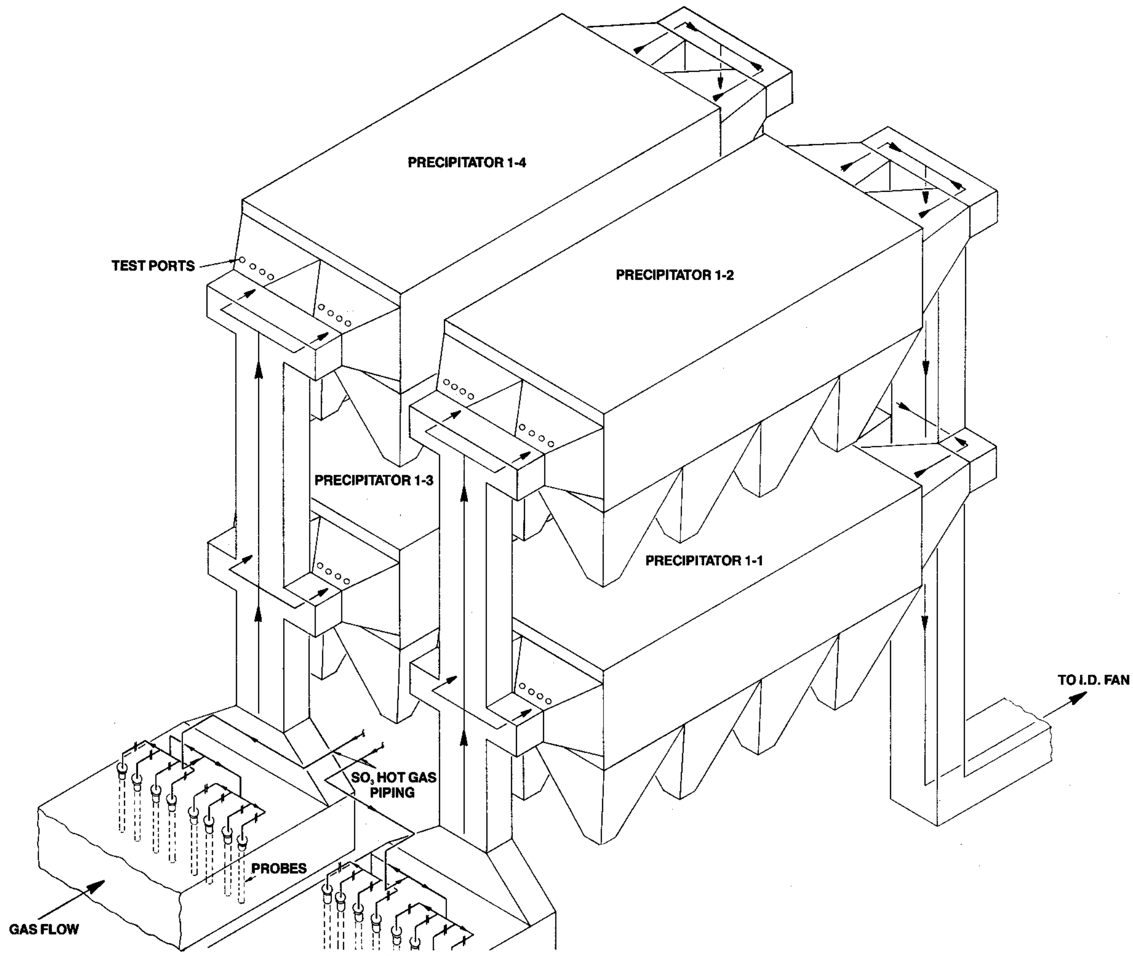


Figure 2. Isometric View of Precipitator Arrangement at Pleasant Prairie.



The primary objective of the field evaluation at Pleasant Prairie will be achieved through eight technical tasks. In the overall program these tasks are numbered 2 through 9. The tasks are identified in the following flow chart.

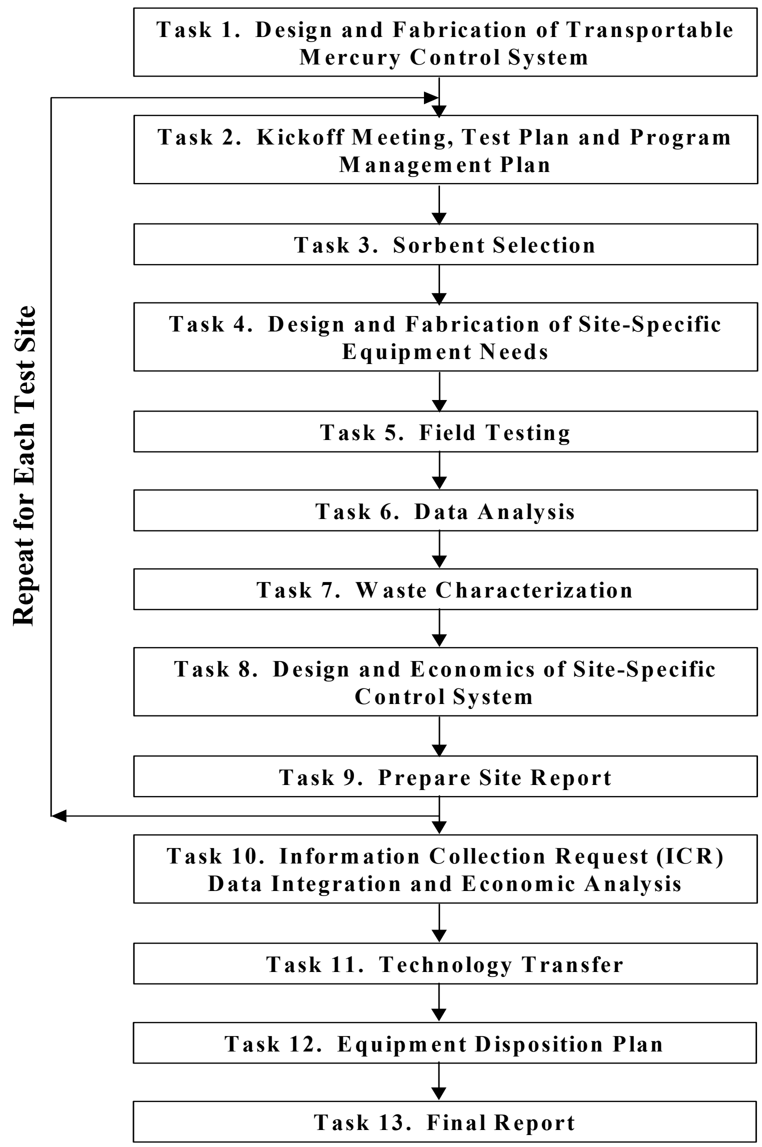
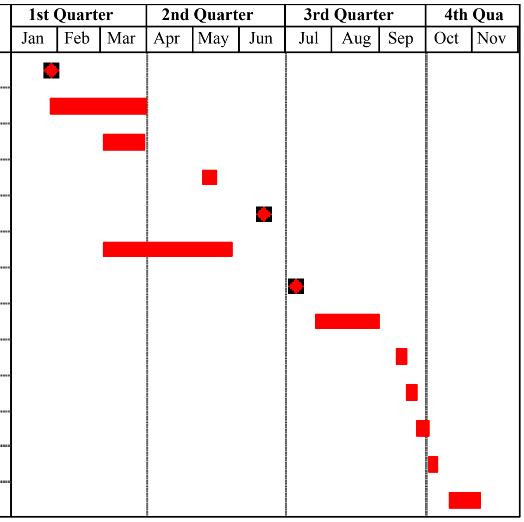


Figure 3 presents a tentative schedule for the test program at Pleasant Prairie. Figure 3 shows that field testing should be completed in Fall 2001.

Figure 3. Test Schedule for Pleasant Prairie Unit 2.

ID	Name	Early Start	Early Finish
1	Kickoff Meeting at Pleasant Prairie	Jan 26 '01	Jan 26 '01
2	Test Plan Finalized	Jan 26 '01	Mar 29 '01
3	Unit 2 Planned Outage	Mar 2 '01	Mar 28 '01
4	Likely Schedule for Sorbent Screening	May 7 '01	May 15 '01
5	~7-day Sorbent Screening Tests Completed By	Jun 15 '01	Jun 15 '01
6	Quality Assurance/Control Plan	Mar 2 '01	May 24 '01
7	Review of Sorbent Screening Results Complete by	Jul 5 '01	Jul 5 '01
8	Site Mods, Equipment Install, System Checkout	Jul 20 '01	Aug 30 '01
9	Baseline Tests	Sep 11 '01	Sep 17 '01
10	Series 1: Parametric Temperature	Sep 18 '01	Sep 24 '01
11	Series 2: Parametric Injection Rate	Sep 25 '01	Oct 1 '01
12	Series 3: Alternate Sorbent	Oct 2 '01	Oct 8 '01
13	Long-Term Tests	Oct 16 '01	Nov 5 '01



Task 2 – Kickoff Meeting, Detailed QA Plan and Test Matrix

A kickoff meeting was held January 26, 2001 with appropriate plant, project and environmental personnel. At this meeting the overall scope of the program, the potential impact on plant equipment and operation, environmental permitting issues and site-specific goals were discussed.

This document is the detailed Quality Assurance plan and test matrix that includes a breakdown of expected settings for the parametric tests, a list of samples and test procedures, a task schedule and QA protocol. The detailed test results from Sorbent Screening tests are included in this Test Plan.

Task 3 – Sorbent Selection

The test schedule allows for the evaluation of three or four sorbents. The benchmark sorbent that has been tested in many research and pilot-scale programs to date is a lignite-derived activated carbon referred to as Darco FGD carbon. The sorbents for Pleasant Praire testing have been selected based on test results in laboratory, slipstream, and full-scale (at Gaston) tests. These sorbents shall include Norit's Darco FGD, finely ground Darco FGD, and Insul carbons. In addition FGL-2, which is a developmental Norit activated carbon, will be tested (assuming appropriate quantities can be obtained). Norit's alternative activated carbons such as FGL-2 are projected to be less expensive than Darco FGD, due to shorter processing time. Valley ash was also evaluated as a potential sorbent for Pleasant Praire, but has been excluded from the full-scale test plan based on processing costs, the small quantities that are available, and low effectiveness as a sorbent.

Sorbent selection criteria have been developed so that sorbent vendors/developers can clearly understand the needs and requirements of this program. In summary an alternative sorbent (in this case the Valley processed ash, the alternate Norit product, or other recommended sorbents) must:

1. Be at least 25% less expensive than FGD carbon;
2. Be available in quantities of at least 15,000 lbs and 250,000 lbs for site tests;
3. Show that this sorbent will be available in sufficient quantities to supply at least 100 tons per year by 2007 (not applicable to Valley fly ash); and
4. Have a capacity of at least 100 μg/g as measured in the laboratory by URS Corporation.

A summary of other sorbents that were evaluated in laboratory and slipstream testing is included in the Sorbent Screening Summary (separate document).

Subtasks 3.1 & 3.2 – Activated Carbon and Site-Specific Sorbents Screening

Sorbents being considered for the full-scale evaluation were screened for adsorption capacity on a slip stream of flue gas using a fixed bed device. A significant amount of testing has already been conducted by Wisconsin Electric and EPRI. The results from those tests flow into this program and have allowed us to streamline these tests. This section discusses the background of prior tests. Additional test results obtained during June 2001 are presented under Subtask 5.2, Table 6.

EPRI, in conjunction with WE, Apogee, and Radian, ran mercury control tests on a slipstream from Pleasant Prairie in 1999-2000 utilizing both a fixed-bed sampler and a device that tests sorbent injection (PoCT tester). The results of these tests were reviewed and are being used to determine which sorbents and operating conditions are of interest, to make the full-scale testing as informative as possible. Some further tests were conducted in June 2001 by URS using the fixed-bed sampler.

The fixed-bed sampler can determine the mercury adsorption capacity of a dry sorbent at controlled-temperature conditions. The sampler can be located upstream or downstream of SO_3 injection. These two variables, temperature and SO_3 injection, are of interest for different reasons. Tests indicate that mercury removal may involve both physical- and chemical-adsorption mechanisms. Mercury adsorption decreases as the reaction temperature increases, typical of physical adsorption. Flue gas constituents like SO_3 may influence the chemical adsorption mechanisms.

At Pleasant Prairie, temperature variation in the range of 275-300F did not appear to have a significant effect on the results from activated carbon or Valley ash. Definite temperature trends, however, can be observed in the adsorption capacities between 250 and 300 F, as shown in Table 6, Subtask 5.2.

SO_3 injection is of interest on the basis of the EPRI test series results. A significant enhancement to mercury capacity of sieved Valley ash (+100 mesh) was measured in the presence of SO_3, resulting in a high enough capacity to make the ash of interest for further evaluation as a full-scale sorbent.

Pleasant Prairie hopes to reduce or remove SO_3 injection in the future. The SO_3 influence on mercury capture by sorbents, positive or negative, needed evaluation for applicability to this and other ESP units. The quantity of SO_3 injected during “normal” SO_3 injection is not accurately known. Carbon-based and Valley ash sorbents were both tested under conditions including no SO_3 (upstream of SO_3), and “normal” SO_3 (downstream of SO_3).

Valley ash was tested, with the results shown in Table 6. This ash has now been eliminated as a full-scale test sorbent. Test results were not favorable enough to merit testing it full-scale in light of the other sorbents available, and their broader applicability. Valley ash processing included a step to sieve the ash to +100 mesh, concentrating the high-carbon (large) fraction, and a second step to grind this product to a specification close to that of Darco FGD.

Task 4 – Design and Fabrication of Site-Specific Equipment Needs

The mercury control process equipment has been fabricated and will be delivered to the plant by the end of July, 2001. Injection ports, sampling ports and access platforms were installed by the plant during the spring 2001 outage. The objective is to have the equipment fully installed by August 23, 2001 to be ready to show in a plant tour in conjunction with the AWMA Mercury Specialty Conference.

Sorbent Injection System

The transportable sorbent injection system consists of a bulk-storage silo and twin blower/feeder trains each rated at 750 lb/hr. Sorbents will be delivered in bulk pneumatic trucks and loaded into the silo, which is equipped with a bin vent bag filter. From the two discharge legs of the silo, the reagent is metered by variable speed screw feeders into eductors that provide the motive force to carry the reagent to the injection point. Regenerative blowers provide the conveying air. A PLC system is used to control system operation and adjust injection rates.

Flexible hoses will carry the reagent from the feeders to distribution manifolds that are located on the ESP inlet duct, feeding the injection probes. Each manifold will supply 4 to 6 injectors. The number and position of the injectors will be determined through system shake down and optimization tests.

In addition to the injection system, some simple equipment will be required to safely and easily collect flyash samples from the baghouse hoppers. ADA-ES will provide a sketch and materials list to the plant for this assembly. The plant will purchase and install.

ADA-ES will work with the station and its installation subcontractors to provide all required information for system installation and operation. ADA-ES has provided a drawing package of the ADA-ES supplied equipment and installation requirements as well as criteria and specifications for Balance of Plant (BOP) equipment and materials provided by others. ADA-ES has also provided a final list of utility requirements (electric power, water, compressed air) for the injection system.

The sorbent injection silo/feeder system, designed and supplied by Norit, is described below:

- 2500 ft^3 storage silo with twin discharge
- Bin vent bag filter
- Level switches and radar type level transmitter
- Two rotary valves

- Two feeder hoppers
- Two volumetric feeders
- Two Pneumatic blower and eductor trains
- Load cells
- Pressure switches
- NEMA 4/4x design
- PLC system control panel
- Safety and trip interlocks
- Electrical requirement: 480V/3ϕ/60Hz : 80 Amps
- Compressed air requirement: 8 scfm @ 30 psig of instrument-quality air (intermittent use)

Responsibility for procurement of the sorbent injection system is divided between ADA-ES and WE as shown in Table 4.

Table 4. Scope Split for Sorbent Injection System

ADA-ES Transportable System	Provided by Host Site
Silo/Feeder System	Injection ports
Sorbent Distribution Manifolds	Test ports
Conveying Hose (400 ft)	Access platforms
Sorbent Injectors	Installation labor/Materials
PLC Controls, HMI and Programming	Compressed air
Hg SCEMs	480V Power
Office Trailer	Signal Wiring

Spray Cooling System

A transportable spray cooling system will be used to obtain low-temperature operation at Pleasant Prairie. Envirocare International designed and built this system that employs a downstream thermocouple array to minimize temperature stratification and maintain tight control of the target temperature. The EnviroCare system consists of a skid mounted pump and valve rack, air and water manifolds, spray lances and fast response thermocouples for precision feedback control.

The main features of a portable spray cooling system are:

- Pump skid
- Clean, filtered water requirements: about 45 gpm
- Valve rack assemblies
- Spray lance headers
- Fast response thermocouple system
- Safety interlocks

- NEMA 4/4x design
- PLC system control panel
- Electrical requirement: 480V/3ϕ/60Hz : 30 Amps plus compressor load
- Compressed air requirement: to be designed, probably supplied by rental compressor.

Responsibility for procurement of the humidification system was divided between ADA-ES and WE as shown in Table 5.

Table 5. Scope Split for Spray Cooling System

ADA-ES Transportable System	Provided by Host Site
Pump Skid	Spray Lance Mounting Boxes
Valve Racks	Thermocouple Ports
Air and Liquid Manifolds	Inspection Ports
Spray lances	Access Platforms
Fast Response TCs	Installation labor/materials
Hoses and Fittings	Compressed air (Rental Compressor)
PLC Controls, HMI and Programming	480V Power
In-duct video camera	Signal Wiring
Deposition probes	
Acid Dewpoint Meter	

Task 5 – Field Testing

The field tests will be accomplished through a series of nine (9) subtasks. The subtasks are independent from each other in that they each have specific goals and tests associated with them. However, they are also interdependent with the results from each task influencing the test parameters of subsequent tasks.

Subtask 5.1 – Pre-Baseline Measurements

This test series is not necessary at Pleasant Prairie due to the availability of prior measurement results from this site. The findings of past testing done using the Ontario-Hydro test method ICR tests) and EPRI's S-CEM showed that there is very little or no control of mercury across the ESP. These tests also indicated that the majority of mercury is in the vapor-phase, elemental form.

Some preliminary measurements are planned for August 19-20 using the S-CEM. These will occur during a flash burn, test conditions will be determined by WE.

Subtask 5.2 – Sorbent Screening

Sorbent screening was conducted on a slipstream of flue gas from Unit 2. Test locations were upstream and downstream of SO_3 conditioning. Table 6 summarizes the actual test results from the screening.

Valley ash sieved to +100 mesh contains about 65% carbon and has shown good mercury adsorption capacity, but only with SO_3 injection. This triggers further investigation, but the +100 mesh size does not stay entrained and is therefore not useful as an ESP-injected sorbent. Since these tests are focused on practical sorbents, we tested only ground sieved ash, yielding a smaller size distribution that will stay entrained. The sieving step in the process is necessary because native Valley fly ash contains only about 35% carbon, which means that twice as much non-separated ash would have to be injected for an equivalent mass of carbon. This extra injection requirement would be an additional load on the precipitator that would be prohibitive.

Valley ash has been eliminated from the full-scale test matrix based on the test results from sorbent screening, combined with the processing expense and the relatively low availability of this ash.

Based on results from Gaston earlier this year, FGD carbon ground to a smaller particle size ("Fine FGD Carbon" in the table) was of interest. At Gaston a significant improvement was seen in comparison with the capture by FGD Carbon. The mass median diameter of FGD carbon is about 15 microns, whereas Fine FGD Carbon is about 6 microns. Gaston is a COHPAC baghouse and results may not be found in an ESP, but the improvement was significant enough to merit further testing. The results in Table 6 show that Fine FGD Carbon has high sorbent capacity, but not as high as FGD Carbon. This result of a single test could be attributable to different sorbent packing characteristics that led to channeling in the packed bed test device. The high sorbent capacity does make Fine FGD Carbon interesting for further tests, and it has been selected for full-scale injection.

Norit Insul Carbon shows extremely high adsorption capacity, and has also been selected for full-scale testing. It will be tested at lower injection rates than the Darco FGD in order to make up for the higher cost of the Insul Carbon. A third Norit product that is of interest, and that was not screened at Pleasant Prairie, has also been selected (FGL-2), based on the low cost of this sorbent, attributable to a shorter processing time in the manufacture as compared with Darco FGD.

A summary of the test results from June 2001 is presented in Table 6. General observations include:

- The Norit carbons displayed very high adsorption capacities;
- FGD and Insul looked very similar;
- The presence of SO_3 from flue gas conditioning inhibited adsorption;
- The capacity of the Fine FGD sample was high, but lower than regular FGD;
- Ground VAPP ash showed improvement as temperature decreased from 300 to 250°F;
- The higher capacity of the hand-ground VAPP sample was surprising because this sample appeared to have larger particles than the "ground" VAPP ash. Differences may be due to how these sample pack and possible channeling of the flow (this may also be the reason for lower capacity of the Fine FGD);
- The Sorbent Technology (SorbTech) sample looked good (near 1900) downstream of SO_3 conditioning;
- The two Nuchar samples showed no capacity;

- The P4 ash shows no appreciable adsorption.

Carbon/Lime Tests:

- Adsorption capacities of FGD+Lime were no better than FGD alone.
- Sorbalit (lime-carbon mixture produced by Dravo) showed high adsorption upstream of SO_3. This sample had a lime/carbon ratio of 20:1.

Table 6

Results from Sorbent Screening Tests Conducted by URS Radian (June 2001)

Sample Name	SO3 Conditioning	Field Temp (°F)	Field Equilibrium Adsorption Capacity (μg/Nm³)
FGD Carbon	Upstream	250	8823
FGD Carbon	Downstream	250	3355
Fine FGD Carbon	Upstream	250	4032
VAPP [+100]-ground	Downstream	300	18
VAPP [+100]-ground	Downstream	250	82
VAPP [+100]-hand ground	Downstream	300	402
Nuchar Carbon	Downstream	300	0
Nuchar DC	Downstream	300	0
Norit Insul Carbon	Upstream	250	8754
Norit Insul Carbon	Downstream	250	1069
Sorb Tech-2	Downstream	300	1889
P4 Ash	Upstream	250	0.15
P4 Ash	Downstream	250	3
Lime+FGD (60:1)	Downstream	250	2091
Lime+FGD (60:1)	Downstream	300	>1504
Sorbalit (20:1)	Upstream	250	>10261
Lime	Downstream	250	0.13

Subtask 5.3 – Site Modifications, Equipment Installation and System Checkout

ADA-ES will oversee installation and checkout of the mercury control equipment. The mercury control process equipment has been fabricated and will be delivered to the plant by the end of July, 2001. Injection ports, sampling ports and access platforms were installed by the plant during the spring 2001 outage. The objective is to have the equipment fully installed by August 23, 2001 to be ready to show in a plant tour in conjunction with the AWMA Mercury Specialty Conference.

The plant and its installation subcontractors will install the equipment including any forklift or crane support. This will include anchoring of the injection skid, running and supporting the flex hose, mounting the injection manifold, providing and terminating electric power and compressed air to the injection skid.

Fly ash from all four ESPs are combined in the ash pull system and sold. To assure that sorbents that are used for mercury capture do not contaminate the balance of ash, the test ESP (precipitator 2-4) will be isolated from the ash system during testing. The ash from precipitator 2-4 will be directed into the economizer silo, separate from the sold flyash.

Samples will be collected during system checkout and TCLP and concrete tests will be conducted before any ash is combined. The plan is to isolate the test ESP hoppers while the sorbent injection system is operated at maximum feedrate. Ash will not be blended with the balance of plant ash while analyses of the samples are being conducted. If a problem is identified, this same procedure will be used to isolate ash during testing.

Subtask 5.4 – QA/QC Plan

Subcontractors will be performing the various sampling and analytical functions required to evaluate the effectiveness of the mercury controls. All testing personnel will be required to adhere to written QA/QC procedures. QA/QC procedures will be prepared as part of detailed test matrices that will be submitted ahead of testing dates for approvals by Wisconsin Electric, DOE and EPA. The plans will include the necessary QA/QC activities that are required to assure the validity of collected data. At a minimum, the QA/QC Plan will include a description of the test methods to be used; instrument/equipment testing, maintenance and inspection procedures; instrument calibration and frequency; inspection/acceptance requirements for supplies and consumables; procedures for checking data reduction and validation; and sample handling and chain of custody requirements. Standard methodologies and procedures have been established for all the methods to be used in the testing, therefore no new or unproved techniques will be introduced to the project.

Subtask 5.5 – Baseline Testing

An overview of the planned full-scale tests is shown in Table 7. The various tests are described below in their corresponding Subtask.

Table 7
Planned Full-Scale Test Sequence for Pleasant Prairie

Test Description	Dates	Parameters/Comments
Preliminary S-CEM measurements	August 19 and 20 (or so)	Mercury measurements with flash burn
Baseline tests	Sept 10 – 14	No injection, Ontario Hydro Tests
Equipment check out	Sept 17 – 21	Unload truckload of FGD carbon into silo. Run carbon and humidification systems for check out. Checkout the significance of co-current vs. counter-current injection of sorbents.
Parametric Week 1	September 24 - 28	***Norit FGD (45,000 lbs)*** Day 1 – Inject at 10 lbs/Mmacf Day 2 – 20 lbs/Mmacf Day 3 – 30 lbs/Mmacf Day 4 – Spray cooling (possibly w/SO_3 off) Day 5 – SO3 Off (if possible with ESP performance); run out carbon
Parametric Week 2	October 1 – 5	***Fine Carbon (28,000 lbs)*** Day 1 – Load Carbon Day 2 – Inject at 10 lbs/Mmacf Day 3 – 20 lbs/Mmacf Day 4 – 30 lbs/Mmacf Day 5 - Spray cooling (feed out carbon)
Parametric Week 3	October 8 – 12	***FGL-2/Insul (20,000/5,000 lbs)***[a] Day 1 – Load FGL-2 Day 2 – Inject at 30 lbs/Mmacf Day 3 – 30 lbs/Mmacf and Spray Cooling Day 4 – Feed out ash, load Insul Day 5 - Inject Insul at 15 lbs/MMacf
Optional Week 4	October 15 – 19	***Insul/Other (10,000-20,000 lbs)***[a] Day 1 – Load new sorbent Day 2 – Inject at 10 lbs/Mmacf Day 3 – 15 lbs/Mmacf Day 4 – Feed out sorbent, shut down systems.
Break	October 15 – 26 or October 22 – November 2	
Long Term Test	October 29 – November 9 Or November 5 - 16	Sorbent - Norit FGD

a. Quantity of Insul was estimated for a 1 day test.

After equipment installation, a baseline tests are scheduled to occur immediately prior to the first parametric test series to best document baseline conditions. During this test boiler load will be held steady at "full-load" conditions during testing hours, nominally 7:00 am to 7:00 pm. Mercury across the selected ESP chamber will be measured using two separate methods:

1) the S-CEM; and
2) standard Ontario Hydro Testing.

A description of the mercury S-CEM can be found in Appendix C.

The Ontario Hydro tests will be conducted by Mostardi-Platt. Mostardi-Platt will prepare a detailed test plan, complete with QA/QC procedures, prior to testing.

Performance of the ESP is critical to the success of sorbent injection for mercury control. Boiler (Unit 2) operation is important in order to determine that the tests are conducted under obtainable, sustainable operating conditions. The main operating indicators of interest are described here and listed in Tables 8 & 9.

ESP Performance (both 2-4 and 2-2 to be recorded and compared)

Electrical Parameters: Primary and secondary voltage and current, as well as spark rate, will be monitored using existing instrumentation to document any changes in ESP power characteristics.

Flue Gas Temperature: Recorded from plant instrumentation and during any manual traverses.

Rapping Pattern: Any change to the rapping pattern that is required for good performance will be recorded and evaluated.

SO_3 Injection: SO_3 will be injected at the plant's normal operating condition, as required in the permit, for most tests. Under some test conditions it may be desirable to increase SO_3 by increasing the sulfur flow. Also SO_3 may be turned off for some tests, this will be coordinated in advance with the plant and if necessary, a Variance will be requested. The high- and no-SO_3 conditions will only be required for brief periods of one or two days while measurements are made during the parametric test series.

Opacity/Emissions: Ash resistivity, electrical characteristics, and rapping affect collection efficiency across the ESP. We have calculated that it is not expected emissions will increase with this series of tests, however emissions will be documented by both manual measurements and the site's opacity monitor. Particulate measurements following EPA Test Method 5 will be conducted in conjunction with the Ontario Hydro measurements.

<u>Coal, Ash and Flue Gas Samples</u>

Ash Samples: Fly ash hopper samples will be taken from the ESP hoppers. These ash samples will be analyzed for mercury to compare to in-situ measurements. It is anticipated that samples will be taken during each test condition. Other analyses such as carbon content and composition will be conducted as needed.

Coal Samples: Coal samples will be collected daily. These samples will be analyzed for mercury.

Acid Dew Point Measurements: Tests have shown that mercury removal efficiencies improve at lower temperatures and in some cases downstream of SO_3 conditioning. It is of interest to document this parameter for future analyses. Measurements will be made with a Land Dew Point Analyzer.

SO_3 Injection: Currently Unit 2 is being retrofit with new controllers that may enable operation without flue gas conditioning. This parameter will be monitored, and will be operated at “normal” and “high” conditions. There may be test conditions during parametric tests during which SO_3 is turned off, if a Variance is obtained in advance. During baseline tests SO_3 will be operated normally.

<u>Unit 2 Operation</u>

System Operation: Boiler load, stack opacity, other stack CEM measurements, flue gas temperatures before and after the ESP, coal source and documentation of operation that may affect the combustion process such as pulverizers that may not be working, etc.

Table 8 presents data to be collected during baseline, parametric and long term testing. These data will be used to evaluate sorbent injection performance. Data will also be collected simultaneously from the control ESP, the adjacent ESP (2-2), for a direct comparison of the impact of sorbent injection on precipitator performance. Table 8 shows data that will be monitored from both the control and test chambers during testing.

Table 8
Test Data Collected from Sorbent Injection Chamber During Evaluation

PARAMETER	SAMPLE/SIGNAL/TEST	BASELINE	PARAMETRIC/ LONG-TERM
Coal	Batch sample	Yes	Yes
Coal	Plant signals: burn rate (lb/hr) quality (lb/MMBTU, % ash)	Yes	Yes
Fly ash	Batch sample	Yes	Yes
pH of ESP ash	Batch sample	Yes	Yes
Unit operation	Plant Signals: Boiler load Flow rates and temperatures	Yes	Yes
Temperature	Plant signal at inlet and outlet of ESP	Yes	Yes
Temperature	Full traverse, inlet & outlet	Yes	No/Yes
Duct Gas Velocity	Full traverse, inlet & outlet	Yes	No/Yes
Mercury (total and speciated)	Full traverse, inlet with S-CEM	Yes	No
Mercury (total and speciated)	Ontario Hydro, inlet and outlet	Yes (1 set)	No/Yes (1 set)
Sorbent Injection Rate	PLC, lbs/min	No	Yes
CEM data (NO_x, O_2, SO_2)	Plant data – stack	Yes	Yes
Acid Dew Point	Acid dew point probe, inlet to ESP	Yes	Yes
LOI	LOI monitor, inlet to ESP	Yes	Yes
Stack Opacity	Plant data	Yes	Yes
SO_3	Plant chart/catalyst temperature and flow	Yes	Yes
ESP operation	Plant data (ESP electrical, rapping, etc.)	Yes	Yes

Table 9
Test Data Collected From Test and Control Chambers During Evaluation

SAMPLE/SIGNAL/TEST	CONTROL CHAMBER	TEST CHAMBER
ESP Operation	Yes	Yes
SO_3 Injection	Yes	Yes
Mercury S-CEM	Yes (Intermittent)	Yes
Mercury Ontario Hydro Method	No	Yes
Hopper Ash Samples	Yes	Yes

Subtask 5.6 – Parametric Test Series 1: Mercury Removal with Benchmark Activated Carbon (Darco FGD) at Three Injection Rates and with and without spray cooling

A series of parametric tests will be conducted at full-load conditions to document sorbent injection requirements at three sorbent injection rates. The maximum injection rate is not to exceed 17 lb/min, corresponding to 30 lb/Mmacf carbon concentration in the flue gas. This maximum has been set because of the results of previous testing by others that show diminishing returns as well as precipitator performance impacts at high injection rates. EPRI's position is that injection rates higher than about 20 lb/Mmacf are not practical. Testing at the higher rate will not be conducted if 20 lb/Mmacf results in either very high mercury removal (90%) or in unacceptable degradation of precipitator performance. The maximum carbon concentration tested will therefore be either 20 lb/Mmacf or a higher rate up to 30 lb/Mmacf. The removal rates will be checked with feedback from the S-CEM. Two lower rates than maximum will be tested in order to trend injection rates with removal efficiencies. An example of possible sorbent injection rates using FGD carbon for high efficiencies, as projected by Meserole, is presented in Table 10. Operating and performance parameters to be monitored during this test are documented in Table 8. This test is scheduled for 1 week.

Spray cooling will also be tested during this first week of tests, as shown in Table 7. If time permits and ESP performance will allow, tests with SO_3 injection off will also be conducted. This is a tentative test condition because SO_3 can only be turned off to the entire unit (all four precipitators, not just the tested chamber).

DOE may provide (or coordinate with Wisconsin Electric) for additional sampling during the parametric testing. DOE would primarily be concerned with co-pollutant control measurements of SO_3, HF, NO_x, HCl, multi-metals and fine particulate matter.

Table 10
Predicted Injection Rates for FGD Carbon on Test ESP

POSSIBLE HG REMOVAL EFFICIENCY (%)	PREDICTED INJECTION RATE (LBS/MIN)
50	5.5
75	10
90	17

Subtask 5.7 – Parametric Test Series 2: Mercury Removal as a function of Alternate Sorbent Injection

A series of parametric tests will be conducted similar to those in subtask 5.6 to correlate mercury removal to sorbent injection rate. The sorbent selected for this full range of injection rates series is Fine FGD Carbon. This test is scheduled for 1 week. Further testing will occur with Norit's Insul Carbon and with Norit's FGL-2. These tests will each take a week and will include a limited range of injection rates. These tests are described above in Table 7.

Subtask 5.8 – Parametric Test Series 3: Mercury Removal with Alternate Sorbents at Different Temperatures

The minimum flue gas temperature that would be tested is 250 F, and careful monitoring of precipitator performance and SO_3 injection will be done in conjunction with these tests.

Depending on baseline flue gas temperature, temperature will be lowered at each condition to document the effect of 10 - 20^{o}F decrease in temperature, and the agreed minimum temperature (currently proposed at 250 F) on mercury removal efficiencies. The effect of temperature will be evaluated at a minimum of one mercury removal level, as achieved during Subtask 5.7 tests. The sorbent injection rates to achieve these removal rates will be set with feedback from the S-CEM. Operating and performance parameters to be monitored during this test are documented in Table 8. This test is scheduled in conjunction with the alternate sorbent injection tests, as shown in Table 7.

After this test the test crew will leave the site to analyze data and work with team members on establishing conditions for the long term test. Two weeks are scheduled between subtask 5.8 and the long term tests, subtask 5.9.

Subtask 5.9 – Long Term Testing

Mercury removal validation testing will be conducted for a maximum of fourteen days at the "optimum" plant operating conditions (lowest cost/highest mercury removal) as determined from the parametric tests. The sorbent used will be the Benchmark Activated Carbon, since this is the only sorbent that can feasibly be obtained in time and in the large quantity needed for these tests. The project team will obtain concurrence from DOE and Wisconsin Electric on the exact length of testing. The S-CEM will be used for continuous monitoring of mercury removal. Ontario

Hydro measurements at the inlet and outlet will be conducted periodically. A summary of the parameters to be monitored during this test is presented in Table 8. A preliminary report shall be prepared documenting the removal efficiency over time, the effects on the ESP and balance of plant equipment, and operation of the injection equipment to determine the viability and economics of the process.

Task 6 – Data Analysis

Data collected during the field evaluation will be used to prepare a summary report on the effect of sorbent injection on mercury control and the impact on existing pollution control equipment. Various plant signals will be monitored to determine if any correlation exists between changes in mercury concentration and measured plant operating conditions. This analysis will include a characterization of mercury levels and plant operation for baseline conditions, various injection rates, various temperatures (if determined appropriate), and two sorbents. This analysis will also identify effects of sorbent injection on operation and predict long term impacts.

Coal and fly ash samples will be collected during baseline and long term tests for analysis. Ultimate and proximate analysis and measurements for mercury, chlorine and sulfur of the coal will be conducted. Ash samples will be analyzed for mercury and carbon content. Ash samples will also be analyzed by hopper section to determine if there is mercury segregation across the ESP. Task 7 describes further analyses

A full temperature, velocity, particulate loading and mercury (total and speciated) traverse at the inlet and outlet at full load conditions will be conducted to determine profiles for appropriate sampling and sorbent distribution. The S-CEM will be placed at a location with average velocity for sampling. While the first S-CEM is operation, the second S-CEM will be connected to the same probe to verify that both are measuring the same mercury concentration. The second S-CEM shall then be moved to the outlet at a location identified from the traverse to have a duct average concentration.

Full duct traverses at the inlet will be conducted using the S-CEM to document variation in mercury concentration.

Task 7 – Waste Characterization

Ash generated from Pleasant Prairie is beneficially reused. There are two main concerns of the waste characterization effort: one is assessing the stability of the mercury contained on the ESP collected materials, and the other is whether the presence of the sorbent with the ash affects its marketability.

The standard testing technique used for assessing hazardous waste characteristics is the Toxicity Characteristic Leaching Procedure (TCLP, SW846-1311). The test protocol involves exposing a 100-gram sample of ash to 1-liter of acidic solution (acetic acid-or acetate based) for 24 hours. The solution is then analyzed for several metals (including mercury) to determine how much of each target metal was leached from the solid sample. Results are compared against limits established by regulation. In the case of mercury, a maximum leachable level of 0.2 mg/liter has been established. (Note: in most cases the TCLP limits for mercury cannot be exceeded even if all the mercury leaches. These tests will be performed to establish a record of the wastes generated during the program.)

A second series of tests will be performed to answer the question of the stability of the mercury. The potential long-term environmental impact of the mercury-laden ash will be determined using two techniques, leaching and thermal desorption. These tests will be conducted by the Energy and Environmental Research Center (EERC). Leaching tests are done using a method known as the synthetic groundwater leaching procedure (SGLP) (Hassett, et al., 1999). This test is modeled after the TCLP, but modified to allow for disposal scenarios. A shake extraction technique is used to mix the solid sample with an aqueous solution. Aliquots of the liquid are then analyzed after 18 hours, 2 weeks, and 4 weeks.

Thermal desorption tests will be performed using a special test fixture that is heated using a programmable temperature controller. The temperature of the ash sample is ramped to 500 ^{o}C at a rate of 20 ^{o}C per minute. Mercury that is released by the sample is swept to a spectrophotometer for mercury measurement as a function of time and temperature.

Another set of analytical tests will be performed by Microbeam to evaluate whether the waste ash is suitable for use in concrete formulations. Tests are conducted to evaluate properties under ASTM Specification C618, which include chemical and physical property analysis. Air entrainment shaker tests will also be performed as part of the concrete suitability test series.

Sampling and QA/QC procedures will be documented in the test plan as described in Subtask 5.4.

Task 8 – Design and Economics of Site Specific Control System

After completion of testing and analysis of the data, the requirements and costs for full-scale, permanent commercial implementation of the necessary equipment for mercury control using sorbent injection technology will be determined. It will be necessary to meet with Wisconsin Electric engineering and environmental affairs personnel to develop plant specific design criteria. Process equipment shall be sized and designed based on test results and the plant specific requirements (reagent storage capacity, plant arrangement, retrofit issues, winterization, controls interface, etc.). A conceptual design document shall be developed with drawings and equipment lists. Modifications to existing plant equipment shall be determined and a work scope document developed based on input from the plant that may include modifications to the particulate collector, ash handling system, compressed air supply, electric power capacity, other plant auxiliary equipment, utilities and other balance of plant engineering requirements. Reagent type and sources shall be evaluated to determine the most cost -effective reagent(s) for the site. Operational parameters such as utilizing SO_3 injection or operating at lower temperatures may also be included.

A cost estimate to implement the control technology will be developed. This shall include capital cost estimates for mercury control process equipment as well as projected annual operating costs, and impacts such as ash sales. Where possible, order-of-magnitude estimates will be included for plant modifications and balance of plant items

Task 9 – Site Report

A site report documenting all measurements, test procedures, analyses, and results obtained in Tasks 2 through 8 will be prepared. This report shall be a stand alone document providing a comprehensive review of the testing and data analysis.

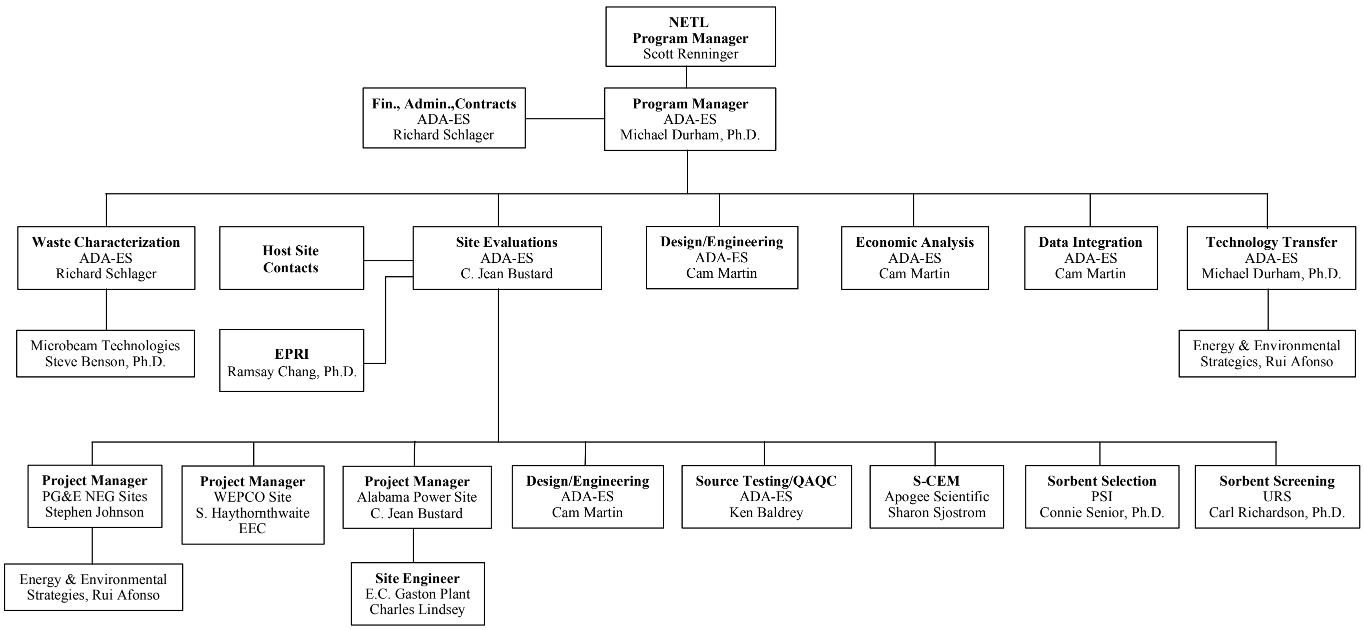
KEY PERSONNEL

The overall program manager for ADA-ES is Dr. Michael Durham. Jean Bustard is coordinating the efforts among all sites. She is also acting as project manager for the field evaluation at Pleasant Prairie with the assistance of Sheila Haythornthwaite of Orion Power Holdings. Figure 4 presents an overall program organizational chart. Table 11 presents key personnel, their roles and phone numbers for the Pleasant Prairie field evaluation.

Table 11
Key Project Personnel for Pleasant Prairie Hg Field Evalation

NAME	COMPANY	ROLE	PHONE #	EMAIL
Dick Johnson	Wisconsin Electric	Project Manager	414 221-4234	Dick.johnson@wepco.com
Dave Michaud	Wisconsin Electric	Env. & Mercury Specialist	414 221-2187	Dave.michaud@wepco.com
Ed Morris	Wisconsin Electric	Sr. Plant Engineer	262 947-5625	Ed.morris@wepco.com
Terry Coughlin	Wisconsin Electric	Environmental Mgr.	414 221-2293	Terry.coughlin@wepco.com
Michael Durham	ADA-ES	Program Manager	303 734-1727	Miked@adaes.com
Jean Bustard	ADA-ES	Project Manager	303 734-1727	Jeanb@adaes.com
Sheila Haythornthwaite	Orion Power Holdings	Site Project Manager	410 230-3067	sheila.haythorn@orionpower.com
Anthony Pons	EEC	On-Site Lead	P 262 544-7500 x0568	Abpons@worldnet.att.net
Cam Martin	ADA-ES	Equipment Design	303 734-1727	Camm@adaes.com
Richard Schlager	ADA-ES	Contracts, Waste Issues	303 734-1727	Richards@adaes.com
Sharon Sjostrom	Apogee	Hg S-CEM	303 783-9599	Ssjostrom@apogee-sci.com
Ramsay Chang	EPRI	Air Toxics Expert	650 855-2535	Rchang@epri.com

Figure 4



Overall Project Organizational Chart

REFERENCES

1. Meserole, F.B., C.F.Richardson, S.D. Miller, K. Searcy, and R.Chang, "Estimating the Costs of Electric Utility Mercury Control Using Sorbent Injection," Air & Waste Mange. Assoc., Conference Proceedings, 93rd Annual Meeting, June 2000.

ATTACHMENT A

DESCRIPTION OF FIXED BED MERCURY ABSORPTION SCREENING DEVICE

BENCH SCALE FIXED BED ADSORPTION TEST DEVICE

Mercury adsorption tests are conducted by saturating sorbents with either elemental mercury or mercuric chloride in the presence of simulated flue gas. The test apparatus is illustrated in Figure A-1. In the laboratory, simulated flue gas is prepared by mixing heated nitrogen gas streams containing SO_2, HCl, NO_x, CO_2, H_2O, and O_2. Mercury is injected into the gas by contacting nitrogen carrier gas with either recrystallized mercuric chloride solids or with an elemental mercury permeation tube (VICI Metronics) housed in a mercury diffusion vessel. Mercury concentration is controlled by the temperature of the diffusion vessel and the nitrogen carrier gas flow rate. During field testing, actual flue gas is drawn into the apparatus.

Sorbents are mixed in a sand diluent prior to being packed in a temperature-controlled, adsorption column (1.27 cm ID). A ratio of 20 mg sorbent to 10 g of sand is generally used for carbon-based sorbents and zeolites, and 200 mg sorbent to 10 g of sand was used for fly ashes. These mass-loadings are chosen to achieve reasonable mercury breakthrough times with the respective sorbents. Prior to flue gas exposure, the sorbent fixed-bed is heated to the desired temperature for periods up to one hour. During this time, the flue gas is by-passed directly to the analytical system to determine the "inlet" mercury concentration. Adsorption tests were initiated by flowing flue gas downward through the fixed-bed column at a flow rate near 1 L/min. Mercury measurements are made with a mercury semi-continuous emissions analyzer (S-CEM) described later in this section.

The amount of mercury exiting the sorbent column is measured on a semi-continuous basis. Gas is passed through the column until 100% of the inlet mercury is detected at the outlet (100% breakthrough). The 100% breakthrough (equilibrium) capacity of the sorbent (µg Hg/g sorbent) is determined by summing the total mercury adsorbed until the time when the outlet mercury concentration is first equal to the inlet concentration.

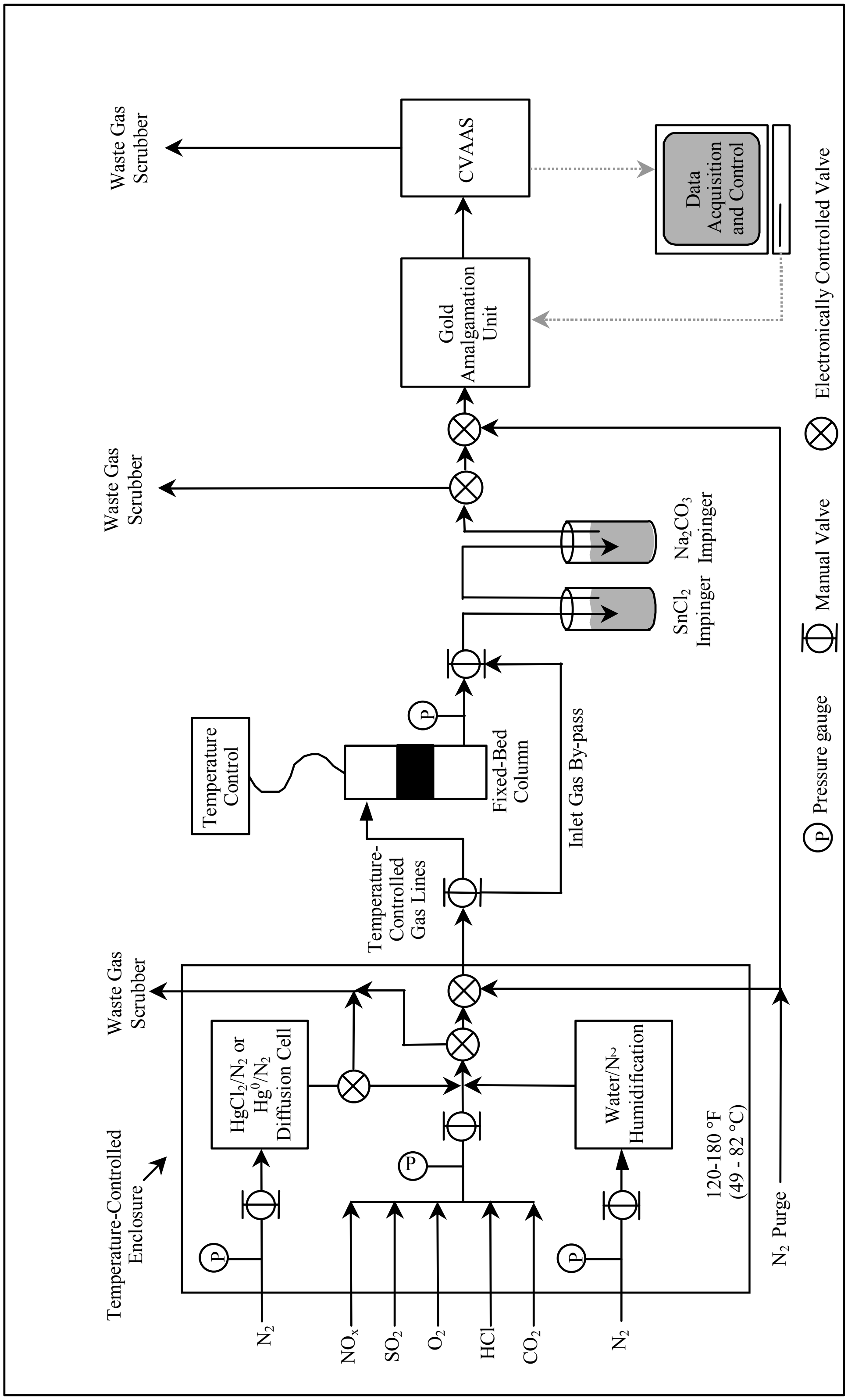


Figure A-1
Bench Scale Fixed Bed Adsorption Test Device

ATTACHMENT B

SORBENT SELECTION CRITERIA

DRAFT
REQUEST FOR ALTERNATIVE SORBENTS

The program called "Field Test Program to Develop Comprehensive Design, Operating, and Cost Data for Mercury Control Systems on Non-Scrubbed Coal-Fired Boilers" is sponsored by DOE, EPRI, and EPA. The program is being conducted by ADA Environmental Solutions (ADA-ES) and its team members. The overall objective is to determine the cost and impacts of sorbent injection into particulate control devices for various mercury removal levels at full-scale, coal-fired power plants.

Full-scale sorbent injection will be tested at four sites as shown below.

Test Site	Coal	Particulate Control
PG&E NEG Salem Harbor	Low S. Bituminous	Cold Side ESP
PG&E NEG Brayton Point	Low S. Bituminous	Cold Side ESP
WEPCO Pleasant Prairie	PRB	Cold Side ESP
Alabama Power Gaston	Low S. Bituminous COHPAC FF	Hot Side ESP

At each site, two sorbents will be evaluated for one week and, if promising, another two weeks of testing may be conducted. A standard activated carbon will be included at each of the test sites. It is expected that the standard sorbent will be a lignite-derived activated carbon, supplied by American Norit™. Norit has quoted delivered prices for FGD activated carbon for these demonstrations of $0.44/pound and has guaranteed availability of the product. The second sorbent will be site-specific, either carbon or ash-based products that show the appropriate capacity for mercury uptake, are economically attractive and readily available in appropriate quantities.

ADA-ES, as prime contractor on the project, is looking for sorbents other than the baseline FGD carbon that can be tested at full scale. ADA-ES envisions a multi-step process for evaluating alternative sorbents, leading to full scale testing as follows.

1. Request for Evaluation. The vendor or developer of an alternative sorbent submits a request for evaluation to ADA-ES. This request should contain enough information to allow ADA-ES and the members of the team to make a decision as to whether the sorbent is a candidate for testing. At a minimum, this request should

   a) describe the sorbent in non-proprietary terms (note that the name of the sorbent and developer can be kept confidential in public release of information, but will be disclosed to team members, as well as to DOE, EPA, and EPRI),

   b) provide evidence that the cost for removing mercury (per pound of mercury removed) will be at least 25% less than that of FGD carbon (including not only the cost for producing the carbon but transportation, handling, feeding, and waste handling costs that may differ from FGD),

   c) demonstrate that the sorbent will be available in quantities of a minimum of 15,000 lbs for a one week test; note that the amount required is site-specific and some sites may require as much as 250,000 lbs minimum, and

   d) provide evidence that sufficient quantities will be available to supply at least 100 tons per year by 2007, when mercury emission regulations for coal-fired power plants will be in force.

2. Laboratory characterization. If the team members feel that the sorbent has potential based on the information disclosed in Step 1, then a small sample of sorbent will be provided by the sorbent developer for characterization by URS Corporation (previously Radian) as to the capacity and reactivity of the sorbent. Cost for these tests will be paid for by the vendor or developer.

3. Estimate of sorbent requirements. The team members will use information from Step 2 to calculate how much sorbent will be required per pound of mercury removed and will compare this against the baseline sorbent. If the amount is reasonable from both an operational and cost standpoint, the sorbent will be selected for small-scale field screening.

4. Small-scale field screening. The sorbent will be tested at the specific site using a small fixed bed screening device supplied by URS Corporation.

5. Final evaluation decision. The team will evaluate all the results (cost and performance) and decide whether or not to go ahead with the full scale testing. The plant personnel at the site will review the sorbent data and have the right to refuse to test the sorbent if there is the potential for negative operational impacts such as a) corrosion due to operation at low temperature; b) deposition on duct internals; c) impacts on ash; d) ESP/FF operating characteristics.

6. Field testing. If the sorbent is approved at a particular site, the team will conduct one week of full scale testing for the alternative sorbent and for the baseline sorbent. There is the potential for another two weeks of testing at the same site for sorbents that perform well.

Note that information generated or disclosed in the process described above will be made available to ADA-ES and all team members as well as to the sponsoring agencies (DOE, EPA, EPRI).

ATTACHMENT C

DESCRIPTION OF SEMI CONTINUOUS EMISSIONS MONITOR FOR MERCURY

Mercury S-CEM

A semi-continuous mercury analyzer will be used during this program to provide near real-time feedback during baseline, parametric and long-term testing. Continuous measurement of mercury at the inlet and outlet of the particulate collector is considered a critical component of a field mercury control program where mercury levels fluctuate with boiler operation (temperature, load, etc.) and decisions must be made concerning parameters such as sorbent feed rate and cooling. The analyzers that will be used for this program consist of a commercially available cold vapor atomic absorption spectrometer (CVAAS) coupled with a gold amalgamation system (Au-CVAAS). Radian developed this type of system for EPRI (Carey, et al., 1998). A sketch of the system is shown in the figure below. One analyzer will be placed at the inlet of the particulate collector and one at the outlet of the particulate collector during this test program.

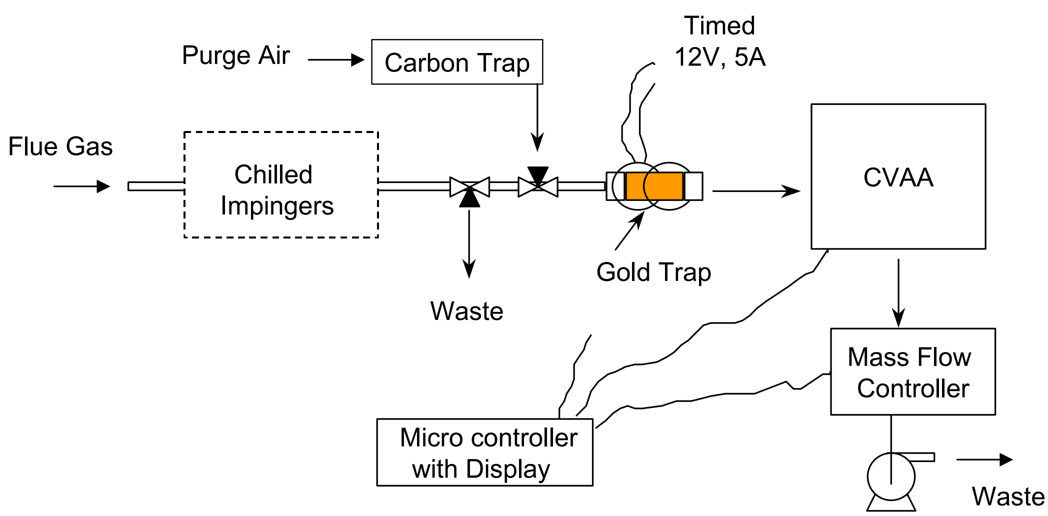


Figure C-1
Sketch of Mercury Measurement System

Although it is very difficult to transport non-elemental mercury in sampling lines, elemental mercury can be transported without significant problems. Since the Au-CVAAS measures mercury by using the distinct lines of UV absorption characteristic of elemental Hg (Hg^0), the non-elemental fraction is either converted to elemental mercury (for total mercury measurement) or removed (for measurement of the elemental fraction) near the sample extraction point. This minimizes any losses due to the sampling system.

For total vapor-phase mercury measurements, all non-elemental vapor-phase mercury in the flue gas must be converted to elemental mercury. A reduction solution of stannous chloride in hydrochloric acid is used to convert Hg^{2+} to Hg^0. The solution is mixed as prescribed in the draft Ontario Hydro Method for manual mercury measurements.

To measure speciated mercury, an impinger of potassium chloride (KCl) solution mixed as prescribed by the draft Ontario Hydro Method is placed upstream of the stannous chloride solution to capture oxidized mercury. Unique to this instrument is the ability to continuously refresh the impinger solutions to assure continuous exposure of the gas to active chemicals.

The Au-CVAAS system is calibrated using elemental mercury vapor. The instrument is calibrated by injecting a metered volume of mercury-laden air into the analyzer. The mercury-laden air is from the air-space of a vial containing liquid mercury at a precisely measured temperature. The concentration of the mercury in the air is determined by the vapor pressure of the mercury at that temperature.

The Au-CVAAS can measure mercury over a wide range of concentrations. Since the detection limit of the analyzer is a function of the quantity of mercury on the gold wire and not concentration in the gas, the sampling time can be adjusted for different situations. Laboratory tests with stable permeation tube mercury sources and standard mercury solutions indicate that the noise level for this analyzer is 0.2 ng mercury. It is reasonable to sample at 50 – 100 times the noise level, therefore, during field testing the sampling time is set so at least 10 ng mercury is collected on the wire before desorption. The following table shows the sampling time required for different concentrations of mercury in the flue gas with 2 liters per minute sample flow.

Sampling Time Required for Au-CVAA Analyzer

VAPOR-PHASE MERCURY CONCENTRATION ($\mu G/M^3$)	MINIMUM SAMPLE TIME (MIN)	NOISE LEVEL ($\mu G/M^3$)
5	1	0.1
2.5	2	0.05
1	5	0.02
0.5	10	0.01

An oxygen analyzer will be placed downstream of the Au-CVAAS to monitor and store the oxygen levels in the gas stream. This is particularly useful when measuring changes in mercury across a pollution control device on a full-scale unit where air inleakage into the unit may dilute the gas sample and bias results. It is also useful to assure that no leaks develop in the sampling system over time.

Particulate is separated from the gas sample using a self-cleaning filter arrangement modified for use with this mercury analyzer under an EPRI mercury control program. This arrangement uses an annular filter arrangement where excess sample flow continuously scours particulate from the filter so as to minimize any mercury removal or conversion due to the presence of particulate.

The mercury analyzer described has been used extensively for lab testing and field testing at three full-scale coal-fired power plants burning Powder River Basin (PRB), eastern bituminous, and lignite coals under EPRI programs. Although draft Ontario Hydro mercury measurements were not conducted while the analyzer was on-site, levels measured by the analyzer were well within the range expected based on previous measurements with either the draft Ontario Hydro Method or a solid carbon trap.

In order to assure the quality of the data to be obtained during the field operations, Standard Operating Procedures have been developed and will be followed for these tests.

ATTACHMENT D

REQUEST FOR PROPOSAL FOR ONTARIO HYDRO TESTING

REQUEST FOR PROPOSAL
MERCURY SAMPLING AT GASTON

Background

To address critical questions related to cost and efficiency of mercury control technologies, the U.S. Department of Energy (DOE) has undertaken an initiative titled "Testing and Evaluation of Promising Mercury Control Technologies for Coal-Based Power Systems" for the purpose of collecting cost and performance data with parametric and long term field experiments at power plants with existing air pollution control devices. Results of this project will be utilized by the U.S. EPA, the DOE, and others to develop mercury control regulations for coal-fired power plants.

ADA Environmental Solutions (ADA-ES), under contract with the U.S. Department of Energy, National Energy Technology Laboratory (NETL), is conducting full-scale high-efficiency mercury removal tests at selected electric utilities. As part of this effort, dry sorbent injection upstream of a COHPAC fabric filter will be evaluated at Alabama Power E.C. Gaston Steam Plant. ADA-ES will team with Alabama Power and Southern Co., the Electric Power Research Institute (EPRI), Hamon Research Cottrell, and others on this project. A critical part of this work will be characterization and measurement of particle-bound and vapor phase mercury upstream and downstream of the COHPAC baghouse on Unit 3 at Gaston.

ADA-ES is seeking a qualified Contractor to conduct the necessary mercury speciation and related stack sampling for this program. The work requested is similar in scope to EPA's 1999 Information Collection Request (ICR) for mercury emissions from coal-fired power plants.

Proposals are solicited based on the following Scope of Work, Performance Requirements, and Additional Requirements. Proposal content and format are at the discretion of the bidder.

SCOPE OF WORK

Characterization and speciation of mercury will be conducted in two separate campaigns. The first (Baseline) source test will be conducted prior to the start of mercury sorbent injection. The Baseline test will then be followed by a 6 – 8 week parametric evaluation of activated carbon and other sorbents for mercury control at various process conditions. At the conclusion of the parametric evaluation, a to-be-determined, Optimized Condition, will be evaluated. A second set of mercury measurements, identical in scope to the baseline, will then be conducted at the optimized condition.

Baseline Condition

Services and testing requested for the Baseline Condition are as follows:
Source measurements of elemental, oxidized, and particle-bound mercury per the Ontario-Hydro Method[1] at the Alabama Power Company's Plant E.C. Gaston, Wilsonville, Alabama. Triplicate runs are to be conducted at two locations:

1. Inlet to COHPAC, Unit No. 3, Side B; and
2. Outlet to COHPAC, Unit No. 3, Side B.

Inlet and outlet sampling runs will be conducted concurrently on Side B ducts. Figures D-1 and D-2 show overall process layout for Unit 3. Figures D-3 and D-4 show the duct layout at the Side B COHPAC inlet and outlet, respectively. For each test, average stack gas velocity and stack gas flow rate, dry stack gas composition, and moisture content shall be determined in addition to mercury speciation.

Total particulate measurement, EPA Method 5. Triplicate runs would be conducted at the inlet to Unit 3 COHPAC. This is requested as a separate proposal line item. These tests would be conducted either prior to or after the Ontario Hydro tests during the Baseline sampling.

Optimized Condition

Services and testing requested for the Optimized Condition are as follows:

1. Source measurements of elemental, oxidized, and particle-bound mercury per the Ontario-Hydro Method[1] at the Alabama Power Company's Plant E.C. Gaston, Wilsonville, Alabama. Triplicate runs are to be conducted at the same locations as for the Baseline tests. Inlet and outlet sampling runs shall be conducted concurrently.

Quality Assurance/Quality Control Plan

Contractor shall prepare and submit a pre-test Quality Assurance/Quality Control (QA/QC) Plan for the activities included in the Scope of Work. This plan will be reviewed and approved by ADA-ES and research partners prior to the start of the test program.

Laboratory Analysis

Laboratory analytical procedures and the labs proposed for the project are to be identified in the proposal. Laboratory QA/QC procedures, including blank analysis and spiking of samples, shall be detailed in the QA/QC Plan.

Contingency

Repeat of sampling runs due to non-representative process conditions may be required, at the discretion of the Test Coordinator. Pricing for additional sampling on a Time-and-Materials basis is requested.

Contractor Responsibility

- Contractor shall provide all equipment and personnel to accomplish the Scope of Work.
- Contractor shall provide any on-site temporary lab facilities necessary to complete the scope of work, independent of plant facilities.
- Contractor shall be responsible for overseeing and coordinating all analytical laboratory work.

Plant Responsibility

- Space for a temporary laboratory trailer will be provided in close proximity to the test locations. Electrical power for the trailer, as required, will be provided.
- 110 VAC electrical power will be available at each test location. Contractor shall verify the reliability, adequacy, and the location of circuit disconnect(s) prior to test startup.
- Test ports will be cleaned, flanges and caps loosened, prior to test startup.

ADA-ES Responsibility

- ADA-ES will provide a Test Coordinator for the duration of the on-site sampling period. The Test Coordinator will be available to assist the Contractor as necessary and to coordinate with plant personnel.

- The Test Coordinator, in consultation with other research partners, will be responsible for determining when to commence sampling runs and to oversee the process.

- ADA-ES will be responsible for collection of process data, coal samples and COHPAC hopper ash samples.

Performance Requirements

- Measurements shall be conducted according to standard EPA Reference Methods 1 – 5 [3] and draft Ontario-Hydro method.

- A separate report shall be issued for each of the two sampling campaigns. Report format shall follow EPA's Emission Measurement Center (EMC) guidelines[2]. Field data sheets and chain of custody forms shall be included in appendices.

- Quality assurance and calibration procedures, including laboratory procedures, shall be as specified in EPA Methods 1 – 5 and draft Ontario-Hydro[1, 3]. All quality assurance activities shall be agreed upon and executed as per the QA/QC Plan.

- Acceptance of isokinetic test results shall be based on standard criteria averaged over the entire test run. Determination shall be made at the conclusion of each test run such that a repeat may be conducted immediately in the event of a non-isokinetic result.

- Sample time for each run shall be at least 2 hours with sample volume of >1.0 dscm per the draft Ontario-Hydro specification[1].

Additional Requirements

Specific terms and conditions will be negotiated upon award of contract. The following items are to be considered in proposal submission.

Insurance

Contractor shall provide certification of insurance for all workers, agents, and subcontractors proposed for this project including Worker's Compensation Insurance, Commercial General Liability Insurance, and Commercial Automobile Liability Insurance.

Safety and Work Practice

Contractor shall ensure that its activities and those of its employees, agents, and subcontractors are in compliance with all applicable OSHA and environmental regulatory requirements and with all applicable plant health and safety procedures.

Data Rights and Data Access

Due to the nature of the contractual arrangements for this government project, all data including deliverable reports, original data sheets, and computer generated spreadsheets, with the exception of restricted computer software, are to be available for inspection by the DOE, EPA, and others as authorized by ADA-ES.

Test Observers

Representatives of the EPA and DOE and others as authorized by ADA-ES may be on site during the test period(s) as observers. Details of the work scope and QA/QC procedures as agreed to in the QA/QC plan will not be affected.

Cost Breakdown

Proposal bid pricing is requested as fixed price for the entire Scope of Work excluding the Baseline Condition particulate tests that are requested as a separate line item. Pricing for additional work beyond the Scope of Work on a Time-and-Materials basis is also requested.

References and Work Experience

Relevant experience of bidder with the specific test methods, including that of laboratory participants, is requested.

Schedule

Proposals are to be submitted to ADA-ES on or before January 15, 2001. Contract award is expected by January 31, 2000. A Draft QA/QC Plan is to be submitted within 30 days of award of contract. Baseline testing is scheduled for March 4 -9, 2001. Testing of the Optimized Condition is scheduled for late April. Please indicate availability and notification requirements for any schedule changes in proposal.

Additional Information

Site visits, if necessary, may be scheduled by contacting ADA-ES, who will arrange such with Alabama Power Company. Questions and requests for additional information, as required to respond to this Request For Proposal, should be addressed to:

ADA-ES
8100 SouthPark Way
Unit B2
Littleton, Colorado 80120

Attn. Ken Baldrey
Technical Services Manager
303-734-1727
303-734-0330
kenb@adaes.com

REFERENCES

1. "Standard Test Method for Elemental, Oxidized, Particle-Bound, and Total Mercury in Flue Gas Generated from Coal-fired Stationary Sources (Ontario Hydro Method), ASTM draft method, available from U.S. EPA OAQPS Emission Measurement Center.

2. "Preparation and Review of Emission Test Reports", U. S. EPA OAQPS Emission Measurement Center Guideline Document GD-043, Nov. 1998.

3. EPA Methods 1 through 5, Code of Federal Regulations, Title 40, Part 60, Appendix A, July 1991. Available from the U.S. Environmental Protection Agency's OAQPS Emission Measurement Center.

Figure D-1
Process Layout

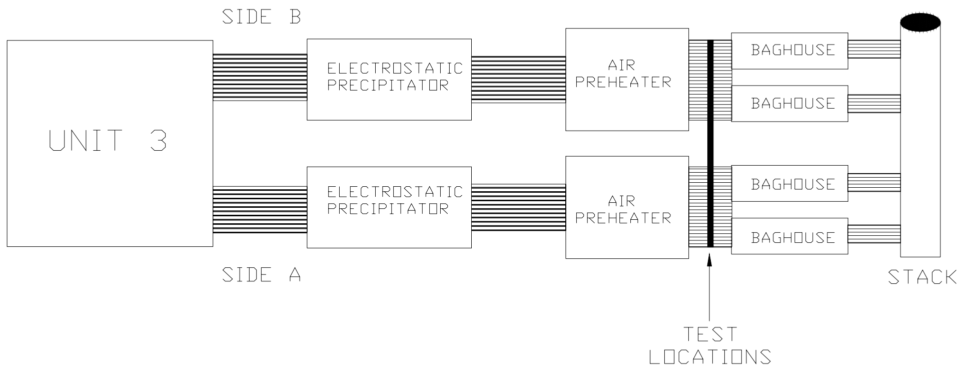


Figure D-2
Overall Duct Arrangement, Unit 1

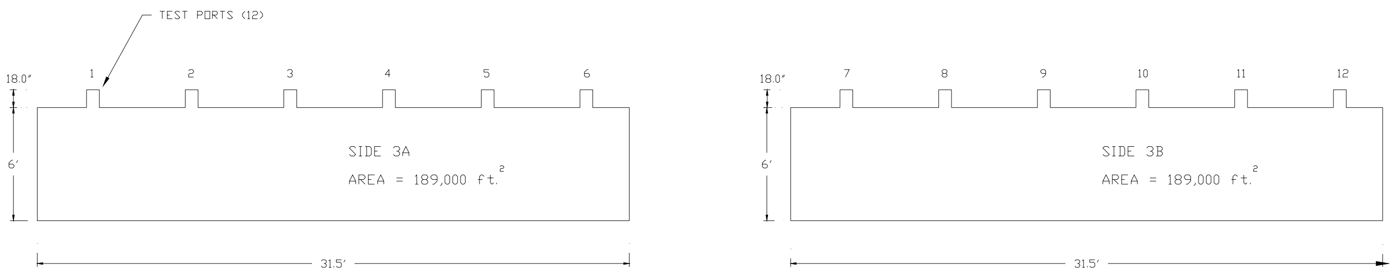


Figure D-3
ESP Inlet Port Arrangement

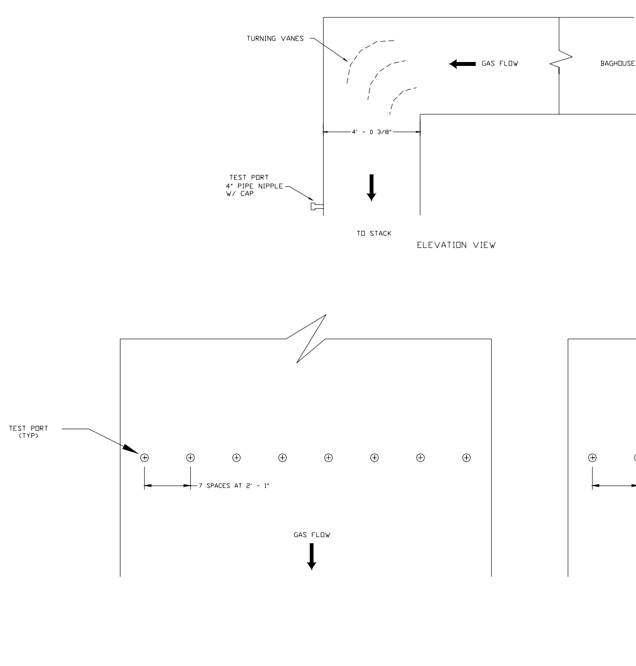


Figure D-4
Outlet Port Arrangement

APPENDIX B

BASELINE MEMO AND DATA

September 20, 2001

ADA Environmental Solutions, LLC

8100 SouthPark Way, B-2
Littleton, Colorado 80120
Fax: 303.734.0330
***303.734.1727** or 1.888.822.8617*

memorandum

To: Dick Johnson, Ed Morris, Ramsay Chang, Sharon Sjostrom, Charles Lindsey

From: Jean Bustard, Sheila Haythornthwaite

CC: Cam Martin, Travis Starns, Ken Baldrey, Mike Durham, Richard Schlager, Scott Renninger, Jim Kilgroe, Jeff Ryan, Morgan Jones, Dale Kanary, Rene Mangal, Tom Burnett, Brian Donnelly, Connie Senior, Carl Richardson

Date: September 20, 2001

RE: Preliminary results from Baseline tests

Note: These data are preliminary and confidential to PPPP team members.

Primary Goals for Week of September 10: Baseline Tests:

1. Measure vapor phase mercury with Apogee's S-CEMs
2. Measure baseline mercury following EPA approved draft test procedures (Draft Ontario Hydro measurements should be made at full load);
3. Determine coal and ash sampling procedures; and
4. Determine data collection procedures.

Completed Tasks:

1. Apogee started up and calibrated the analyzers at the inlet and outlet of 2-4 ESP. Analyzers were in operation from Monday through Wednesday.
2. Ash and coal samples were collected by PPPP personnel and delivered to the ADA-ES trailer. A summary of the collected samples collected is presented in Table 1.
3. Mostardi Platt (MP) completed 3, simultaneous Ontario Hydro tests: one on Monday afternoon and two on Tuesday. Their professionalism and efficiency were impressive.
4. MP completed 3 Method 29 tests (multi-metals) at the 2-4 ESP outlet on Wednesday.
5. MP provided copies of their run sheets for the OH tests so we could look at the flow distribution in the duct. These data were used to choose the location of the portable opacity monitor (RM-41-P).
6. MSI removed the Durag Hg analyzer from port 7 so Mostardi would have access to this port for the manual sampling.

7. Set-up and installed the RM41-P in port 5 at the outlet of the 2-4 ESP. Eric Reber, MSI, and PPPP I&C provided and ran signal wire from the RM41-P to the MSI data logger. The RM41-P is hooked up but the readout on the data logger incorrect.
8. Worked with Todd Campbell, EEC, to learn how to get ESP operating and performance data from the BHA control system. We can plot real-time performance data and save hourly historical data to txt files.
9. Ed Morris set up procedures to obtain operation and performance data from the plant archive system and from the MSI data logger. A complete listing of the parameters logged from these two systems is presented in Table 2. Ed sends spreadsheets daily to Sharon Sjostrom (Apogee), cc: ADA-ES, so she can integrate these data with her S-CEM data.
10. A database was set-up to track and label coal and ash samples.

Results and Comments:

1. Sharon provided Figure 1 showing vapor phase, speciated mercury concentrations at the inlet and outlet of 2-4 ESP during the baseline tests. This figure also shows inlet and outlet flue gas temperature, Unit 2 boiler load and particulate emissions measured from the MSI particulate monitor. *Note: we need to check on the scaling factors for the PM monitor. Data are presented for the periods when the Ontario Hydro tests were conducted.*
2. Total mercury at the inlet varied between 11 and 14 $\mu g/sm^3$. There was nominally 20% oxidized mercury.
3. Total mercury at the outlet varied between 8 and 13 $\mu g/sm^3$. These tests showed significant oxidation of mercury across the ESP; with nominally 50% oxidized mercury at the outlet.
4. There appears to be nominally 10 – 15% mercury removal across the ESP.
5. In previous tests conducted by Apogee and URS the conclusions included: "inlet flue gas mercury at all three sites (upstream of air preheater, inlet to ESP, outlet of ESP) was primarily elemental (>90%) and removal across the ESP was <5%".
6. Apogee will verify speciation measurements when they are on-site next week.
7. Temperature at the inlet varied between 270 and 300°F. There was no change in mercury concentration or removal with respect to changes in temperature.
8. Baseline data on the ESPs were collected. Unfortunately these data were left on-site and will be reported with the first week of parametric tests.

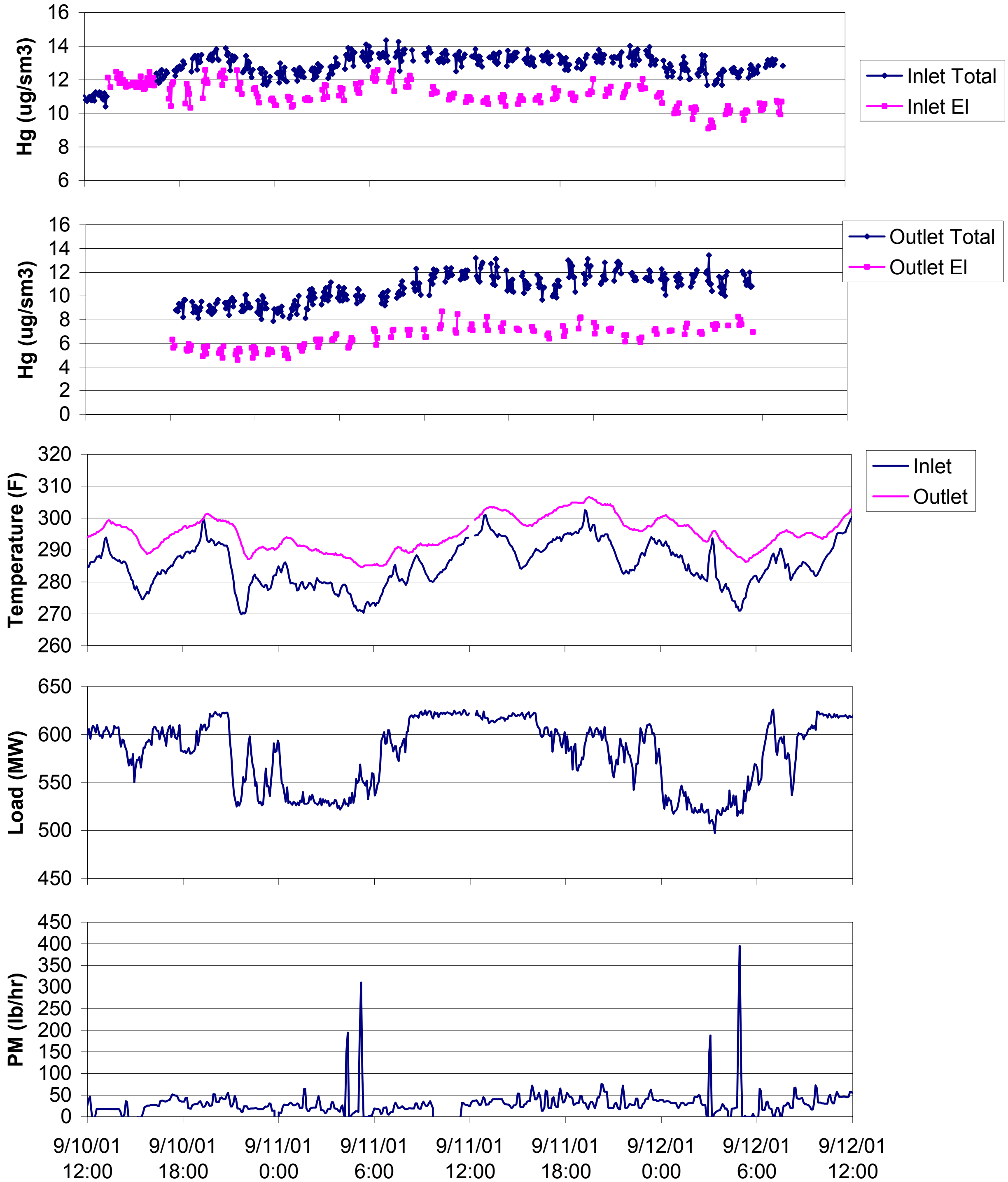
Table 1: Ash and Coal Samples Collected During Baseline Tests

Sample	Location	Quantity Per Sample (Total)	Frequency	Requested By
Coal	Feeders (5)	1 liter per feeder each day (15 l)	M, T, W	Jean Bustard
Coal	Train	5 gal each day (15 gal)	M, T, W	Jeff Withum (Consol)
ESP Ash	Hoppers (8)	1 liter per hopper each day (24 l)	M, T, W	Jean Bustard
ESP Ash	Front Hopper Composite	5 gal each day (15 gal)	M, T, W	Jeff Withum (Consol)
ESP Ash	Front Hopper Composite	5 gal	Tuesday	Ken Ladwig (EPRI)
ESP Ash	Front Hopper Composite	5 gal	Wednesday	Susan Thornloe (EPA)
Bottom Ash	Pile	5 gal (15 gal)	Monday	Jeff Withum (Consol)

Table 2: Data Logged Specifically For Hg Test Program

Plant Archive		MSI Data Logger	
Signal	**Units**	**Signal**	**Units**
Gross Load (2)	MW	Stack Flow	(acfm)
Coal Feed	(Klb/hr)	Unit 2 CO_2	(%)
Coal Btu	(Btu/lb)	Duct Flow 2-4	(acfm)
ESP Inlet Temp	^oF	Opacity 2-4 (Rm41-P)	%
ESP Outlet Temp	^oF	Mercury (Durag)	G/sm^3
Main Steam Flow	Klb/hr	PM	Lbs/MBtu
Main Steam Temp	^oF	Stack Megawatts	MW
Boiler O_2	%	Unit 2 Megawatts	MW
Air Heater O_2 (A)	%	Mercury emissions (Durag)	(lb/hr)
Air Heater O_2 (B)	%		
Air Heater O_2 (C)	%		
Air Heater O_2 (D)	%		
Stack SO_2	ppm		
U2 Duct NO_x	ppm		
2-3/2-4 Duct Opacity	%		
2-1/2-2 Duct Opacity	%		
6-min Avg. Stack Opacity	%		
U2 Duct CO_2	%		
SO_3 Converter Outlet Temp	^oF		
SO_3 Burner Outlet Temp	^oF		
SO_3 Air Htr. Outlet Temp	^oF		

Figure 1: Trend data, baseline tests.



APPENDIX C

PARAMETRIC TEST MEMOS AND DATA

WEEK 1 DATA October 2, 2001

WEEK 2 DATA October 9, 2001

WEEK 3 DATA October 17, 2001

ADA Environmental Solutions, LLC

8100 SouthPark Way, B-2
Littleton, Colorado 80120
Fax: 303.734.0330
***303.734.1727** or 1.888.822.8617*

memorandum

To: Dick Johnson, Ed Morris, Terry Coughlin, Dave Michoud, Ramsay Chang, Sharon Sjostrom, Sheila Haythornthwaite, Cam Martin, Brian Donnelly, Paul Harrington

From: Jean Bustard, Travis Starns

CC: PPPP Team, ADA-ES Team

Date: October 2, 2001

RE: Preliminary results from Week 1 Parametric Tests

Primary Goals for Week of September 24: Parametric Tests Darco FGD PAC:

1. Perform parametric tests using Norit America's powdered activated carbon (PAC) Darco FGD at three different injection rates.
2. Evaluate the effect on mercury removal of decreasing flue gas temperatures to no less than 250°F by spray cooling. Injection rate will be determined based on results from Goal #1.
3. Evaluate the effect on mercury concentrations of turning off SO_3 flue gas conditioning at the same PAC injection rate used in Goal #2.
4. Operate at each parametric condition for 6 – 8 hours.
5. Measure vapor phase, speciated mercury at the inlet and outlet of 2-4 ESP for each parametric test condition.
6. Evaluate impact of carbon injection, spray cooling and turning off SO_3 conditioning on short-term ESP performance.
7. Collect ash and coal samples each day per sampling schedule presented in test plan.
8. Finish installation and checkout of portable opacity monitor.
9. Assemble and install acid dew point analyzer.
10. Empty carbon silo by injecting remaining carbon into duct to be ready to accept new shipment "fine" carbon on Monday morning.

Completed Tasks:

1. Final installation and checkout of the carbon and water injection systems were completed the week of September 17.
2. The EnviroCare skid was operated on Friday September 21 for about 6 hours. Injection rate was slowly increased (temperature lowered) while checking for any sign of deposition using the in-duct camera and deposition probes (sorbent injection lances installed about 40' downstream of the water injection lances). Maximum cooling was set to an average duct temperature of 260°F (average starting duct temperature was 290°F). This system is very responsive, target temperatures are attained within 5 seconds after changing the setpoint.
3. The Norit carbon injection system was operated on Saturday September 22. Bucket calibrations were performed at 5 injection rates (10, 20, 50, 80, and 100% of motor speed). The maximum injection rate was 850 lbs/h on one feeder with FGD carbon. The minimum is

about 40 lbs/h (per feeder). Note: Maximum feedrate is limited by the eductor to nominally 700 lbs/h per feeder.

4. Apogee started up and calibrated the analyzers at the inlet and outlet of 2-4 ESP. Analyzers were in operation Monday September 24 through Friday September 28.
5. Ash and coal samples were collected by PPPP personnel and delivered to the ADA-ES trailer. A summary of the collected samples is presented in Table 1.
6. Completed all scheduled test conditions for the week. The order of testing was shifted because SO_3 conditioning tripped off line on Saturday, September 22, 2001. Testing on Monday was without SO_3 conditioning. Conditioning was restarted on Tuesday morning @ 7:50 a.m. Actual test schedule is presented in Table 2.

Results and Comments:

1. Sharon Sjostrom, Apogee, provided Figures 1, 2 and 3. Figure 1 shows total vapor phase mercury concentrations at the inlet and outlet of 2-4 ESP during Week 1 Parametric tests. This figure also shows Unit 2 boiler load and inlet and outlet flue gas temperature (measured at the Apogee sampling probe).
2. Table 3 is a summary of test conditions, operating conditions and results for Monday through Friday.
3. Figure 2 shows total mercury as measured by the Apogee instruments and the Verewa (Durag) instrument, elemental mercury at the inlet and outlet (from the Apogee instrument), and total mercury corrected to 3% oxygen.
4. Figure 3 presents flue gas data collected on plant data loggers. This figure shows:
   a) opacity from the stack, 2-1&2-2 duct, 2-3&2-4 duct, and from the portable opacity monitor installed in the 2-4 outlet,
   b) SO_2 and NO_x concentration,
   c) estimate 2-4 duct flow,
   d) oxygen levels at the boiler and inlet and outlet of the ESP, and
   e) mass emissions from the PM monitor.
5. **Figure 1 shows immediate reductions in mercury levels when carbon injection is started. There is some incremental improvement in mercury collection with time, but the majority is immediate. Some additional improvement may be expected when carbon is injected continuously during the long term tests, as carbon works it way through to the back fields of the ESP.**
6. **Increasing injection concentration by a factor or 2 and 3 showed marginal improvement (60% at 10 lbs/Mmacf and 64% at 30 lbs/Mmacf).**
7. **Although there appears to be a significant difference in removal efficiencies with and without SO_3 injection (higher removal efficiencies with no SO_3 conditioning) Sharon suspects that the outlet analyzer was not functioning properly during this test. Because of these results, SO_3 on/off will be tested again next week to confirm results.**
8. **Cooling flue gas temperature to 260 and 250^{o}F had no impact on mercury removal.**
9. **Removal efficiencies were significantly higher than predicted for the lower injection rates and somewhat higher for the high injection rates. Table 4 is the original test plan for week 1, showing predicted removal efficiencies.**
10. **Acid dew point temperature was measured with and without spray cooling (SO_3 on). Measurements showed dew point temperatures between 130 and 140^{o}F. These are typical temperatures for units firing PRB coals.**
11. Spray cooling was in service for about 4 ½ hours, starting at 1000. At a target temperature of 260^{o}F the North duct temperatures were reduced by nominally 40^{o}F and the South by

10^{o}F. Note: the Apogee mercury analyzers are on the South duct. To confirm no impact of cooler temperatures on mercury removal, the target temperature was lowered to 250^{o}F at 1300. Again no effect on mercury removal was measured; however, there was some build up on one of the sorbent injection lances on the North side after 1 hour of injection at this higher rate (50^{o}F reduction in temperature and injection rate of 14 gpm – North Side). The target temperature was immediately increased to 260^{o}F. After review of the data showing absolutely no impact on mercury removal, the spray cooling system was turned off at 1420. The lances were inspected again Friday morning and the small deposit that had formed was scoured clean.

12. The Durag (Verewa) instrument stopped matching the Apogee instruments after the first day of carbon injection. Eric Reber of MSI is aware of this and is working with Durag to correct these problems.
13. **Todd Campbell with EEC observed ESP performance during the injection tests and saw no significant difference in performance for any of the test conditions. In some cases it appeared that ESP performance improved with carbon injection. This phenomenon (better performance with higher carbon) has been documented at other plants. However, it is important to remember that some carbon is good, but too much carbon can deteriorate performance. The long term tests should provide better insight into the effect of carbon injection on the ESP. Daily reports from Todd will be included in future reports.**
14. **There was no measurable increase in either opacity or mass emissions with carbon injection.**
15. No equipment operational problems were noted. Both suppliers, Norit Americas and EnviroCare, have provided well designed, dependable equipment.

Table 1: Ash and Coal Samples Collected During Week 1 Parametric Tests

Sample	Location	Quantity Per Sample (Total)	Frequency
Coal	Feeders (1)	1 liter per day	M,T,W,Th,F
ESP Ash	Hoppers (2)	1 liter per hopper per day	M,T,W,Th,F
PAC (FGD)	Sorbent Silo	2 liters per truckload	M

Table 2: Test Schedule For Week 1 Parametric Tests

Date	Injection Concentration (lbs/mmacf)	SO_3 Conditioning	Spray Cooling
9-24-01	10.3	off	off
9-25-01	10.5	on	off
9-26-01	22.1	on	off
9-27-01	21.4	on	on
9-28-01	30	on	off

Table 3: Summary of Parametric Tests Week 1

Pleasant Prairie Power Plant Mercury Control Test Program: ESP 2-4

Date		**9/24/2001**	**9/25/2001**	**9/26/2001**	**9/27/2001**	**9/28/2001**
Test ID		P-1	P-2	P-3	P-4	P-5
Start/End Time		0830/1505	0900/1700	0815/1615	0900/1600	0920/1527
Load (min)	MWg	606	592	606	612	616
Load (max)	MWg	622	627	623	628	629
SO3 Injection	on/off	off	on	on	on	on
Sorbent Type		Norit FGD	Norit FGD	Norit FGD	Norit FGD	Norit FGD
Sorbent Size, other	notes	18 micron typical	18 micron typical	18 micron typical	18 micron typical	18 micron typical
Injection Concentration (target)	lb/Mmacf	10	10	20	20	30
Injection Concentration (actual)	lb/Mmacf	10.3	10.5	22.3	21.6	31.9
Total carbon fed	lb					
Humidification	on/off	off	off	off	on	off
Target Temperature	F	N/A	N/A	N/A	260	N/A
Duct camera	on/off	off	off	off	on	off
Acid Dew Point	F, range	off	off	135-140 F		off
Ash Samples	quantity	1	2	2	2	2
Ash samples: complete?	notes	no back row	complete	back row small	complete	complete
Coal Samples	quantity	1	1	1	1	1
Coal samples: complete?	notes	complete	complete	complete	complete	complete
Inlet Hg						
Total Vapor (final)	µg/dNm3	9.79	10.44	10.30	10.2	10.9
Elemental Vapor (final)	µg/dNm3	9.12	9.84	9.45	9.1	9.1
Outlet Hg						
Total Vapor (final)	µg/dNm3	3.23	4.14	4.25	3.9	3.91
Elemental Vapor (final)	µg/dNm3	2.23	3.08	3.02	2.9	3.39
Hg removal	%	67	60	59	62	64
Opacity (RM41-P)	%	6.5	6.1	5.6	6.0	4.9
Durag(before inj)	µg/dsm3	NA	8.6	7.4	6.4	5.5
Durag(during inj)	µg/dsm3	8.3	6.4	5.6	5.5	5.4
PM (Beta monitor)	lb/hr	16.9	38	36	43	28
SO2 (CEMS)	ppm	269	287	289	271	290
NOx (CEMS)	ppm	287	290	274	270	272
Duct Flow	acfm	601385	588879	555556	574757	576081
ESP Inlet Temperature (Plant, avg)	F	288	288	284	286	281
ESP Outlet Temperature (Plant, avg)	F	290	290	289	289	287
Other samples (M29, O-H)	list	none	none	none	none	none
Injection system interruptions			tripped off 30 min.	tripped twice briefly		
Unit operation problems						

Table 4: Original, Week 1 Parametric Test Plan and Predicted Removal

Test ID (Day)	Carbon	Target Injection Rate		Predicted Removal[a]	Condition/Comments
		lbs/Macf	lbs/hr[b]	%	
P-1: Low Rate (Mon)	FGD	10	360	22	Standard operating conditions
P-2: Medium Rate (Tues)	FGD	20	720	40	Standard operating conditions
P-3: High Rate (Wed)	FGD	30	1080	55	Standard operating conditions
P-4: Reduce Temp (Thurs)	FGD	TBD (no more than 20)	< 720	TBD	Water injection on, target temperature 250^{o}F
P-5: No SO_3 (Fri)	FGD	TBD (no more than 20)	< 720	TBD	SO_3 off 1 hour before start of PAC injection

a. Prediction from Meserole model with 1 sec residence time
b. Based on average flow of 600,000 acfm

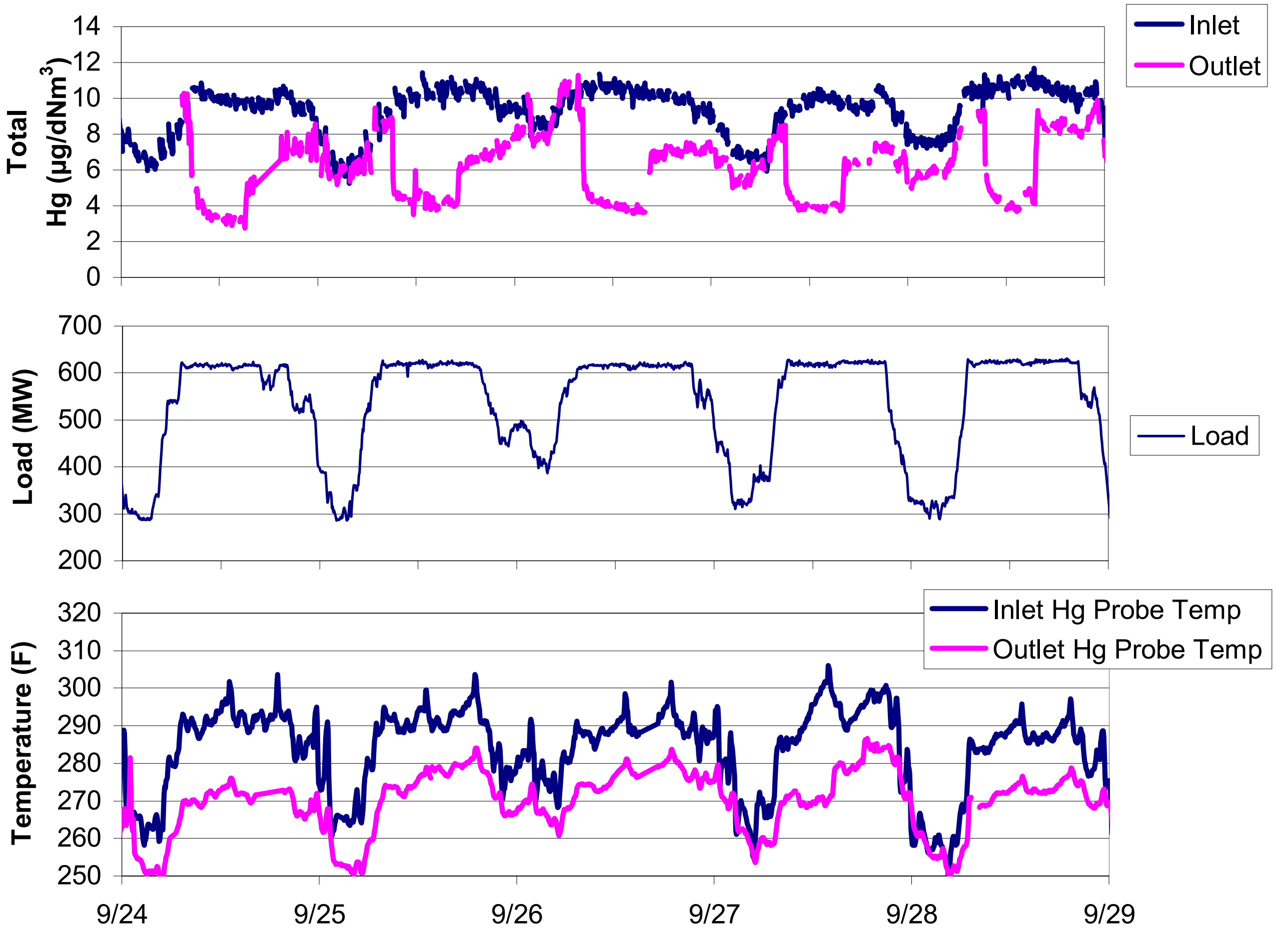


Figure 1. Parametric Tests Week 1 Trends

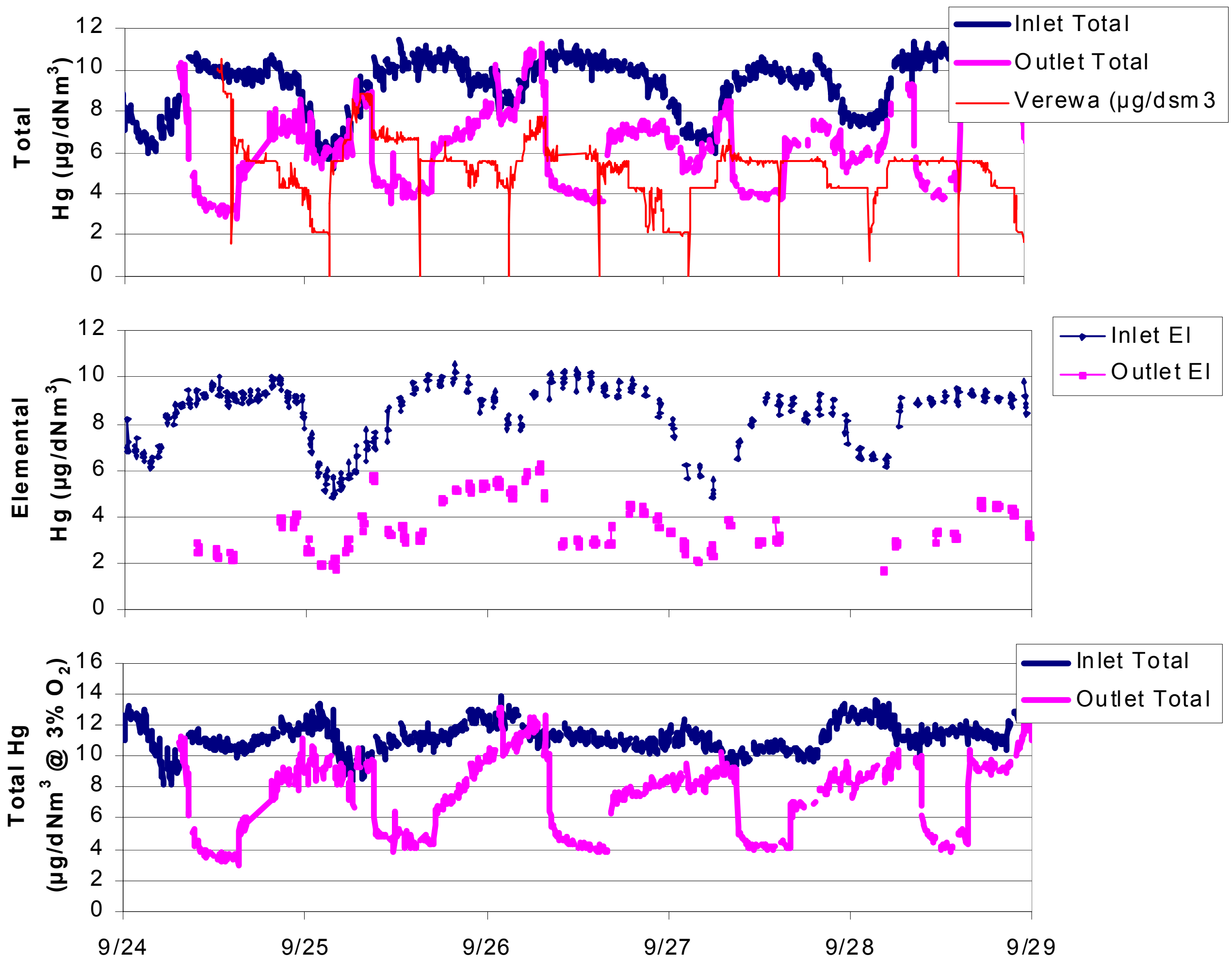


Figure 2: Total and speciated mercury trends for week 1 parametric tests.

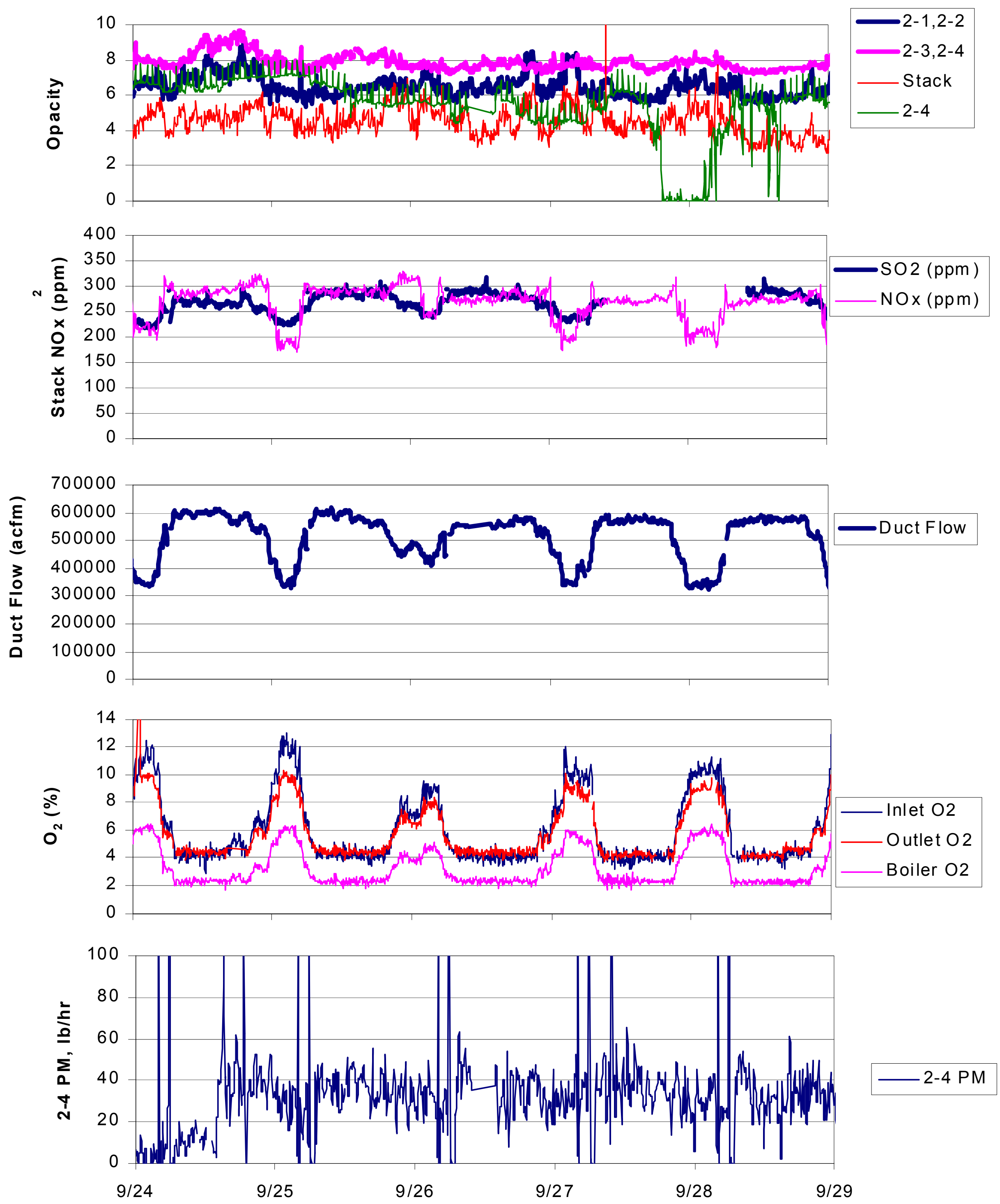


Figure 3: Operating Condition Trends for Week 1 Parametric Tests

ADA Environmental Solutions, LLC

8100 SouthPark Way, B-2
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memorandum

To: Dick Johnson, Ed Morris, Terry Coughlin, Dave Michaud, Ramsay Chang, Sharon Sjostrom,

From: Jean Bustard, Travis Starns

CC: PPPP Team

Date: October 9, 2001

RE: Preliminary Results from Week 2 Parametric Tests

These data are confidential to PPPP Team Members. Please limit distribution.

Primary Goals for Week of October 3: Parametric Tests "Fine" FGD PAC:

1. Compare performance difference between Norit Americas' standard FGD and ground FGD at 10 lbs/Mmacf. Note: Norit's final size distribution on the "ground" carbon was a D50 of 14 microns instead of the target of 12 microns. Standard FGD has D50 of 18 microns. (D50 = 50% of particles less than this number.)
2. Rerun SO_3 on/off test to confirm effect.
3. Evaluate effect of lower injection concentration, 5 lbs/Mmacf, on mercury removal.
4. Operate at each parametric condition for 6 – 8 hours.
5. Measure vapor phase, speciated mercury at the inlet and outlet of 2-4 ESP for each parametric test condition.
6. Collect ash and coal samples each day per sampling schedule presented in Table 3. All samples should be taken to the ADA-ES trailer.
7. Empty carbon silo by injecting remaining carbon into duct to be ready to accept new shipment FGL carbon on Monday morning

Extra Tests Added After Review of Results and High Feedrate to Empty Silo:

8. Evaluate performance of ground FGD at 2.5 lbs/Mmacf.
9. Evaluate performance of ground FGD at 1.0 lbs/Mmacf.
10. Run feeders near maximum to empty out hoppers. A large quantity of unused carbon was leftover because target federates were lowered. Carbon was injected at high rates Thursday night, Friday night and Saturday until 1,500 lbs was left in the silo for testing on Monday. The Apogee S-CEMs were in operation during these periods.

Completed Tasks:

1. Carbon from week 1 tests was feed at a rate of 1,100 lbs/h on Saturday and part of Sunday.
2. A delivery of ground FGD was loaded into the silo Monday morning.
3. Apogee's analyzers were in operation over the weekend and throughout the week.
4. Ash and coal samples were collected by PPPP personnel and delivered to the ADA-ES trailer. A summary of the collected samples is presented in Table 1.
5. Completed tests scheduled for Monday through Wednesday. Based on results, additional low injection concentration tests were conducted on Thursday and Friday. Actual test conditions for week 2 parametric tests are presented in Table 2.
6. Conducted evaluation at 2.4 lbs/Mmacf on Thursday. Test duration about 5 hours.
7. Fed carbon into duct at high rate for several hours Thursday afternoon.
8. Based on Thursday's results, feedrate lowered to 1 lb/Mmacf (40 lbs/h) for test on Friday.
9. To obtain the 40 lb/h feedrate, the Norit system was operated with one feeder instead of two. The splitters that distribute carbon to the injection lances only have 6 connections per splitter. For the 40 lb/h test, only one splitter was used. Hoses were cut so that the one splitter could feed 3 lances on the north side and 3 lances on the south side, 6 lances total. All previous tests were run with 5 lances on each duct, 10 lances total.

Results and Comments:

1. Sharon Sjostrom, Apogee, provided Figures 1 - 4. Figure 1 shows total vapor phase mercury concentrations at the inlet and outlet of 2-4 ESP and injection concentration during Week 2 Parametric tests. This figure also shows Unit 2 boiler load and inlet and outlet flue gas temperature (measured at the Apogee sampling probe). Note: mercury concentrations are not corrected for O_2.

2. Table 3 is a summary of test conditions, operating conditions and results for Monday through Friday.
3. Figure 2 shows total mercury as measured by the Apogee instruments and the Verewa (Durag) instrument, elemental mercury at the inlet and outlet (from the Apogee instrument), and percent oxidized mercury at the inlet and outlet.
4. Figure 3 shows measured mercury removal as a function of carbon injection concentrations for tests conducted with the ground FGD.
5. Figure 4 presents flue gas data collected on plant data loggers. This figure shows:
   a) opacity from the stack, 2-1&2-2 duct, 2-3&2-4 duct, and from the portable opacity monitor installed in the 2-4 outlet,
   b) SO_2 and NO_x concentration,
   c) estimate 2-4 duct flow,
   d) oxygen levels at the boiler and inlet and outlet of the ESP, and
   e) mass emissions from the PM monitor.
6. **Table 3 shows that the mercury removal with ground FGD and SO_3 conditioning (Test P-6) was 60%. This is identical to results from the standard FGD tests in week 1. There was no measurable difference between the ground and standard FGD.**
7. **Retest of the SO_3 on/off conditions showed minimal difference (60% versus 63%) when compared to results from the previous week. Previous weeks results showing a significant difference were probably due to problems with the outlet analyzer.**
8. **Reducing injection concentration from 10 to 1 lb/Mmacf reduced mercury removal from 60 to 46%.**
9. **Figure 1 shows that outlet mercury levels did not come back to baseline after injecting carbon at a high rate on Thursday afternoon. Even so, when carbon was injected at 1 lb/Mmacf outlet mercury immediately decreased. Because outlet mercury levels did not recover fully before starting the tests on Friday, this condition will be repeated on Monday.**
10. **Mercury removal at the lower rates is much higher than predicted.**
11. **Figure 2 shows outlet elemental mercury stays fairly constant with and without carbon injection. There is a much greater percentage of oxidized mercury at the outlet than expected based on earlier tests, nominally 50 – 60%.**
12. **During high injection periods on Friday and Saturday (nominal injection concentration = 35 lbs/Mmacf) removal efficiencies increased to over time 70%.**
13. **Figure 3 shows that there is marginal improvement as carbon injection is increased and that SO_3 conditioning did not have any effect on mercury removal.**
14. **The ESP appears to show improved performance with carbon injection.**

Table 1: Ash and Coal Samples Requested for During Week 2 Parametric Tests

Sample	Location	Quantity Per Sample (Total)	Frequency
Coal	Feeders (1)	1 liter per day	M,T,W,Th,F
ESP Ash	Hoppers (2)	1 liter per hopper per day	M,T,W,Th,F
Ground FGD	Sorbent Silo	1 liter	M

Table 2: Test Conditions For Week 2 Parametric Tests

Date	Injection Concentration (lbs/mmacf)	SO_3 Conditioning	Spray Cooling
10-1-01	10.4	on	off
10-2-01	9.9	off	off
10-3-01	5.0	on	off
10-4-01	2.2	on	off
10-5-01	1.1	on	off

Table 3: Summary of Parametric Tests Week 1

Pleasant Prairie Power Plant Mercury Control Test Program: ESP 2-4

Date		10/1/2001	10/2/2001	10/3/2001	10/4/2001	10/5/2001
Test ID		P-6	P-7	P-8	P-9	P-10
Start/End Time		0930/1650	0802/1605	1200/1800	0800/1320	0900/1230
Load (min)	MWg	595	548	611	618	626
Load (max)	MWg	625	629	626	631	634
SO3 Injection	on/off	on	off	on	on	on
Sorbent Type		Norit FGD-ground	Norit FGD-ground	Norit FGD-ground	Norit FGD-ground	Norit FGD-ground
Sorbent Size, other	notes	14 micron typical	14 micron typical	14 micron typical	14 micron typical	14 micron typical
Injection Concentration (target)	lb/Mmacf	10	10	5	2.5	1.5
Injection Concentration (actual)	lb/Mmacf	10.4	9.9	5.0	2.2	1.1
Total carbon fed	lb	2621	2800	1061	423	177
Humidification	on/off	off	off	off	on	off
Target Temperature	F	N/A	N/A	N/A	N/A	N/A
Duct camera	on/off	off	off	off	off	off
Acid Dew Point	F, range	off	off	off	off	off
Ash Samples	quantity	0	1	1	1	2
Ash samples: complete?	notes	no samples	front hoppers only	front hoppers only	front hoppers only	complete
Coal Samples	quantity	1	1	1	1	1
Coal samples: complete?	notes	complete	complete	complete	complete	complete
Inlet Hg						
Total Vapor (final)	µg/dNm3	11.8	11.1	11.5	11.4	12.4
Elemental Vapor (final)	µg/dNm3	11.7	10.4	#DIV/0!	10.3	10.9
Outlet Hg						
Total Vapor (final)	µg/dNm3	4.7	4.0	4.9	5.5	6.61
Elemental Vapor (final)	µg/dNm3	3.2	2.9	3.5	3.3	4.05
Hg removal	%	60	63	57	51	47
Opacity (RM41-P)	%	5.7	5.7	6.4	6.3	6.1
Durag(before inj)	µg/dsm3	4.3	4.3	3.1	4.3	3.0
Durag(during inj)	µg/dsm3	4.4	3.9	2.4	4.0	2.3
PM (Beta monitor)	lb/hr	40.8	39.4	54.9	43.2	2.3
SO2 (CEMS)	ppm	297	268	276	276	287
NOx (CEMS)	ppm	298	298	282	296	307
Duct Flow	acfm	573583	585137	594569	586615	563232
ESP Inlet Temperature (Plant, avg)	F	293	294	298	292	294
ESP Outlet Temperature (Plant, avg)	F	297	296	303	295	295
Other samples (M29, O-H)	list	none	none	none	none	none
Injection system interruptions						
Unit operation problems						
Other test notes					1400/1888 inject @ 1100 lbs/h to empty hopper	1315/2300 inject @ 1150 lbs/h to empty hopper

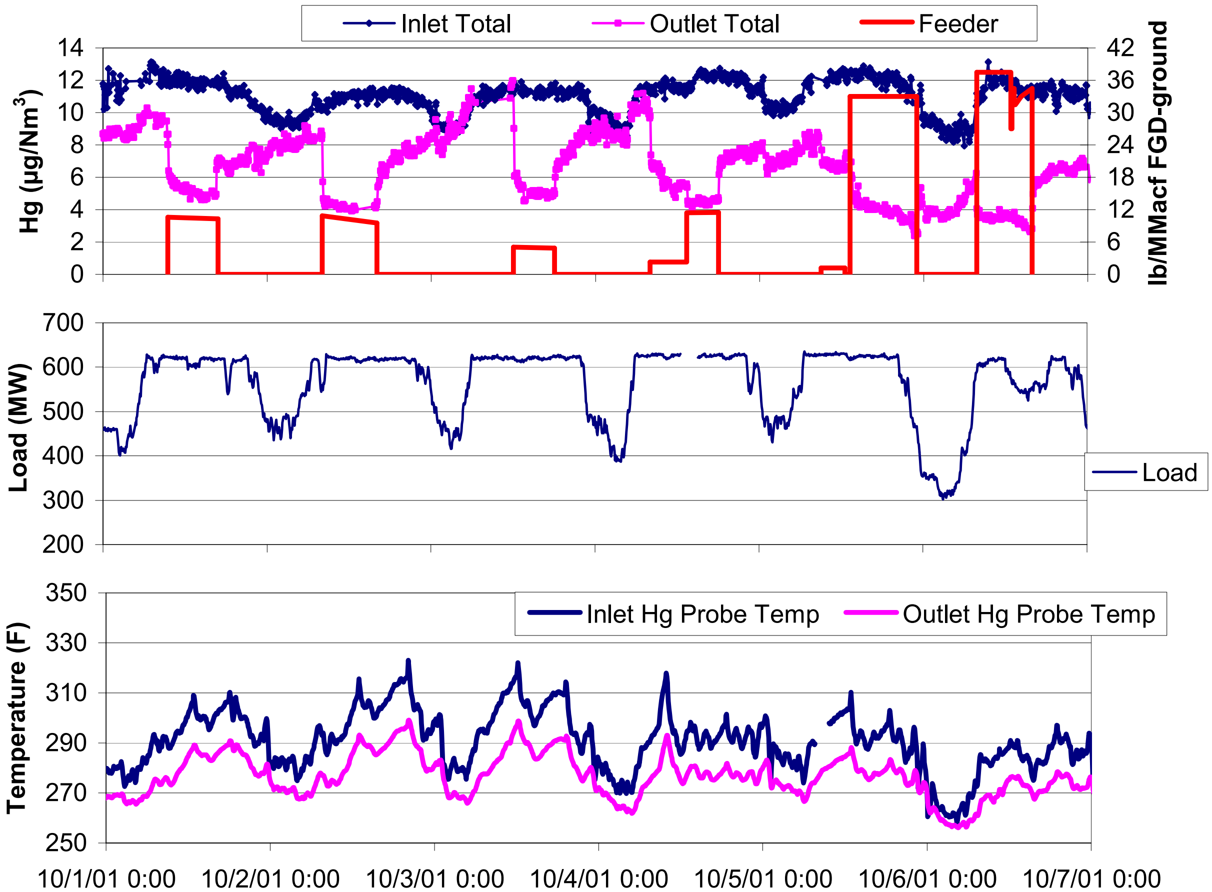

Figure 1. Parametric Tests Week 2 Trends

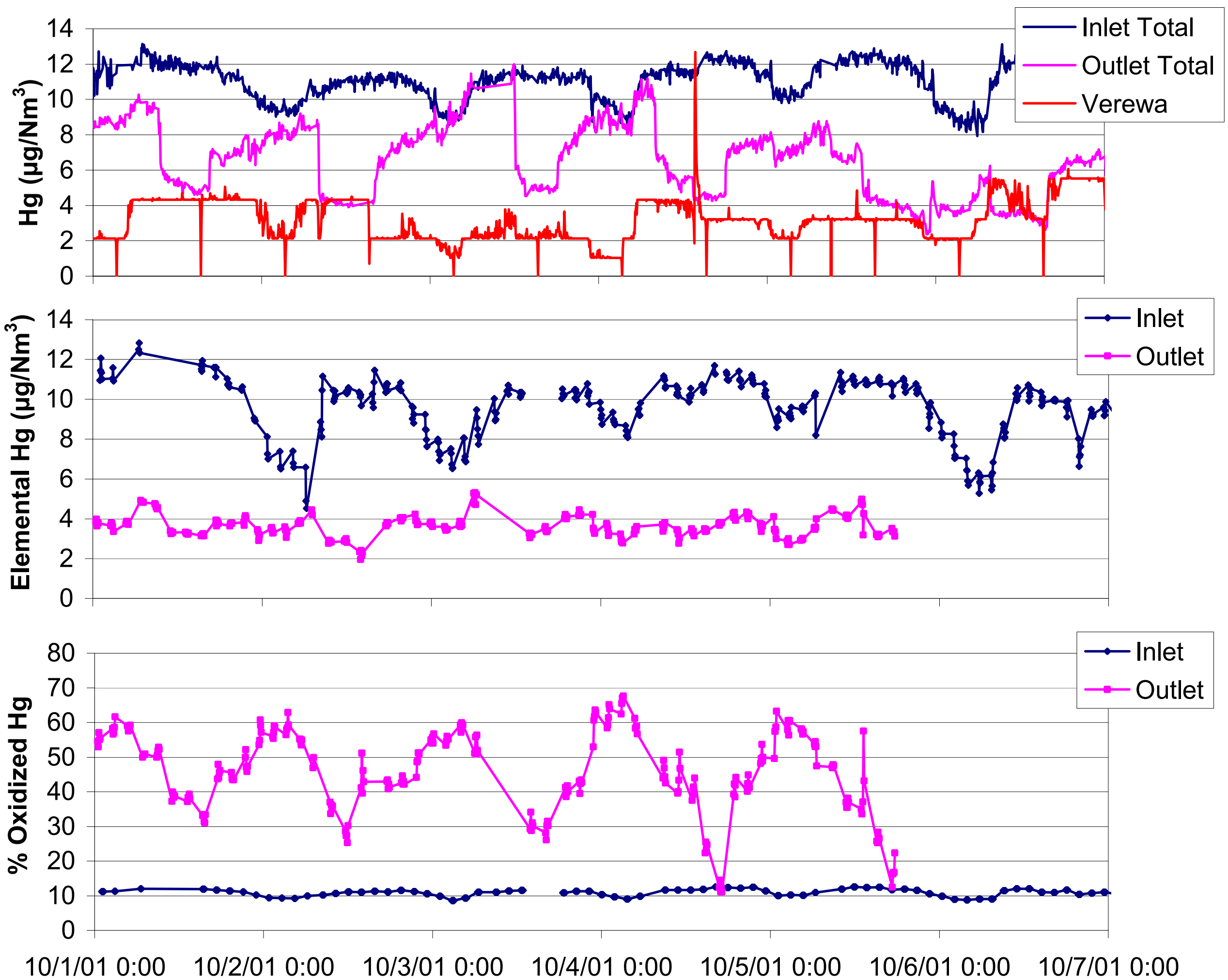

Figure 2: Total and speciated mercury trends for week 2 parametric tests.

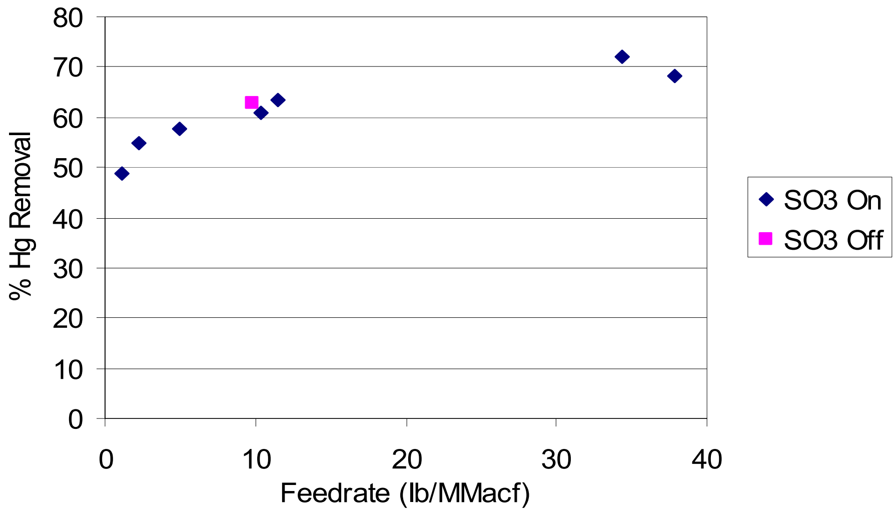

Figure 3: Mercury removal versus carbon injection concentration for week 2 testing with "ground FGD" carbon.

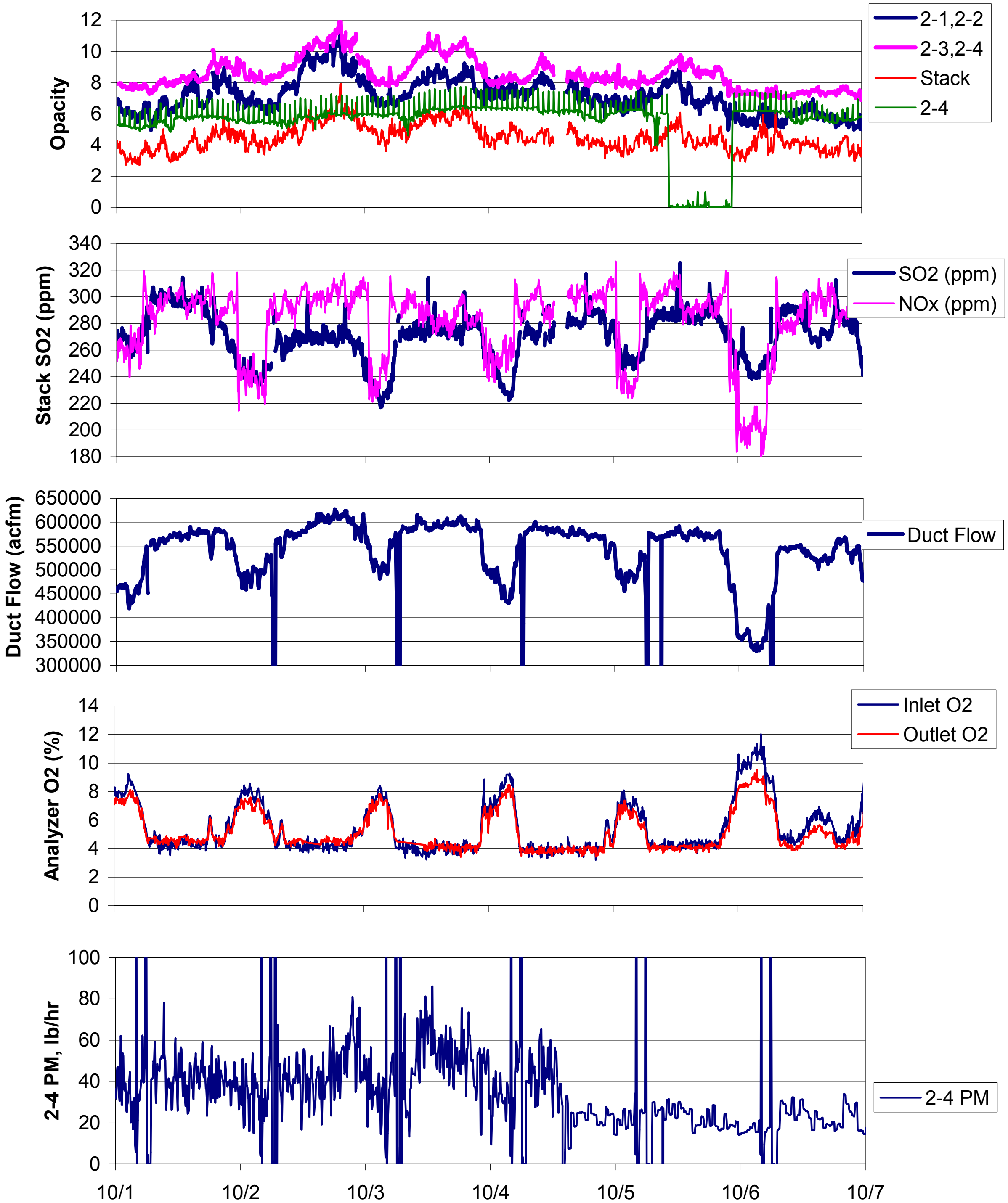

Figure 4: Operating Condition Trends for Week 2 Parametric Tests

ADA Environmental Solutions, LLC

8100 SouthPark Way, B-2
Littleton, Colorado 80120
Fax: 303.734.0330
***303.734.1727** or 1.888.822.8617*

memorandum

To: Dick Johnson, Ed Morris, Terry Coughlin, Ramsay Chang, Sharon Sjostrom, P.J. Harrington, Mike Durham

From: Travis Starns; Jean Bustard

CC: PPPP Team Members

Date: October 17, 2001

RE: Preliminary Results from Week 3 Parametric Tests

Note: These data are confidential to PPPP Team Members. Please limit distribution.

Primary Goals for Week of October 8: Parametric Tests FGL & Insul PAC:

1. Rerun test of ground FGD at injection concentration of 1 lb/Mmacf.
2. Load FGL carbon into silo on Monday afternoon.
3. Compare mercury removal performance of lower capacity FGD, FGL, to standard FGD at 10 lbs/Mmacf.
4. Evaluate performace of FGL at TBD injection concentration.
5. On Wednesday start PAC injection at a high injection concentration (30 lbs/Mmacf) and after an hour of operation, decrease injection concentration to 5 lbs/Mmacf. Evaluate mercury removal performance based on these two parameters.
6. Empty silo for delivery of Insul Wednesday afternoon.
7. Evaluate the performance of Insul carbon to determine if finer, higher surface area achieves better mercury control in an ESP.
8. Calibrate both feed hoppers after Insul is loaded into Silo. Re-calibration is necessary due to the significant difference in bulk density and particle size of Insul.
9. Operate at each parametric condition for a minimum of 3-4 hours, 6-8 preferred.
10. Measure vapor phase, speciated mercury at the inlet and outlet of 2-4 ESP for each parametric test condition.
11. Collect ash and coal samples each day per sampling schedule presented in Table 1. All samples should be taken to the ADA-ES trailer.
12. Collect PAC samples from silo with each delivery.

Completed Tasks:

1. Rerun ground FGD test at a rate of 40 lbs/hr (1 lb/Mmacf) on Monday. Test duration about 6 hours.
2. To obtain the 40 lb/h feedrate, the Norit system was operated with one feeder instead of two. The splitters that distribute carbon to the injection lances only have 6 connections per splitter. During Monday's test, only one splitter was used.

3. A delivery of PAC (FGL) was loaded into the silo Monday at noon.
4. Reconfigured all 10 carbon injection lances back into normal operation with 2 splitters.
5. Fed out ground FGD carbon into duct at high rate on Monday afternoon. Total duration about 1.3 hours.
6. Apogee's analyzers were in operation over the weekend and throughout the week.
7. Daily ash and coal samples were collected by PPPP personnel and delivered to the ADA-ES trailer. Actual collected samples are documented in Table 1.
8. Started FGL carbon injection at 30 lbs/Mmacf (1100 lbs/hr) for 1 hour. Reduced injection concentration to 5 lbs/Mmacf (186 lbs/hr) and operated at this condition for 3.5 hours. Evaluated mercury removal performance based on step down change in injection concentration.
9. Fed out remaining FGL carbon at 400 lbs/hr for 40 minutes.
10. A delivery of PAC (Insul) was loaded into the silo on Wednesday at noon.
11. Calibrated both feeders since Insul has lower bulk density. Maximum feedrate with Insul was 410 lbs/hr/feeder.
12. Started Insul carbon injection at 50 lbs/hr. Test duration about 1 hour.
13. Performed parametric evaluation of Insul on Thursday. Started carbon injection at 1.08 lbs/Mmacf (40 lbs/hr) and continued to feed at this rate for 3 hours. Increased total feedrate to 80 lbs/hr for 1 hour. Increased total feedrate to 184 lbs/hr (5 lbs/Mmacf). Operated at this condition for 1 hour. Continued to increase injection concentration to 10 lbs/Macf (376 lbs/hr). Operated at this condition for 2 hours. At 4:00 p.m. increased total feedrate to 800 lbs/hr. Injection system started to experience feed problems approximately 2 hours after feedrate was set to 800 lbs/hr. Stopped test. Test duration about 9.25 hours.
14. On Friday decision was made to use FGD for long term testing. The remaining 8200 lbs of insul was emptied out of the silo. Analyzers were shut down.
15. No further activity until long-term testing.

Results and Comments:

1. Sharon Sjostrom, Apogee, provided Figures 1, 2 3, and 4. Figure 1 shows total vapor phase mercury concentrations at the inlet and outlet of 2-4 ESP and injection concentration during Week 3 Parametric tests. This figure also shows Unit 2 boiler load and inlet and outlet flue gas temperature (measured at the Apogee sampling probe).
2. Figure 2 shows total mercury as measured by the Apogee instruments and the Verewa (Durag) instrument, elemental mercury at the inlet and outlet (from the Apogee instrument), and percent oxidized mercury at the inlet and outlet and total mercury corrected to 3% O_2.
3. Figure 3 presents flue gas data collected on plant data loggers. This figure shows:
   a) opacity from the stack, 2-1&2-2 duct, 2-3&2-4 duct, and from the portable opacity monitor installed in the 2-4 outlet,
   b) SO_2 and NO_x concentration,
   c) estimate 2-4 duct flow,
   d) oxygen levels at the boiler and inlet and outlet of the ESP, and
   e) mass emissions from the PM monitor.
4. Figure 4 represents mercury removal versus carbon injection concentration for all parametric tests.
5. Figure 5 represents total 2-4 ESP power and average power for each side (north and south).
6. **FGL showed a decrease in mercury removal at the same injection concentration as FGD. Table 3 and Figure 4 show FGL has slightly lower mercury removal efficiencies at the lower injection rates (<10 lbs/Mmacf).**
7. **Theory predicts with a smaller particle size, we would see increased mercury removal. Insul has a particle size of 7μm compared to FGL or FGD, which has a particle size of 18μm. Because of the smaller particle size, the number of particles injected per lb of carbon,**

increased by a factor of 4. Test data indicated that the fine, higher surface area Insul carbon was not any better than the standard FGD carbon in mercury removal.

8. **During testing of Insul, various injection rates were tested and mercury removal levels were about the same as the other different PAC's. With these results, the decision has been made to test FGD during the long term test. This particular test will start October 31, 2001. Testing is scheduled to end the week of November 12th.**
9. **Figure 5 shows an increasing trend in ESP power at the start of carbon injection on Sept. 22, 2001. There doesn't seem to be any detrimental affects to the ESP due to carbon injection.**

Table 1: Requested Ash and Coal Samples For Week 3 Parametric Tests

Sample	Location	Quantity Per Sample (Total)	Frequency
Coal	Mill 2 or 3	1 liter per day	M,T,W,Th,F
ESP Ash	Hoppers (2)	1 liter per hopper per day	M,T,W,Th,F
ESP Ash	Front Hopper	5 gal	M
PAC (FGD)	Sorbent Silo	2 liter	M
PAC (Insul)	Sorbent Silo	2 liter	W

Table 2: Summary of Parametric Tests Week 2

Pleasant Prairie Power Plant Mercury Control Test Program: ESP 2-4

Date		10/8/2001	10/9/2001	10/10/2001	10/11/2001
Test ID		P-11	P-12	P-13	P-14
Start/End Time		0945/1515	0830/1545	758/1300	0840/1730
Load (min)	MWg	618	605	615	615
Load (max)	MWg	627	617	624	629
SO3 Injection	on/off	on	on	on	on
Sorbent Type		Norit FGD(g)	Norit FGL	Norit FGL	Norit Insul
Sorbent Size, other	notes				
Injection Concentration (target)	lb/Mmacf	1	10	5 to 30 *	0.5 to 5
Injection Concentration (actual)	lb/Mmacf	1.2	10.3	5.4 to 29.6	0.6 to 5.4
Total carbon fed	lb				
Humidification	on/off	off	off	off	on
Target Temperature	F	N/A	N/A	N/A	N/A
Duct camera	on/off	off	off	off	off
Acid Dew Point	F, range	off	off	off	off
Ash Samples	quantity				
Ash samples: complete?	notes				
Coal Samples	quantity				
Coal samples: complete?	notes				
Inlet Hg					
Total Vapor (final)	µg/dNm3	10.5	9.2	10.1	10.9
Elemental Vapor (final)	µg/dNm3	9.2	7.7	8.9	9.6
Outlet Hg					
Total Vapor (final)	µg/dNm3	6.7	4.2	5.2 to 3.7	9.8 to 6
Elemental Vapor (final)	µg/dNm3	6.2	3.7	NA for all rates	NA for all rates
Hg removal	%	36	54	49	10 to 45
Opacity (RM41-P)	%	6.3	4.9	5.0	5.9
Durag(before inj)	µg/dsm3	6.3	6.3	5.6	5.5
Durag(during inj)	µg/dsm3	6.5	4.0	5.5	3.2
PM (Beta monitor)	lb/hr	25.7	27.1	35.1	31.6
SO2 (CEMS)	ppm	292	264	288	296
NOx (CEMS)	ppm	278	288	273	288
Duct Flow	acfm	559172	561554	572379	578912
ESP Inlet Temperature (Plant, avg)	F	278	284	280	288
ESP Outlet Temperature (Plant, avg)	F	285	291	287	292
Other samples (M29, O-H)	list	none	none	none	none
Injection system interruptions					
Unit operation problems					
Other test notes				* Injection rate equals 5 lbs/Mmacf	

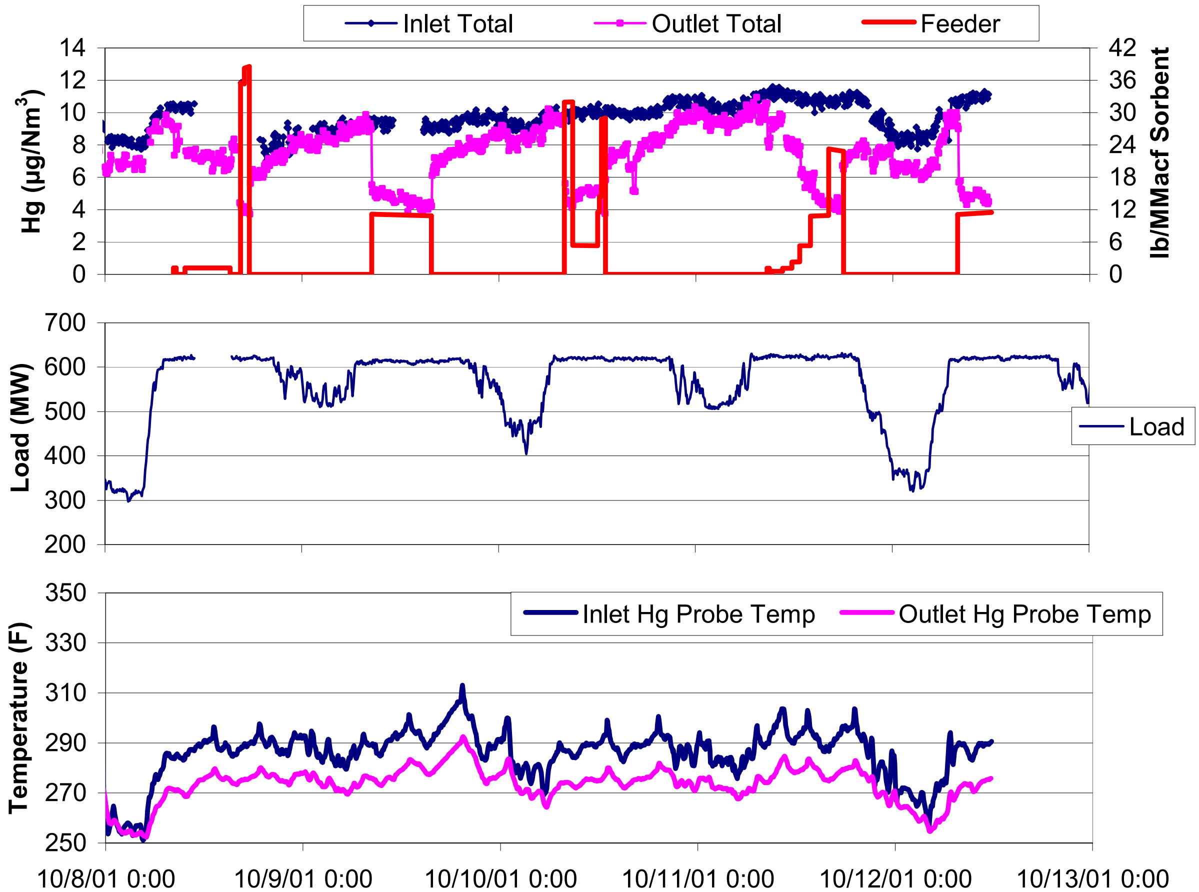

Figure 1. Parametric Tests Week 3 Trends

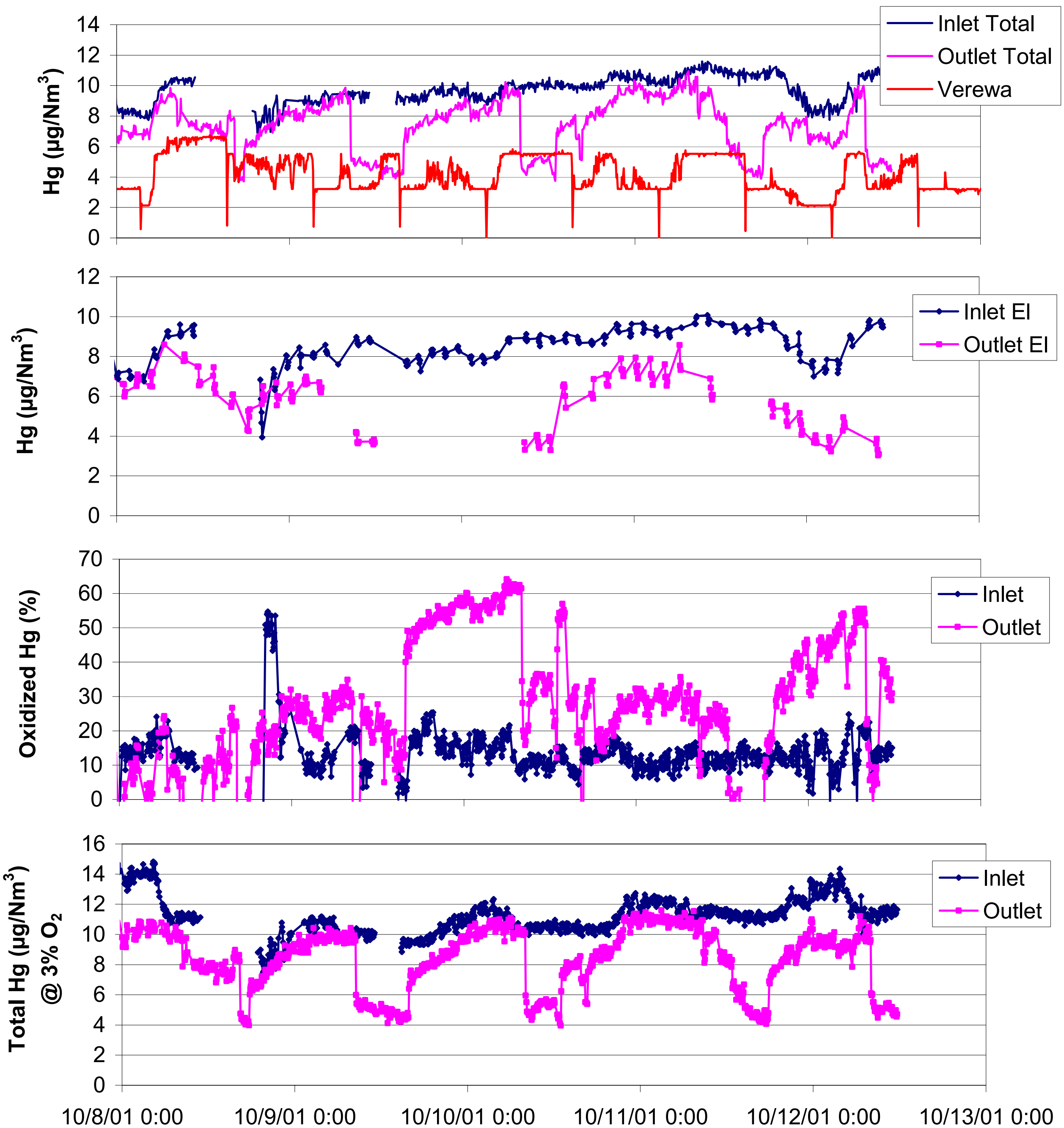

Figure 2: Total and speciated mercury trends for week 3 parametric tests.

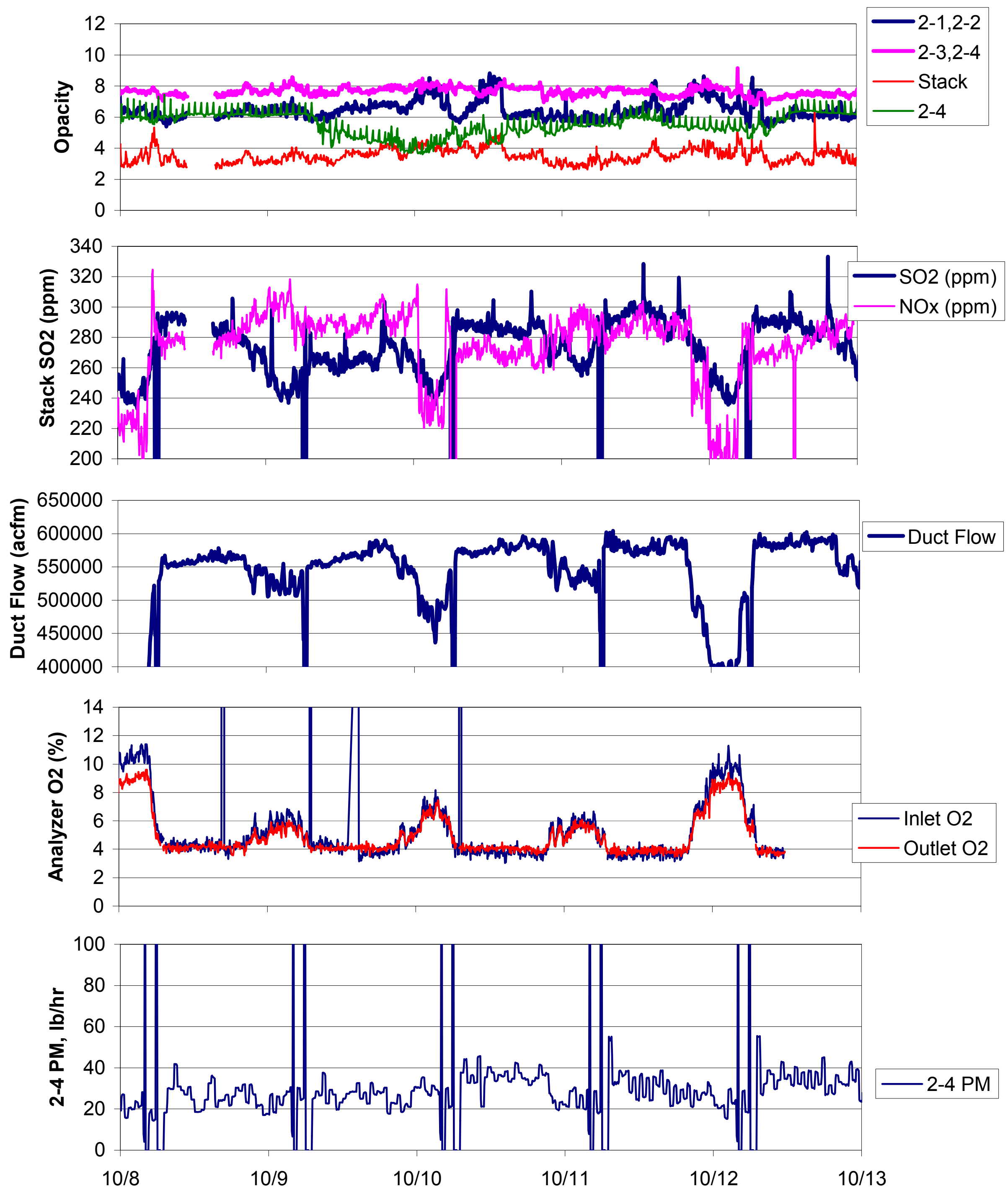

Figure 3: Operating Condition Trends for Week 2 Parametric Tests

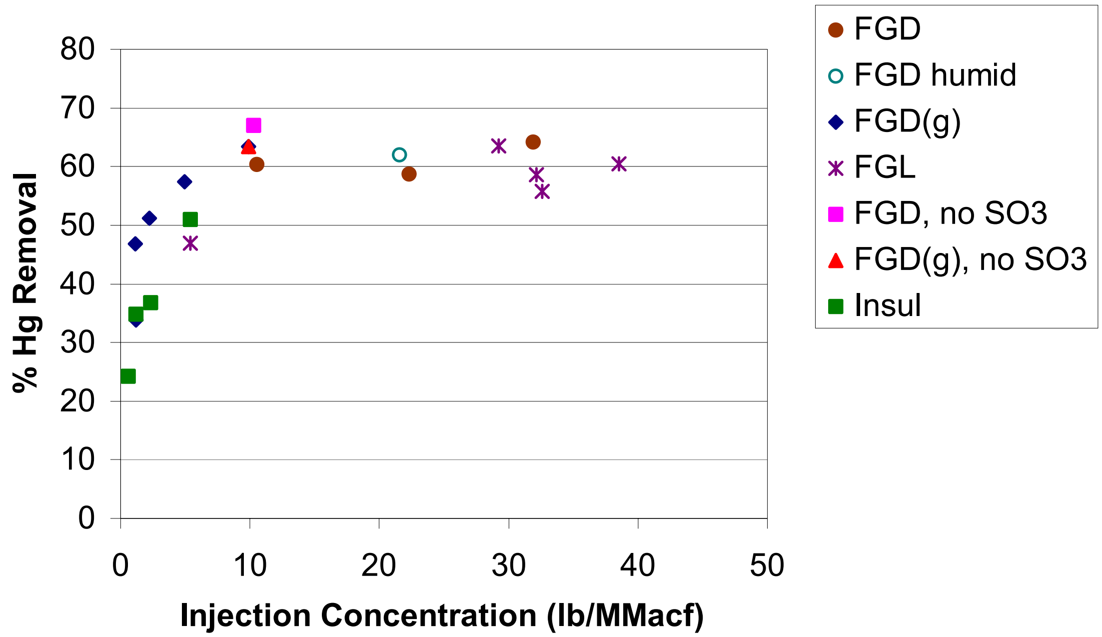

Figure 4: Mercury Removal versus Carbon Injection

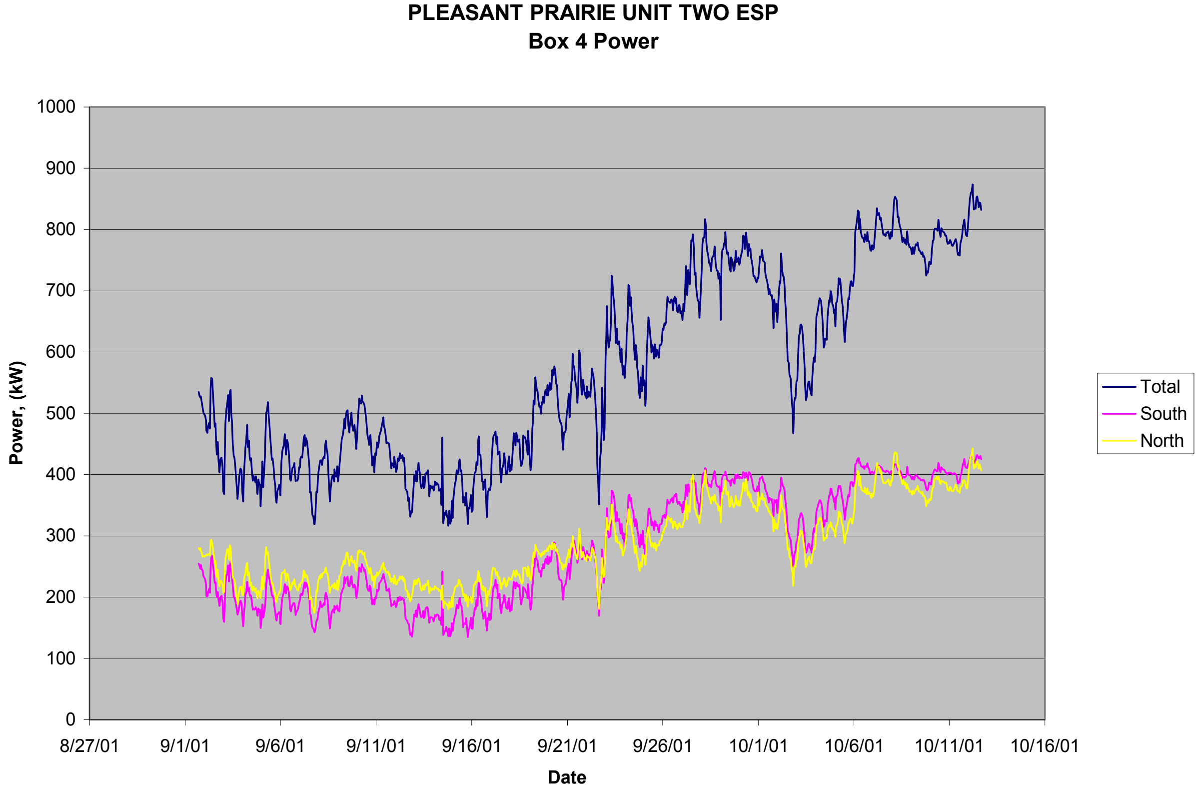

Figure 5: 2-4 ESP Power

APPENDIX D

LONG TERM TEST MEMO

ADA Environmental Solutions, LLC

8100 SouthPark Way, B-2
Littleton, Colorado 80120
Fax: 303.734.0330
303.734.1727 or 1.888.822.8617

memorandum

To:	Dick Johnson, Ed Morris, Terry Coughlin, Dave Michoud, Ramsay Chang, Scott Renninger, Jim Kilgroe, Sheila Haythornthwaite
From:	Jean Bustard, Travis Starns, Sharon Sjostrom
CC:	Connie Senior, Morgan Jones, Dale Kanary, Tho-Dien Le, Tom Burnett, Herb Stowe, Larry Monroe, Brian Wright, Rui Afonso, ADA-ES, WE
Date:	November 16, 2001
RE:	PPPP Long Term Test Completion

The long-term Performance Evaluation for the PPPP Unit 2 NETL Mercury Demonstration was completed as planned October 30 – November 15, 2001. Three injection concentrations were tested for five days each at 1 lb/Mmacf, 3 lb/Mmacf, and 10 lb/Mmacf. During this period, source sampling and other tests as listed in the project Test Plan were successfully conducted. Some observations on the test are included in this memo. Table 1 summarizes the completed test matrix.

Process

As requested, unit operation was maintained at a steady, full load condition from 0600 – 2000 on Mon – Fri during the first two weeks and around the clock on November 11, 12, 13, and 14. This contributed greatly to successful completion of the schedule.

Flyash from ESP 2-4 was isolated from normal collection procedures and sent to a separate silo for disposal. Normal operation of injecting high LOI flyash from nearby WE plants into the boiler (flyash reburn) was halted for these tests. A test with flyash reburn was conducted on November 13 and 14.

Carbon was injected 24 hours/day with no interruptions. Calibration checks of the feed rate indicated that carbon injection was relatively steady at each of the three rates.

Outlet opacity and particulate monitors showed no measurable increase in outlet emissions. ESP power levels showed no detrimental effect from carbon injection.

Source Testing

A complete set of Ontario-Hydro sample runs were conducted by Mostardi Platt on November 11 and 12. Sampling results were acceptable for all of these runs; final results are pending laboratory analysis.

Particle size distribution measurements were conducted at the ESP outlet using cascade impactors. The particulate collected on each stage will be analyzed for carbon content.

Triplicate sets of EPA Method 29 Multi-Metals tests were conducted at the outlet at the request of EPRI and Wisconsin Electric.

Triplicate sets of Mesa Carbon traps were run at 2-4 ESP inlet, 2-4 ESP outlet north side, and 2-4 ESP outlet south side at each injection concentration. Sampling time for these traps are short (10 – 20 min), but they provide a secondary measurement of vapor phase mercury, when sample gas is extracted using the Apogee sampling probe.

Coal and Flyash Sampling

Flyash samples were collected daily from the ESP front and back hoppers. One-liter containers were collected daily and 5-gallon samples collected on designated days during each test condition. Three 5-gallon samples of bottom ash were collected from the combined (units 1 and 2) pile during the high injection rate test for Consol. Consol is under contract with NETL to evaluate the impact of mercury control on use and disposal of coal byproducts. The flyash sampling schedule is shown in Table 2.

One-liter coal samples were collected daily from the feeders. During the high injection rate, 5-gallon coal samples were collected as coal was unloaded from the train. The 5-gallon samples were for Consol.

Mercury Monitors

Apogee Scientific sampled with their extractive monitors at the 2-4 ESP inlet and outlet locations. Data were collected continuously during all test periods. In particular, data were taken simultaneously with each of the Ontario Hydro sample runs. Preliminary results from the S-CEMs indicate 40 - 55% mercury removal at an injection concentration of 1 lb/Mmacf, 55 – 60% removal at 3 lbs/Mmacf and 60 – 65% removal at 10 lbs/Mmacf.

Further Work

All recovered Ontario Hydro samples will be submitted to the analytical laboratory within the next week along with method blanks and prepared QA/QC spikes. Final results should be available within the 45 day holding period or no later than December 28, 2001.

Selected coal and ash samples will be forwarded to Dr. Senior at Reaction Engineering and then to the analytical subcontract laboratories. Wisconsin Electric, Consol, EPA, EPRI and EPA requested flyash samples during the high injection concentration tests. All requesters have agreed to conditions outlined in a Sample Request Criteria, which include getting permission from NETL before making public results from testing on this ash.

Final results from the Mercury S-CEMs are pending review of data and calibrations by Apogee.

Table 1: Test Matrix for Performance Evaluation

Sampling Location	No. of Runs	Parameters	Sampling Method	Tests Completed	Remarks
2-4 ESP Inlet	3	Speciated Hg, moisture, O_2/CO_2	Draft Ontario Hydro Method	One test on 11/11 Two tests on 11/12	Mostardi Platt
2-4 ESP Outlet	3	Speciated Hg, moisture, O_2/CO_2	Draft Ontario Hydro Method	One test on 11/11 Two tests on 11/12	Mostardi Platt
2-4 ESP Inlet	2	Particle size distribution, carbon penetration	Cascade Impactor	One test on 11/11	Mostardi Platt
2-4 Outlet	3	Multi-metals, air toxics	Method 29	3 tests on 11/13	Mostardi Platt
2-4 ESP Inlet	3 sets of 3	Vapor phase Hg	Mesa Carbon Traps	3 tests on 11/3 3 tests on 11/6 3 tests on 11/11	One set of tests per injection condition
2-4 ESP Outlet, North and South Ducts	6 sets of 3	Vapor phase Hg	Mesa Carbon Traps	6 tests on 11/3 6 tests on 11/6 6 tests on 11/11	3 Mesa traps run on north Side, 3 run on south side
2-4 ESP Inlet	Semi-Continuous	Vapor phase speciated Hg	Extractive, impinger based	Data collected during continuously during all tests	Apogee Scientific
2-4 ESP Outlet	Semi-Continuous	Vapor phase speciated Hg	Extractive, impinger based	Data collected during continuously during all tests	Apogee Scientific
Coal Feeders	Daily	Ultimate/Prox., Hg	Grab	Per sampling schedule	
ESP Hoppers	Daily	Hg, LOI in ash	Grab	Per sampling schedule	
Sorbent Feeder	2 liters, 5 gallon	Size distribution	Grab	Samples collected from each delivery truck	1 l samples from all deliveries, 5 gal sample from 1 FGD truck
Plant Process Data	Continuous	MW, coal feed, temps, O_2,	5 minute logged data	Data collected during all test periods	
Plant CEM Data	Continuous	SO_2, NO_x, opacity, CO_2, flow, PM	5 minute logged data	Data collected during all test periods	Plant CEM data subject to final Q/A screening
Sorbent Injection	Continuous	Feedrate, silo weight, coal flow	1 minute	Data collected during all test periods	
ESP Data	Continuous	Power, secondary current and voltage, spark rate	BHA system	6 minute or 1 hour logged data	

Table 2: Ash/Coal Sampling Schedule during Long Term Tests

Date	Coal						Ash								Ash Comp.		B. Ash
	2-1	2-2	2-3	2-4	2-5	Tr.	7-1	7-2	7-3	7-4	8-1	8-2	8-3	8-4	Front	Back	Pile
31-Oct		A	A					A				A					
1-Nov		A	A					A				A					
2-Nov	A	A	A	A	A		A	A	A	A	A	A	A	A	4 B	1 B	
3-Nov																	
4-Nov																	
5-Nov		A	A					A				A					
6-Nov		A	A					A				A					
7-Nov		A	A					A				A					
8-Nov	A	A	A	A	A		A	A	A	A	A	A	A	A	4 B	1 B	
9-Nov		A	A					A				A					
10-Nov																	
11-Nov																	
12-Nov	A	A	A	A	A	1 B		A				A			4 B	2 B	1 B
13-Nov	A	A	A	A	A	1 B	A	A	A	A	A	A	A	A	9 B	1 B	1 B
14-Nov	A	A	A	A	A	1 B		A				A			9 B	1 B	1 B
15-Nov		A	A					A				A					
16-Nov		A	A					A				A					

A = 1 liter sample
B = 5 gallon sample

APPENDIX E
PART 1

SOURCE TEST REPORTS BY GE MOSTARDI PLATT

METHOD 5

ONTARIO-HYDRO

METHOD 29

SPECIATED MERCURY EMISSIONS TESTING
Performed For
ADA ENVIRONMENTAL SOLUTIONS, L.L.C.
At The
Wisconsin Electric Power Company
Pleasant Prairie Power Plant
Unit 2 ESP North Inlet and Outlet Ducts
Kenosha, Wisconsin
September 10 and 11 and November 12 and 13, 2001

GE MOSTARDI PLATT PROJECT G013706/G014603
DATE SUBMITTED: APRIL 11, 2002

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LIST OF PARTICIPANTS

Name	Organization	Project Role
Brenda Bergemann	WEPCO	Plant Coordinator
C. Jean Bustard	ADA Environmental Solutions	Project Consultant
James R. Platt	GE Mostardi Platt	Vice President
John Wendell	GE Mostardi Platt	Laboratory Chemist
Dan Bell	GE Mostardi Platt	Project Manager
Greg Rock	GE Mostardi Platt	Project Supervisor
Mike Ebner	GE Mostardi Platt	Test Engineer
Tim Mei	GE Mostardi Platt	Test Technician
Brad Hofferkamp	GE Mostardi Platt	Test Technician
Gail O'Neil	TEI	Speciated Hg Sample Analysis
Margaret Laumb	MTI	Coal Sample Analysis

CERTIFICATION SHEET

Having supervised and worked on the test program described in this report, and having written 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 MOSTARDI PLATT

____

James R. Platt
Vice President, Emissions Services

Reviewed by:

____

Frank H. Jarke
Manager, Analytical and Quality Assurance

SPECIATED MERCURY EMISSIONS TESTING
Performed For
ADA ENVIRONMENTAL SOLUTIONS, L.L.C.
At The
Wisconsin Electric Power Company
Pleasant Prairie Power Plant
Unit 2 ESP North Inlet and Outlet Ducts
Kenosha, Wisconsin
September 10 and 11 and November 12 and 13, 2001

1.0 INTRODUCTION

1.1 Summary of Test Program

ADA Environmental Solutions, LLC (ADA-ES) working in conjunction with Wisconsin Electric Power Company (WEPCO) conducted speciated mercury emissions measurements at the Pleasant Prairie Power Plant Unit 2 ESP North Inlet and Outlet Ducts of WEPCO in Kenosha, Wisconsin. Simultaneous measurements were conducted at the inlet and outlet of the precipitator of Unit 2 on September 10, 11 and November 12 and 13, 2001. Testing performed in September 2001 represents baseline testing, and November 2001 testing represents long-term testing to confirm mercury emission reductions during a long-term feed of activated carbon. Mercury emissions were speciated into elemental, oxidized and particle-bound mercury using the Ontario-Hydro test method. Fuel samples were also collected concurrently with Ontario-Hydro samples in order to determine fuel mercury content.

1.2 Key Personnel

The key personnel who coordinated the test program and their telephone numbers are:

- GE Mostardi Platt Vice President, James Platt 630-530-6600
- Dick Johnson, WEPCO Plant Coordinator 414-221-4234

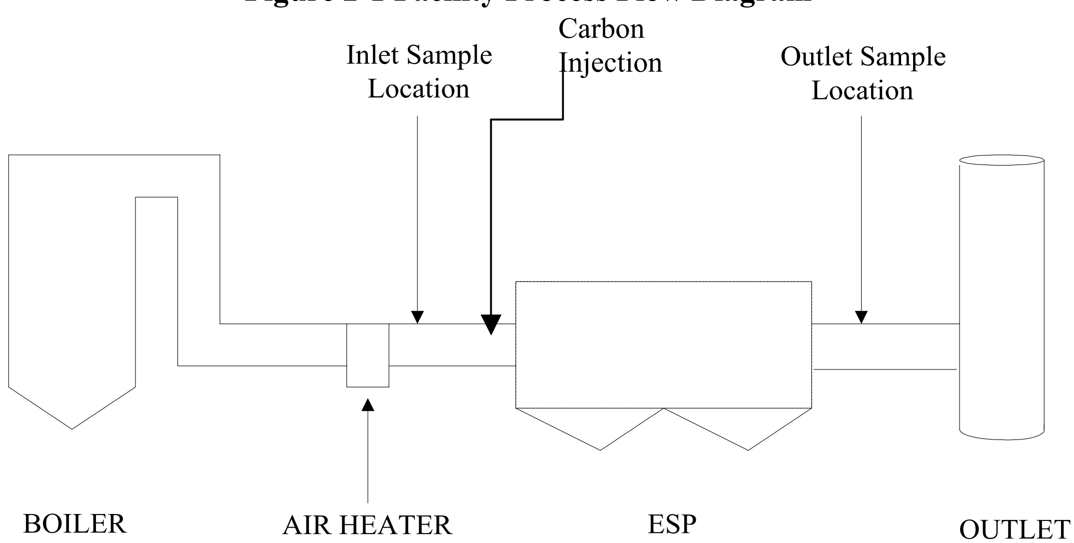
2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 Process Description

Pleasant Prairie Unit 2 is a balanced draft pulverized coal-fired boiler with a rating of 600 MW (net). Figure 2-1 shows a schematic of the boiler and pollution control equipment, including sample points.

Unit 2 is a coal burning steam boiler. The steam is converted into mechanical energy by flowing through a turbine (generator), which produces electrical power. The unit will be operating at or near full load during the tests. Fuel type, boiler operation and control device operation will all be maintained at normal operating conditions.

Figure 2-1 Facility Process Flow Diagram



The following is a list of operating components for this unit:

- Riley Stoker balanced draft, pulverized coal boiler
- 600 MW net capacity
- Fuel:

  Subbituminous coal (0.4% sulfur)
- SO_2 control: None
- NO_X control: None

- Research Cottrell Electrostatic Precipitator with a 99.78% removal efficiency

2.2 Control Equipment Description

Particulate emissions from the boiler are controlled by a Research Cottrell Electrostatic Precipitator with a measured collection efficiency of 99.78%. The precipitator is split in two (2) sections (north and south) with eight (8) individual inlets and outlets in each section.

The flue gas at the inlet was approximately 300ºF. At the outlet, the gas temperature was approximately 300ºF and contained approximately 10 percent (10%) moisture.

2.3 Flue Gas Sampling Locations

2.3.1 Inlet Location

Inlet samples were collected from a single inlet duct. A schematic and cross section of the inlet location are shown in Figure 2-2 and 2-3. This location does not meet the requirements of USEPA Method 1. A cyclonic flow check using Method 1 Section 2.4 was performed.

The flue gas at the inlet was above the method specification of a minimum filtration temperature of 120°C. Therefore, in stack filtration per Method 17 was used.

2.3.2 Outlet Location

Outlet samples were collected at the outlet duct. A schematic and cross section of the stack location is shown in Figure 2-4. One (1) test crew sampled the outlet duct with one (1) sampling train utilizing all test ports.

The flue gas at the outlet was above the method specification of a minimum filtration temperature of 120°C. Therefore, in stack filtration per Method 17 was used.

2.4 Fuel Sampling Location

Fuel samples were collected at the fuel feeders to each individual feeder. One sample was collected from each feeder during each test day, and the feeder samples collected during a test day were composited prior to analysis.

Figure 2-2 Schematic of the Unit 2 Inlet Sampling Location

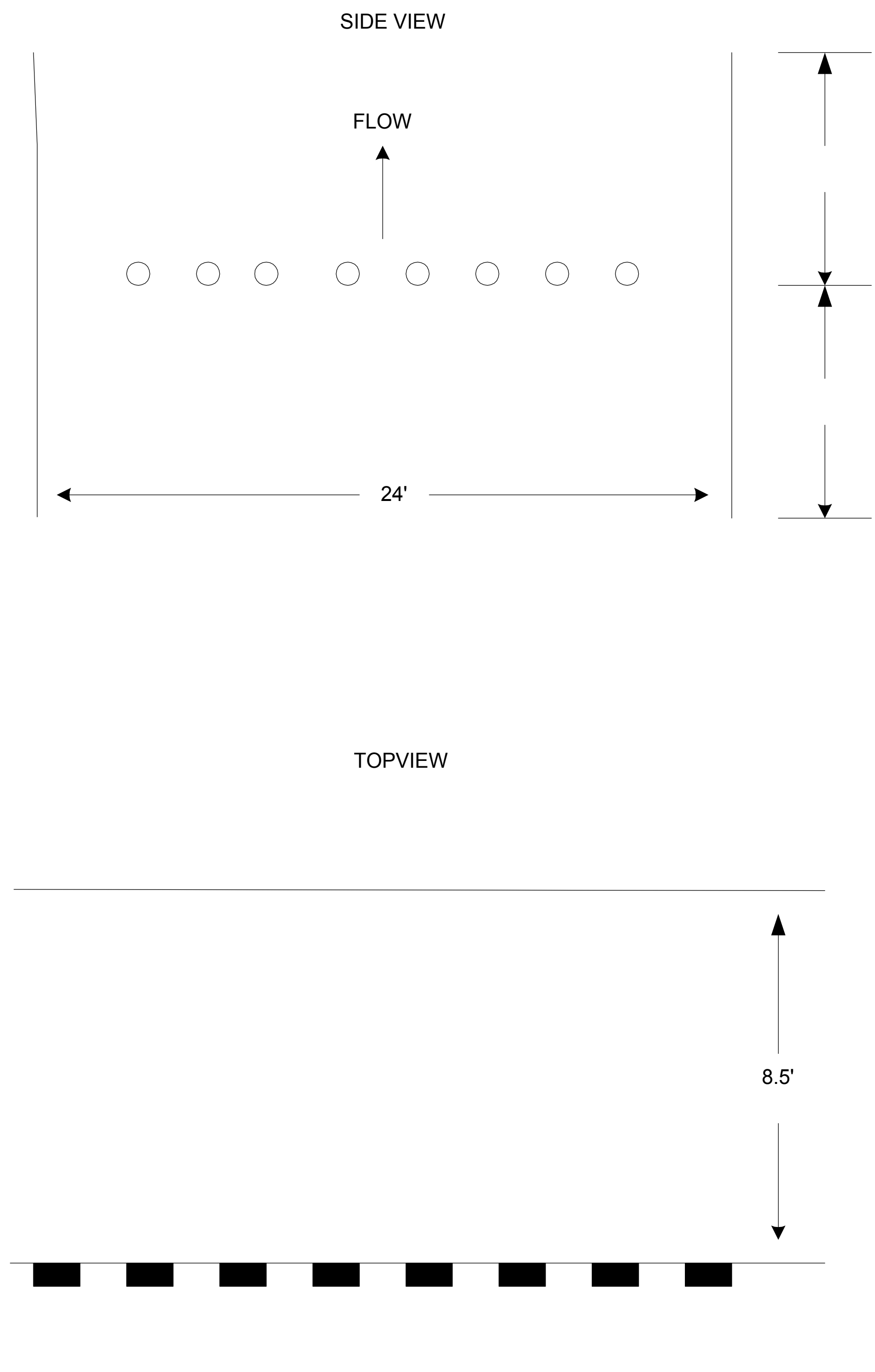
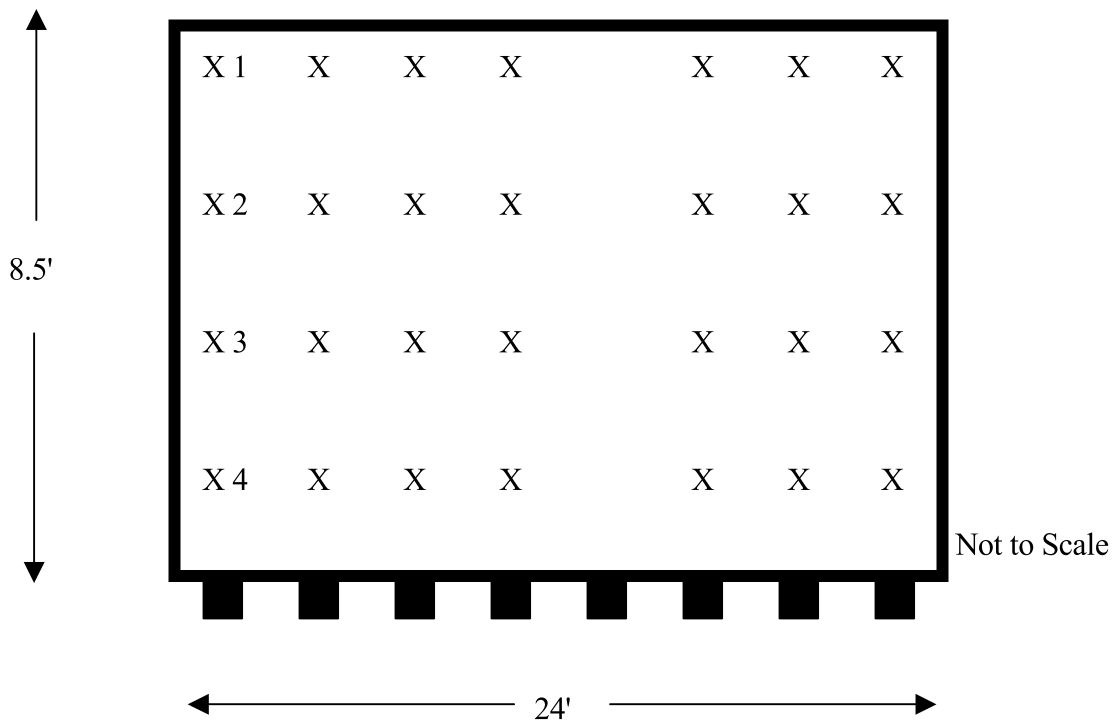
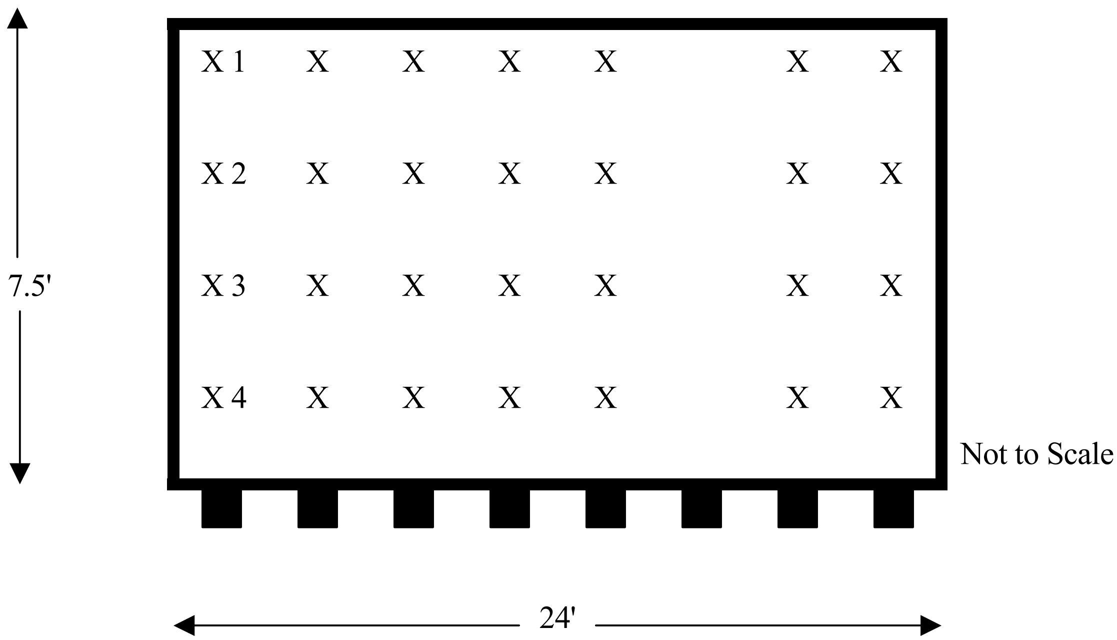


Figure 2-3 Equal Area Traverse For Rectangular Ducts (Inlet)



Job:	WEPCO Pleasant Prairie		
Date:	September 10, 11 and November 12 and 13, 2001		
Unit No:	2	No. Test Ports:	7 (Horizontal)
Length:	8.5 Feet	Tests Points per Port:	4
Width:	24 Feet	Port Length:	30 Inches
Area:	204.00 Square Feet		
Duct No:	Inlet		

Figure 2-4 Equal Area Traverse For Rectangular Ducts (Outlet)



Job:	WEPCO Pleasant Prairie		
Date:	September 10, 11 and November 12 and 13, 2001		
Unit No:	2	No. Test Ports:	7 (Horizontal)
Length:	24 Feet	Tests Points per Port:	4
Width:	7.5 Feet	Port Length:	24 Inches
Area:	180 Square Feet		
Duct No:	Outlet		

3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

3.1 Objectives and Test Matrix

The main purpose of this program is to collect the information on baseline data and confirm that mercury emissions are reduced during a long-term feed of activated carbon. The main objectives are summarized as follows:

- Compare mass flow rates of mercury at the three sampling locations (fuel, inlet to and outlet of the precipitator).
- Measure speciated mercury emissions at the outlet.
- Measure speciated mercury concentrations at the inlet of the last air pollution control device.
- Measure mercury and chlorine content from the fuel being used during the testing.
- Measure the oxygen and carbon dioxide concentrations at the inlet and the outlet.
- Measure the volumetric gas flow at the inlet and the outlet.
- Measure the moisture content of the flue gas at the inlet and the outlet.
- Provide the above information to the USEPA for use in establishing mercury emission factors for this type of unit.

The test matrix is presented in Table 3-1. The table shows the testing performed at each location, methodologies employed and responsible organization.

Table 3-1
TEST MATRIX FOR THE PLEASANT PRAIRIE POWER PLANT

Sampling Location	No. of Runs	Parameters	Sampling Method	Sample Run Time (min)	Analytical Method	Analytical Laboratory
Outlet	3	Speciated Hg	Ontario Hydro	120	EPA SW846 7470	TEI
Outlet	3	Moisture	EPA 4	120	Gravimetric	GE Mostardi Platt
Outlet	3	Flow	EPA 1 & 2	120	Pitot Traverse	GE Mostardi Platt
Outlet	3	O_2/CO_2	EPA 3	120	Orsat	GE Mostardi Platt
Inlet	3	Speciated Hg	Ontario Hydro	120	EPA SW846 7470	TEI
Inlet	3	Moisture	EPA 4	120	Gravimetric	GE Mostardi Platt
Inlet	3	Flow	EPA 1 & 2	120	Pitot Traverse	GE Mostardi Platt
Inlet	3	O_2/CO_2	EPA 3	120	Orsat	GE Mostardi Platt
Fuel Feeders	3	Hg, Cl in Fuel	Grab	1 Sample Per Day	ASTM D3684 (Hg) ASTM D4208 (Cl)	Microbeam Technologies, Inc. (MTI)

3.2 Field Test Changes and Problems

There were no field test changes or problems encountered during the test program.

3.3 Presentation of Results

3.3.1 Mercury Mass Flow Rates

The mass flow rates of mercury determined at each sample location are presented in the following two tables. Baseline test results are summarized in Table 3-2, and Long-term results are summarized in Table 3-3.

Table 3-2
SUMMARY OF BASELINE RESULTS

Sample Location	Elemental Mercury (lb/hr)	Oxidized Mercury (lb/hr)	Particle-Bound Mercury (lb/hr)	Total Mercury (lb/hr)
Fuel				
Run 1				0.07246
Run 2				0.07668
Run 3				0.07668
Average				0.07527
*Unit 2 Inlet				
Run 1	0.01358	0.00271	0.00187	0.01816
Run 2	0.01472	0.00275	0.00338	0.02085
Run 3	0.01302	0.00304	0.00141	0.01746
Average	0.01377	0.00283	0.00222	0.01882
Unit 2 Outlet				
Run 1	0.01007	0.00873	0.00000	0.01880
Run 2	0.01189	0.00585	0.00005	0.01779
Run 3	0.01119	0.00572	0.00003	0.01693
Average	0.01105	0.00676	0.00003	0.01784

* Based on outlet airflow (DSCFM)

Table 3-3
SUMMARY OF LONG-TERM RESULTS

Sample Location	Elemental Mercury (lb/hr)	Oxidized Mercury (lb/hr)	Particle-Bound Mercury (lb/hr)	Total Mercury (lb/hr)
Fuel				
Run 1				0.07375
Run 2				0.07529
Run 3				0.07529

Table 3-3 SUMMARY OF LONG-TERM RESULTS				
Sample Location	**Elemental Mercury (lb/hr)**	**Oxidized Mercury (lb/hr)**	**Particle-Bound Mercury (lb/hr)**	**Total Mercury (lb/hr)**
Average				0.07478
*Unit 2 Inlet				
Run 1	0.01266	0.00266	0.00253	0.01784
Run 2	0.01904	0.00169	0.00024	0.02098
Run 3	0.01941	0.00170	0.00067	0.02179
Average	0.01704	0.00202	0.00115	0.02020
Unit 2 Outlet				
Run 1	0.00470	0.00005	0.00000	0.00476
Run 2	0.00501	0.00069	0.00000	0.00570
Run 3	0.00513	0.00076	0.00000	0.00589
Average	0.00495	0.00050	0.00000	0.00545

3.3.2 Comparison of Volumetric Flow Rate

Volumetric flow rate is a critical factor in calculating mass flow rates. During this test program, Section 2-4 of the precipitator inlet was sampled entirely. However, only the upper precipitator outlet was sampled, resulting in a flow rate at the outlet that is half that of the inlet, as can be seen in Table 3-4, on a thousand standard cubic foot per minute (KSCFM) basis. Volumetric flow results were similar for both test conditions, thus only the Baseline condition is summarized here.

Table 3-4 BASELINE COMPARISON OF VOLUMETRIC FLOW RATE DATA						
Run No.	**Inlet**			**Stack**		
	KACFM	**KSCFM**	**KDSCFM**	**KACFM**	**KSCFM**	**KDSCFM**
Run 1	1010.468	673.646	584.042	550.703	367.162	317.095
Run 2	1061.667	606.118	606.118	564.454	376.475	323.027
Run 3	1034.045	690.642	590.305	582.750	385.020	330.154
Average	1035.393	656.802	593.488	565.969	376.219	323.426

3.3.3 Individual Run Results

A detailed summary of results for each sample run at the inlet and main stack for September and November are presented in Tables 3-5, 3-6, 3-8 and 3-9 respectively.

3.3.4 Process Operating Data

The process operating data collected during the tests is included in Appendix A. A summary of the coal usage and mass emission rate of mercury available from coal samples collected in September and November are presented in Tables 3-7 and 3-10 respectively.

Table 3-5
BASELINE INLET INDIVIDUAL RUN RESULTS

Plant: Wisconsin Electric Power Company, Pleasant Prairie Power Plant	Location: Unit 2 Inlet			
Test Run Number:	**1**	**2**	**3**	**Average**
Source Condition		Normal		
Fuel Factor, dscf/10^6 Btu	9632	9526	9526	
Date	9/10/01	9/11/01	9/11/01	
Start Time	14:45	9:35	12:53	
End Time	17:03	11:51	15:10	
Elemental Mercury:				
HNO_3-H_2O_2, ug detected	0.580	0.466	0.279	0.442
H_2SO_4-$KMnO_4$, ug detected	23.500	25.800	21.800	23.700
Reported, ug	24.080	26.266	22.079	24.142
ug/dscm	11.44	12.17	10.53	11.38
lb/hr	0.02502	0.02762	0.02327	0.02530
lb/hr (based on outlet dscfm)	0.01358	0.01472	0.01302	0.01377
lb/10^{12} Btu	8.50	8.95	7.74	8.40
Oxidized Mercury:				
KCl, ug detected	4.800	4.910	5.150	4.953
Reported, ug	4.800	4.910	5.150	4.953
ug/dscm	2.28	2.27	2.46	2.34
lb/hr	0.00499	0.00516	0.00543	0.00519
lb/hr (based on outlet dscfm)	0.00271	0.00275	0.00304	0.00283
lb/10^{12} Btu	1.70	1.67	1.81	1.72
Particle-bound Mercury:				
Filter, ug detected	3.319	6.029	2.384	3.911
HNO_3, ug detected	ND <0.003	ND <0.003	ND <0.003	ND <0.003
Reported, ug	3.319	6.029	2.384	3.911
ug/dscm	1.58	2.79	1.14	1.84
lb/hr	0.00345	0.00634	0.00251	0.00410
lb/hr (based on outlet dscfm)	0.00187	0.00338	0.00141	0.00222
lb/10^{12} Btu	1.17	2.05	0.84	1.35
Total Inlet Speciated Mercury:				
ug/dscm	15.29	17.23	14.12	15.55
lb/hr	0.03345	0.03912	0.03121	0.03460
lb/hr (based on outlet dscfm)	0.01816	0.02085	0.01746	0.01882
lb/10^{12} Btu	11.37	12.67	10.38	11.48
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	1,010,468	1,061,667	1,034,045	1,035,393
@ Standard Conditions, dscfm	584,042	606,118	590,305	593,488
Average Gas Temperature, ^oF	285.4	292.0	288.0	288.5
Average Gas Velocity, ft/sec	82.55	86.74	84.48	84.59
Flue Gas Moisture, percent by volume	13.30	14.06	14.53	13.96
Average Flue Pressure, in. Hg	28.16	28.31	28.31	
Barometric Pressure, in. Hg	29.30	29.45	29.45	
Average %CO_2 by volume, dry basis	15.0	15.0	15.0	15.0
Average %O_2 by volume, dry basis	4.0	4.0	4.0	4.0
% Excess Air	23.01	23.01	23.01	23.01
Dry Molecular Wt. of Gas, lb/lb-mole	30.560	30.560	30.560	
Gas Sample Volume, dscf	74.355	76.235	74.069	
Isokinetic Variance	104.4	103.2	102.9	

Table 3-6
BASELINE OUTLET INDIVIDUAL RUN RESULTS

Plant: Wisconsin Electric Power Company, Pleasant Prairie Power Plant	Location: Unit 2 Outlet			
Test Run Number:	**1**	**2**	**3**	**Average**
Source Condition		Normal		
Fuel Factor, dscf/10^6 Btu	9632	9526	9526	
Date	9/10/01	9/11/01	9/11/01	
Start Time	14:35	9:30	13:10	
End Time	16:49	11:46	15:44	
Elemental Mercury:				
HNO_3-H_2O_2, ug detected	0.411	0.654	0.556	0.540
H_2SO_4-$KMnO_4$, ug detected	17.700	20.300	19.600	19.200
Reported, ug	18.111	20.954	20.156	19.740
ug/dscm	8.48	9.83	9.05	9.12
lb/hr	0.01007	0.01189	0.01119	0.01105
lb/10^{12} Btu	6.83	7.83	7.16	7.27
Oxidized Mercury:				
KCl, ug detected	15.700	10.300	10.300	12.100
Reported, ug	15.700	10.300	10.300	12.100
ug/dscm	7.35	4.83	4.62	5.60
lb/hr	0.00873	0.00585	0.00572	0.00676
lb/10^{12} Btu	5.92	3.85	3.66	4.48
Particle-bound Mercury:				
Filter, ug detected	<0.010	0.092	0.055	0.052
HNO_3, ug detected	ND <0.003	ND <0.003	ND <0.003	ND <0.003
Reported, ug	0.005	0.092	0.055	0.051
ug/dscm	0.00	0.04	0.02	0.02
lb/hr	0.00000	0.00005	0.00003	0.00003
lb/10^{12} Btu	0.00	0.03	0.02	0.02
Total Outlet Speciated Mercury:				
ug/dscm	15.83	14.71	13.69	14.74
lb/hr	0.01880	0.01779	0.01693	0.01784
lb/10^{12} Btu	12.75	11.72	10.84	11.77
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	550,703	564,454	582,750	565,969
@ Standard Conditions, dscfm	317,095	323,027	330,154	323,426
Average Gas Temperature, ^oF	285.7	288.1	295.2	289.7
Average Gas Velocity, ft/sec	50.99	52.26	53.96	52.40
Flue Gas Moisture, percent by volume	13.64	14.20	14.25	14.03
Average Flue Pressure, in. Hg	28.17	28.27	28.27	
Barometric Pressure, in. Hg	29.35	29.45	29.45	
Average %CO_2 by volume, dry basis	13.6	13.7	13.9	13.7
Average %O_2 by volume, dry basis	5.3	5.3	5.2	5.3
% Excess Air	32.90	32.95	32.18	32.68
Dry Molecular Wt. of Gas, lb/lb-mole	30.388	30.404	30.432	
Gas Sample Volume, dscf	75.442	75.265	78.678	
Isokinetic Variance	103.9	101.7	104.1	

Table 3-7
BASELINE COAL USAGE RESULTS

Plant: Wisconsin Electric Power Company, Pleasant Prairie Power Plant			**Location: Unit 2**	
Test Run Number:	**1**	**2**	**3**	**Average**
Date	9/10/01	9/11/01	9/11/01	
Start Time	14:35	9:30	13:10	
End Time	16:49	11:46	15:44	
Coal Properties:				
Carbon, % dry	68.92	68.75	68.75	68.81
Hydrogen, % dry	5.02	4.81	4.81	4.88
Nitrogen, % dry	1.00	0.98	0.98	0.99
Sulfur, % dry	0.50	0.45	0.45	0.47
Ash, % dry	7.32	7.42	7.42	7.39
Oxygen, % dry (by difference)	17.24	17.59	17.59	17.47
Volatile, % dry	43.14	43.12	43.12	43.13
Moisture, %	31.73	31.68	31.68	31.70
Heat Content, Btu/lb dry basis	12065	12072	12072	12070
F_d Factor O_2 basis, dscf/10^6 Btu	9632	9526	9526	9561
F_c Factor CO_2 basis, scf/10^6 Btu	1834	1828	1828	1830
Chloride, ug/g dry	10.620	12.260	12.260	11.713
Mercury, ug/g dry	0.145	0.145	0.145	0.145
Coal Consumption:				
Total Raw Coal Input, Klbs/hr	732.00	774.00	774.00	760.00
Total Coal Input, lbs/hr dry	499736	528797	528797	519110
Total Mercury Available in Coal:				
Mercury, lbs/hr	0.07246	0.07668	0.07668	0.07527
Mercury, lbs/10^{12} Btu	12.02	12.01	12.01	12.01

Laboratory Analysis can be found in Appendix F.

Table 3-8
LONG-TERM INLET INDIVIDUAL RUN RESULTS

Plant: Wisconsin Electric Power Company, Pleasant Prairie Power Plant	Location: Unit 2 Inlet			
Test Run Number:	**1**	**2**	**3**	**Average**
Source Condition		Normal		
Fuel Factor, dscf/10^6 Btu	9993	10091	10091	
Date	11/12/01	11/13/01	11/13/01	
Start Time	13:30	8:35	11:20	
End Time	15:39	10:40	13:25	
Elemental Mercury:				
HNO_3-H_2O_2, ug detected	0.110	0.040	0.410	
H_2SO_4-$KMnO_4$, ug detected	18.900	30.400	30.800	26.700
Reported, ug	19.010	30.440	31.210	26.887
ug/dscm	9.90	15.46	15.83	13.73
lb/hr	0.02173	0.03416	0.03505	0.03031
lb/hr (based on outlet dscfm)	0.01266	0.01904	0.01941	0.01704
lb/10^{12} Btu	8.28	12.19	12.94	11.13
Oxidized Mercury:				
KCl, ug detected	3.990	2.700	2.740	3.143
Reported, ug	3.990	2.700	2.740	3.143
ug/dscm	2.08	1.37	1.39	1.61
lb/hr	0.00456	0.00303	0.00308	0.00356
lb/hr (based on outlet dscfm)	0.00266	0.00169	0.00170	0.00202
lb/10^{12} Btu	1.74	1.08	1.14	1.32
Particle-bound Mercury:				
Filter, ug detected	3.761	0.390	1.076	1.742
HNO_3, ug detected	0.034	ND <0.003	0.005	0.020
Reported, ug	3.795	0.392	1.081	1.756
ug/dscm	1.98	0.20	0.55	0.91
lb/hr	0.00434	0.00044	0.00121	0.00200
lb/hr (based on outlet dscfm)	0.00253	0.00024	0.00067	0.00115
lb/10^{12} Btu	1.65	0.16	0.45	0.75
Total Inlet Speciated Mercury:				
ug/dscm	13.96	17.03	17.76	16.25
lb/hr	0.03062	0.03763	0.03934	0.03587
lb/hr (based on outlet dscfm)	0.01784	0.02098	0.02179	0.02020
lb/10^{12} Btu	11.67	13.42	14.52	13.21
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	1,008,493	1,015,873	1,037,782	1,020,716
@ Standard Conditions, dscfm	585,791	590,039	591,350	589,060
Average Gas Temperature, °F	290.8	284.2	295.3	290.1
Average Gas Velocity, ft/sec	82.39	83.00	84.79	83.39
Flue Gas Moisture, percent by volume	12.92	12.77	13.15	12.95
Average Flue Pressure, in. Hg	28.38	28.08	28.08	
Barometric Pressure, in. Hg	29.52	29.33	29.33	
Average %CO_2 by volume, dry basis	14.8	14.9	14.9	14.9
Average %O_2 by volume, dry basis	5.3	4.2	4.8	4.8
% Excess Air	33.56	24.48	29.27	29.10
Dry Molecular Wt. of Gas, lb/lb-mole	30.580	30.552	30.576	
Gas Sample Volume, dscf	67.788	69.531	69.640	
Isokinetic Variance	100.0	101.8	101.7	

Table 3-9
LONG-TERM OUTLET INDIVIDUAL RUN RESULTS

Plant: Wisconsin Electric Power Company, Pleasant Prairie Power Plant	**Location: Unit 2 Outlet**			
Test Run Number:	**1**	**2**	**3**	**Average**
Source Condition		Normal		
Fuel Factor, dscf/10^6 Btu	9993	10091	10091	
Date	11/12/01	11/13/01	11/13/01	
Start Time	13:30	8:10	11:20	
End Time	15:45	10:31	13:47	
Elemental Mercury:				
HNO_3-H_2O_2, ug detected	ND <0.003	ND <0.003	ND <0.003	ND <0.003
H_2SO_4-$KMnO_4$, ug detected	7.910	8.810	9.030	8.583
Reported, ug	7.910	8.810	9.030	8.583
ug/dscm	3.68	4.07	4.18	3.98
lb/hr	0.00470	0.00501	0.00513	0.00495
lb/10^{12} Btu	3.06	3.43	3.50	3.33
Oxidized Mercury:				
KCl, ug detected	0.090	1.220	1.340	0.883
Reported, ug	0.090	1.220	1.340	0.883
ug/dscm	0.04	0.56	0.62	0.41
lb/hr	0.00005	0.00069	0.00076	0.00050
lb/10^{12} Btu	0.03	0.48	0.52	0.34
Particle-bound Mercury:				
Filter, ug detected	ND <0.003	ND <0.003	ND <0.003	ND <0.003
HNO_3, ug detected	ND <0.003	ND <0.003	ND <0.003	ND <0.003
Reported, ug	0.000	0.000	0.000	0.000
ug/dscm	0.00	0.00	0.00	0.00
lb/hr	0.00000	0.00000	0.00000	0.00000
lb/10^{12} Btu	0.00	0.00	0.00	0.00
Total Outlet Speciated Mercury:				
ug/dscm	3.72	4.63	4.80	4.38
lb/hr	0.00476	0.00570	0.00589	0.00545
lb/10^{12} Btu	3.09	3.91	4.02	3.67
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	580,627	569,583	573,792	574,667
@ Standard Conditions, dscfm	341,285	328,867	327,487	332,546
Average Gas Temperature, ^oF	294.6	285.7	292.2	290.8
Average Gas Velocity, ft/sec	53.76	52.74	53.13	53.21
Flue Gas Moisture, percent by volume	10.97	13.11	13.36	12.48
Average Flue Pressure, in. Hg	28.23	28.08	28.08	
Barometric Pressure, in. Hg	29.52	29.33	29.33	
Average %CO_2 by volume, dry basis	13.7	13.7	13.7	13.7
Average %O_2 by volume, dry basis	5.2	5.3	5.2	5.2
% Excess Air	32.10	32.95	32.08	32.38
Dry Molecular Wt. of Gas, lb/lb-mole	30.405	30.404	30.400	
Gas Sample Volume, dscf	75.905	76.513	76.293	
Isokinetic Variance	97.1	101.6	101.7	

Table 3-10
LONG-TERM COAL USAGE RESULTS

Plant: Wisconsin Electric Power Company, Pleasant Prairie Power Plant			**Location: Unit 2**	
Test Run Number:	**1**	**2**	**3**	**Average**
Date	11/12/01	11/13/01	11/13/01	
Start Time	13:30	8:10	11:20	
End Time	15:45	10:31	13:47	
Coal Properties:				
Carbon, % dry	69.49	69.79	69.79	69.69
Hydrogen, % dry	5.09	5.66	5.66	5.47
Nitrogen, % dry	1.08	1.06	1.06	1.07
Sulfur, % dry	0.48	0.49	0.49	0.49
Ash, % dry	7.89	7.55	7.55	7.66
Oxygen, % dry (by difference)	15.96	15.46	15.46	15.63
Volatile, % dry	41.83	42.67	42.67	42.39
Moisture, %	29.79	30.02	30.02	29.94
Heat Content, Btu/lb dry basis	11801	11961	11961	11908
F_d Factor O_2 basis, dscf/10^6 Btu	9993	10091	10091	10058
F_c Factor CO_2 basis, scf/10^6 Btu	1890	1873	1873	1879
Chloride, ug/g dry	12.03	12.46	12.46	12.32
Mercury, ug/g dry	0.141	0.145	0.145	0.144
Coal Consumption:				
Total Raw Coal Input, Klbs/hr	745.00	742.00	742.00	743.00
Total Coal Input, lbs/hr dry	523065	519252	519252	520523
Total Mercury Available in Coal:				
Mercury, lbs/hr	0.07375	0.07529	0.07529	0.07478
Mercury, lbs/10^{12} Btu	11.95	12.12	12.12	12.06

Laboratory Analysis can be found in Appendix F.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Test Methods

4.1.1 Speciated mercury emissions

Speciated mercury emissions were determined via the draft "Standard Test Method for Elemental, Particle-Bound, and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario-Hydro Method)", dated April 8, 1999. Any revisions to this test method issued after April 8, 1999, but before July 1, 1999, were incorporated.

The in-stack filtration (Method 17) configuration was utilized at the inlet and outlet test locations. Figure 4-1 is a schematic of the Ontario-Hydro sampling trains.

Figure 4-2 illustrates the sample recovery procedure. The analytical scheme was per Section 13.3 of the Ontario-Hydro Method.

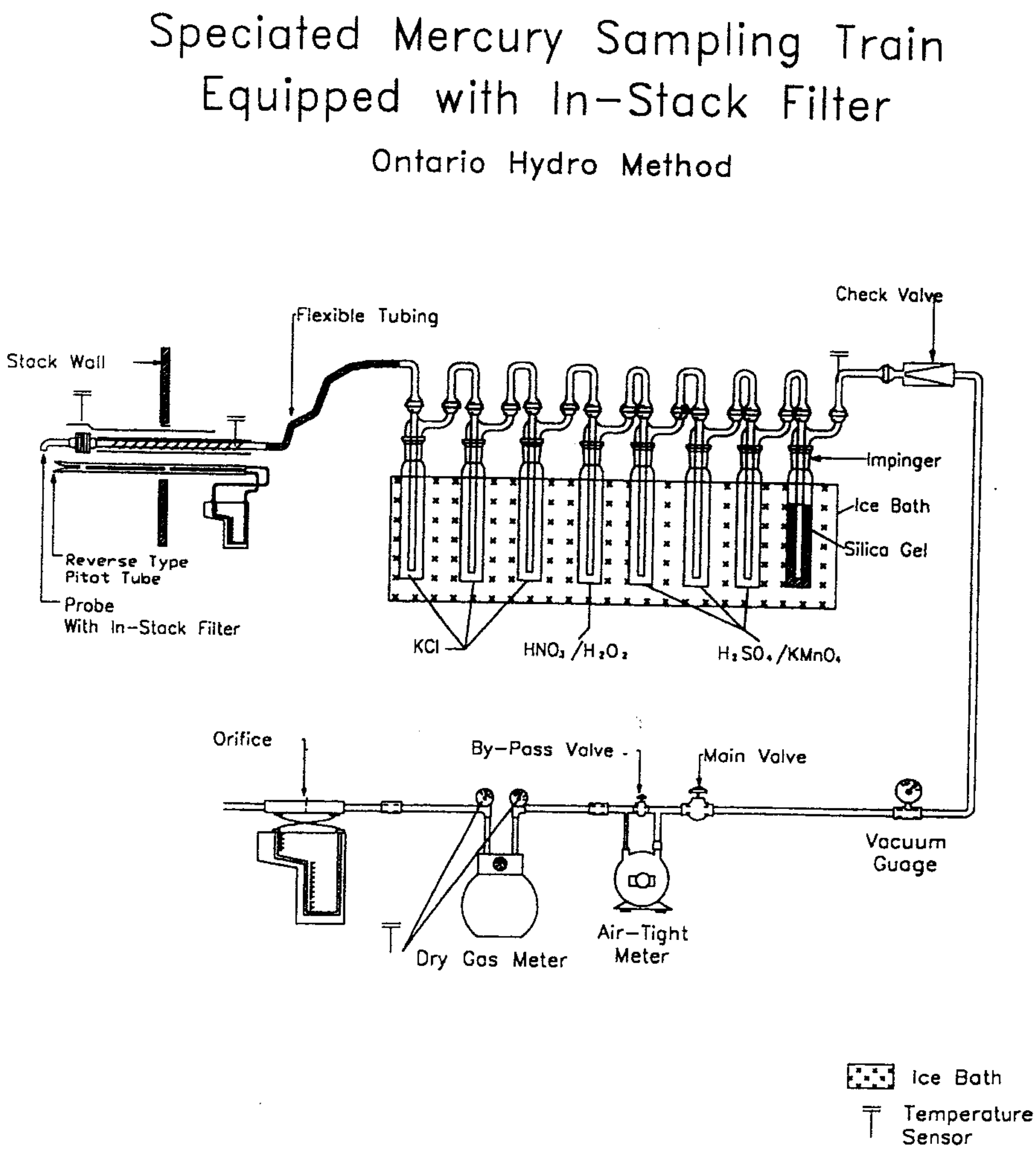


Figure 4-1 Sample Train Diagram for Ontario-Hydro Method Samples

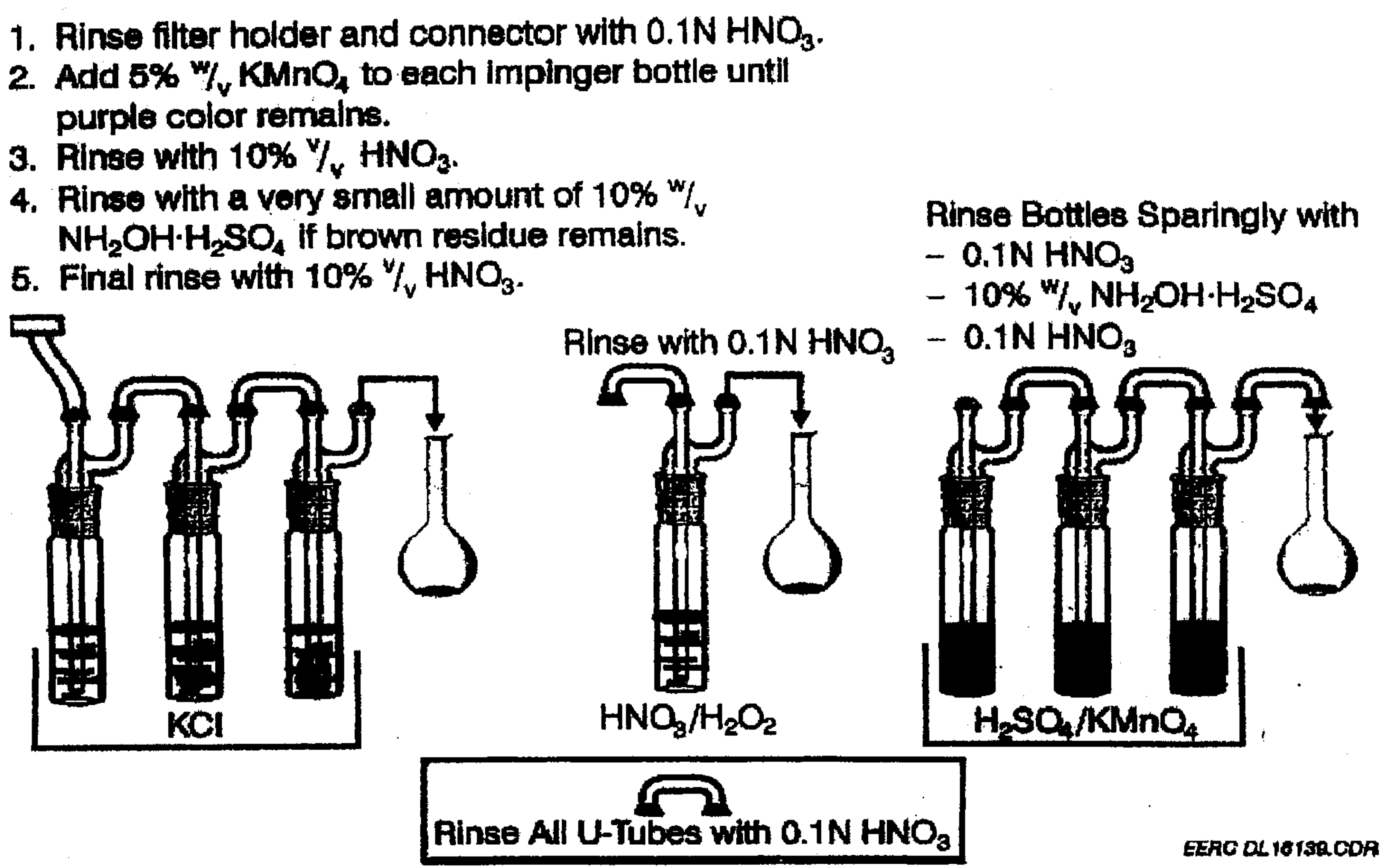


Figure 4-2 Sample Recovery Scheme for Ontario-Hydro Method Samples

4.1.2 Fuel samples

ADA Environmental Solutions L.L.C. personnel collected fuel samples by composite sampling. Samples were collected during each speciated mercury sampling run and composited into a single sample for each test day. Sample analysis was conducted according to the procedures of ASTM D3684 and ASTM D4208.

4.2 Procedures for Obtaining Process Data

Plant personnel were responsible for obtaining process-operating data. The process data presented in Tables 3-7 and 3-10 was continuously monitored by the facility. Process data was averaged over the course of each sample run.

4.3 Sample Identification and Custody

The chain-of-custody for all mercury samples obtained for analysis can be found in Appendix E.

5.0 INTERNAL QA/QC ACTIVITIES

All sampling, recovery and analytical procedures conform to those described in the site-specific test plan. All resultant data was reviewed by the laboratory and GE Mostardi Platt per the requirements listed in the QAPP.

5.1 QA/QC Problems

All quality control samples did not contain mercury at the detection limit and therefore all data is acceptable.

5.2 QA Audits

5.2.1 Reagent Blanks

As required by the method, blanks were collected for all reagents utilized. The results of reagent blank analysis from September and November 2001 are presented in Tables 5-1 and 5-2.

Table 5-1 BASELINE REAGENT BLANK ANALYSIS				
Container #	Sample Fraction	Contents	Mercury (μg)	Detection Limit (μg)
031, 032, 033, 034	Front-half	0.1N HNO_3/Filter	0.0282	0.003
035	1 N KCl	1 N KCl	<0.03	0.03
036	HNO_3/H_2O_2	HNO_3/H_2O_2	0.018	0.03
037, 038	$KMnO_4/H_2SO_4$	$KMnO_4/H_2SO_4$	<0.003	0.003

Table 5-2 LONG-TERM REAGENT BLANK ANALYSIS				
Container #	Sample Fraction	Contents	Mercury (μg)	Detection Limit (μg)
031, 032	Front-half	0.1N HNO_3/Filter	<0.003	0.003
033	1 N KCl	1 N KCl	<0.03	0.03
034	HNO_3/H_2O_2	HNO_3/H_2O_2	0.17 (not subtracted)	0.03
035, 036	$KMnO_4/H_2SO_4$	$KMnO_4/H_2SO_4$	0.007	0.003

5.2.2 Blank Trains

As required by the method, blank trains were collected at both the inlet and stack sampling locations. These trains were collected on September 10 and November 12, 2001. The results of blank train analysis are presented in Tables 5-3 and 5-4.

Table 5-3 BASELINE BLANK TRAIN ANALYSIS				
Container #	Sample Fraction	Contents	Mercury (μg)	Detection Limit (μg)
025	KCl impingers	Impingers/rinse	<0.03	0.03
028	KCl impingers	Impingers/rinse	<0.03	0.03
026	HNO_3-H_2O_2 impingers	Impingers/rinse	0.169	0.03
029	HNO_3-H_2O_2 impingers	Impingers/rinse	0.183	0.03
027	$KMnO_4/H_2SO_4$ impingers	Impingers/rinse	<0.003	0.003
030	$KMnO_4/H_2SO_4$ impingers	Impingers/rinse	<0.003	0.003

Table 5-3 LONG-TERM BLANK TRAIN ANALYSIS				
Container #	Sample Fraction	Contents	Mercury (µg)	Detection Limit (µg)
025	KCl impingers	Impingers/rinse	<0.03	0.03
028	KCl impingers	Impingers/rinse	<0.03	0.03
026	HNO_3-H_2O_2 impingers	Impingers/rinse	<0.03	0.03
029	HNO_3-H_2O_2 impingers	Impingers/rinse	<0.03	0.03
027	$KMnO_4$/H_2SO_4 impingers	Impingers/rinse	0.195	0.003
030	$KMnO_4$/H_2SO_4 impingers	Impingers/rinse	0.083	0.003

5.2.3 Field Dry Test Meter Audit

The field dry test meter audit described in Section 4.4.1 of Method 5 was completed prior to testing. The results of the audit are presented in Appendix C.

TRACE METALS TEST RESULTS SUMMARY				
Plant: WEPCO - Pleasant Prairie Power Plant			**Source: Unit No. 2**	
Test Location	North Outlet Duct			
Test Run Number	1	2	3	
Date	11/14/01	11/14/01	11/14/01	
Time	0735-0950	1020-1235	1254-1505	
Analyte:	Concentration (ug/dscm)*			Average
Arsenic	2.274	2.280	2.275	2.276
Chromium	4.412	4.332	2.957	3.900
Lead	2.274	2.280	2.275	2.276
Mercury	3.565	3.484	3.276	3.442
Nickel	2.274	12.996	2.957	6.076
Selenium	22.742	22.800	22.750	22.764
Analyte:	Emission Rate (lbs/hr)			Average
Arsenic	<0.003	<0.003	<0.003	<0.003
Chromium	<0.005	<0.005	<0.005	<0.005
Lead	<0.003	<0.003	<0.003	<0.003
Mercury	0.004	0.004	0.004	0.004
Nickel	<0.003	0.016	0.004	0.008
Selenium	<0.028	<0.028	<0.028	<0.028
Dscfm	330,312	319,853	327,467	325,877
Vmstd	77.641	77.446	77.616	77.568

PARTICULATE TEST RESULTS SUMMARY				
Plant: WEPCO - Pleasant Prairie Power Plant			**Source: Unit 2**	
Test Run Number	1	2	3	Average
Test Location	North Outlet Duct			
Source Condition	Normal Load			
Date	09/12/01	09/12/01	09/12/01	
Time	0822-1036	1104-1316	1344-1556	
Particulate Concentration:				
@ Flue Conditions, grains/acf	0.0012	0.0017	0.0017	0.0015
@ Standard Conditions, grains/dscf	0.0022	0.0030	0.0030	0.0027
Emission Rate:				
pounds/hour	6.022	8.346	8.737	7.702
pounds/10^6 Btu (F_d = 9780)	0.0041	0.0060	0.0057	0.0053
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	564,088	574,043	599,482	579,204
@ Standard Conditions, dscfm	324,386	325,145	338,121	329,217
Average Gas Temperature, °F	289	299	302	297
Average Gas Velocity, ft/sec	52.230	53.152	55.508	53.630
Flue Gas Moisture, percent by volume	13.6	13.8	13.8	13.7
Average Flue Pressure, in. Hg	28.24	28.24	28.24	
Barometric Pressure, in. Hg	29.42	29.42	29.42	
Average %CO_2 by volume, dry basis	13.6	13.5	13.7	13.6
Average %O_2 by volume, dry basis	5.4	6.3	5.4	5.7
% Excess Air	33.784	42.359	33.840	
Dry Molecular Wt. of Gas, lb/lb-mole	30.392	30.412	30.408	
Gas Sample Volume, dscf	76.226	76.772	80.357	
Isokinetic Variance	102.6	103.1	103.8	

PARTICULATE TEST RESULTS SUMMARY				
Plant: WEPCO - Pleasant Prairie Power Plant			**Source: Unit 2**	
Test Run Number	1	2	3	Average
Test Location	North Outlet Duct			
Source Condition	Normal Load			
Date	11/14/01	11/14/01	11/14/01	
Time	0735-0950	1020-1235	1254-1505	
Particulate Concentration:				
@ Flue Conditions, grains/acf	0.0009	0.0008	0.0009	0.0009
@ Standard Conditions, grains/dscf	0.0016	0.0015	0.0017	0.0016
Emission Rate:				
pounds/hour	4.501	4.151	4.687	4.446
pounds/10^6 Btu (F_d = 9780)	0.0030	0.0028	0.0031	0.0030
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	581,674	584,722	589,966	585,454
@ Standard Conditions, dscfm	330,312	319,853	327,467	325,877
Average Gas Temperature, °F	289	285	288	287
Average Gas Velocity, ft/sec	53.859	54.141	54.626	54.209
Flue Gas Moisture, percent by volume	13.9	17.5	16.0	15.8
Average Flue Pressure, in. Hg	27.99	27.99	27.99	
Barometric Pressure, in. Hg	29.25	29.25	29.25	
Average %CO_2 by volume, dry basis	13.8	13.8	13.7	13.8
Average %O_2 by volume, dry basis	5.2	5.3	5.4	5.3
% Excess Air	32.130	33.006	33.840	
Dry Molecular Wt. of Gas, lb/lb-mole	30.416	30.420	30.408	
Gas Sample Volume, dscf	77.641	77.446	77.616	
Isokinetic Variance	102.6	105.7	103.5	

APPENDIX E
PART 2

METHOD 29 - BASELINE DATA

GE Mostardi Platt
888 Industrial Drive
Elmhurst, Illinois 60126
Ph: 630-530-6600, Fax: 630-530-6630

PARTICULATE AND TRACE METALS EMISSIONS STUDY

Performed For

WISCONSIN ELECTRIC POWER COMPANY

At The

Pleasant Prairie Power Plant
Unit 2 ESP North Outlet Duct
Pleasant Prairie, Wisconsin
September 12, 2001

GE MOSTARDI PLATT PROJECT G013706A
DATE SUBMITTED: OCTOBER 25, 2001

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LIST OF PARTICIPANTS

Name	Organization	Project Role
Brenda Bergemann	WEPCO	Plant Coordinator
C. Jean Bustard	ADA Environmental Solutions	Project Consultant
James R. Platt	GE Mostardi Platt	Vice President
John Wendell	GE Mostardi Platt	Laboratory Chemist
Dan Bell	GE Mostardi Platt	Project Manager
Greg Rock	GE Mostardi Platt	Project Supervisor
Mike Ebner	GE Mostardi Platt	Test Engineer
Tim Mei	GE Mostardi Platt	Test Technician
Brad Hofferkamp	GE Mostardi Platt	Test Technician
Gail O'Neil	TEI	Speciated Hg Sample Analysis
Margaret Laumb	MTI	Coal Sample Analysis

CERTIFICATION SHEET

Having supervised and worked on the test program described in this report, and having written 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 MOSTARDI PLATT

Daniel S. Bell
Project Manager

Reviewed by:

Scott W. Banach
Director, Project Engineering

PARTICULATE AND TRACE METALS EMISSIONS STUDY
Performed For
WISCONSIN ELECTRIC POWER COMPANY
At The
Unit 2 ESP North Inlet and Outlet Duct
Pleasant Prairie, Wisconsin
September 12, 2001

1.0 INTRODUCTION

GE MOSTARDI PLATT, a division of GE Energy and Industrial Services, Inc. (GE Mostardi Platt) performed a particulate and trace metals emission test program on the Unit 2 ESP North Outlet Duct at the Pleasant Prairie Power Plant of Wisconsin Electric Power Company (WEPCO) in Pleasant Prairie, Wisconsin on September 12, 2001. The tests were authorized by and performed for WEPCO.

The purpose of this test program was to determine particulate and trace metals emission rates during normal operating conditions.

The tests were conducted by Messrs. G. Rock, B. Hofferkamp, B. Kauffunger and D. Bell of GE Mostardi Platt. Mr. Ed Morris of WEPCO provided assistance and coordinated plant operating conditions during the test program.

2.0 SUMMARY OF RESULTS

During this test program, three (3) particulate emission tests were performed at the North Outlet Duct of Unit 2. Three (3) trace metal tests were also performed simultaneously for the determination of arsenic, chromium, mercury, lead, nickel and selenium. Complete test results are given on pages 5 and 6. The following table summarizes the particulate results:

Parameter	Unit 2 ESP North Outlet Duct
Particulate Concentration, gr/dscf	0.0027
Particulate Emissions, lbs/hr	7.702
Particulate Emissions, lbs/10^6 Btu	0.0053

3.0 DISCUSSION OF RESULTS

No problems were encountered with the testing equipment during the test program. Source operation appeared normal during the entire test program. Unit operating data was recorded and retained by plant personnel.

4.0 TEST PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed as described in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A (40CFR60), Methods 1-5, 29 and the latest revisions thereof. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, USEPA 600/4-77-027b was used to determine the precise procedures.

4.1 Volumetric Flowrate Determination

In order to determine the emission rate on a lbs/hr basis, the gas velocity and volumetric flowrate were determined at the test locations using Method 2, 40CFR60.

Velocity pressures were determined by traversing the test locations with an S-type pitot tube. Temperatures were measured using a K-type thermocouple with a calibrated digital temperature indicator. 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 analyzed samples collected in an integrated manner 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 28 test points were sampled using 7 ports at the test location.

The particulate sample train was manufactured by Nutech Corporation of Durham, North Carolina and meets all specifications required by Method 5, 40CFR60. A teflon-lined probe was 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 quartz microfibre filters exhibiting a ≥ 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 HPLC reagent-grade acetone. These washes were placed in sealed and marked containers for analysis.

All sample recovery was performed at the test site by the test crew. All final particulate sample analyses were performed by GE Mostardi Platt personnel at the GE Mostardi Platt laboratory in Elmhurst, Illinois. Copies of all sample analysis sheets are appended to this report.

4.4 Trace Metals Determination

The trace metals sample train is one of the comprehensive sampling systems, which is used to sample stack gas effluent. This system is based upon the design of units which are normally employed for sampling under Method 5, 40CFR60. The modified system consisted of a probe, a high-efficiency glass fiber filter stage, and four impingers. The Method 5 sampling train was used in conjunction with the metals tests.

The train consisted of the following components: a glass liner wrapped with heating wire and a stainless steel jacket. Samples were collected while the probe was heated to a gas temperature of 248°F ± 25°F. The filter holder was equipped with a Teflon filter support and a tared glass fiber filter. The filter medium was a Whatman quartz filter exhibiting a > 99.97% efficiency on 0.3 micron DOP smoke particles. The filter holder was contained in an electrically heated enclosed box that was thermostatically maintained at a temperature of 248°F ± 25°F, which is sufficient to prevent water condensation in this portion of the train.

The first and second impingers were modified versions of the Greenburg-Smith design; initially, they were filled with 200 mls of 5% HNO_3/10% H_2O_2. The third impinger was also a Greenburg-Smith impinger. It was filled with 100 mls of acidic $KMnO_4$. The fourth impinger was filled with silica gel to absorb any remaining moisture.

A total number of 28 points using 7 ports was utilized for the test. Tests were performed for a minimum of two hours in length.

All sample contact surfaces of the train were washed with 0.1 N nitric acid. The first two impingers were also washed with 0.1N nitric acid. The third impinger was rinsed with the acidic $KMnO_4$ and 8N HCl. The washes were placed in sealed and marked containers for analysis.

Sample recovery was performed at the test site by the test crew. Samples were transported to an approved lab for analysis. Copies of all sample analysis sheets, explanation of nomenclature and calculations, calibration data, complete test results and raw field data sheets are appended to this report.

Raw data are kept on file at the GE Mostardi Platt 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 Mostardi Platt is advised otherwise.

5.0 QUALITY ASSURANCE PROCEDURES

GE Mostardi Platt 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 Mostardi Platt 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.

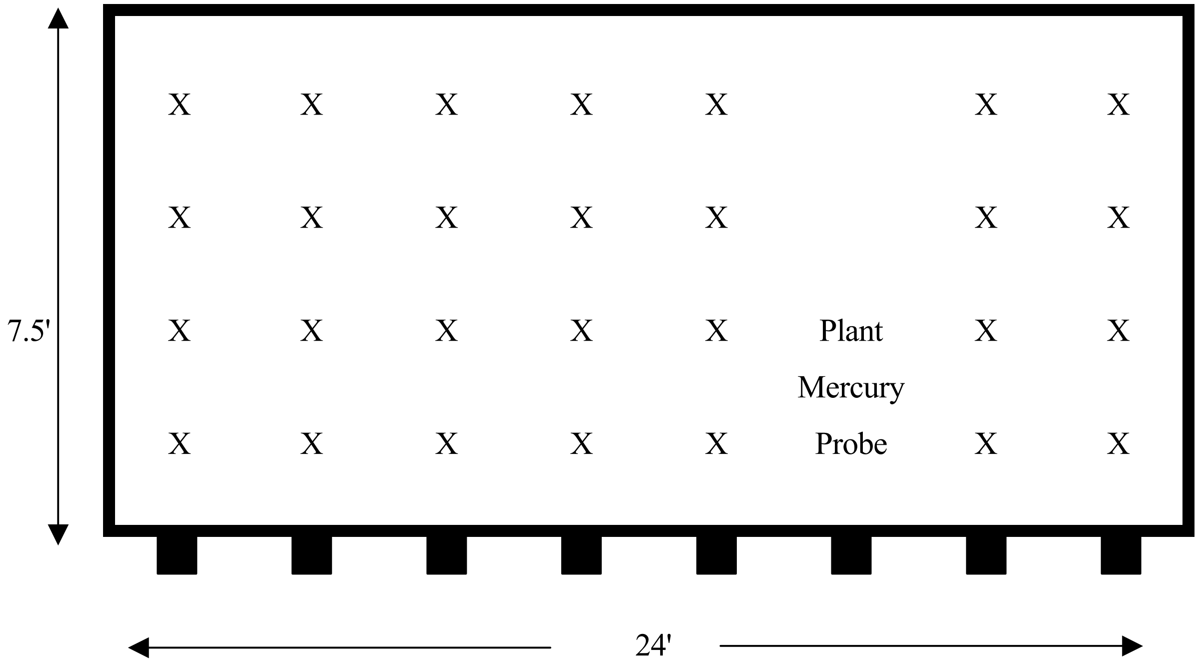
6.0 TEST RESULTS SUMMARY

PARTICULATE TEST RESULTS SUMMARY				
Plant: WEPCO - Pleasant Prairie Power Plant			**Source: Unit 2**	
Test Run Number	1	2	3	Average
Test Location	North Outlet Duct			
Source Condition	Normal Load			
Date	09/12/01	09/12/01	09/12/01	
Time	0822-1036	1104-1316	1344-1556	
Particulate Concentration:				
@ Flue Conditions, grains/acf	0.0012	0.0017	0.0017	0.0015
@ Standard Conditions, grains/dscf	0.0022	0.0030	0.0030	0.0027
Emission Rate:				
pounds/hour	6.022	8.346	8.737	7.702
pounds/10^6 Btu (F_d = 9780)	0.0041	0.0060	0.0057	0.0053
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	564,088	574,043	599,482	579,204
@ Standard Conditions, dscfm	324,386	325,145	338,121	329,217
Average Gas Temperature, °F	289	299	302	297
Average Gas Velocity, ft/sec	52.230	53.152	55.508	53.630
Flue Gas Moisture, percent by volume	13.6	13.8	13.8	13.7
Average Flue Pressure, in. Hg	28.24	28.24	28.24	
Barometric Pressure, in. Hg	29.42	29.42	29.42	
Average %CO_2 by volume, dry basis	13.6	13.5	13.7	13.6
Average %O_2 by volume, dry basis	5.4	6.3	5.4	5.7
% Excess Air	33.784	42.359	33.840	
Dry Molecular Wt. of Gas, lb/lb-mole	30.392	30.412	30.408	
Gas Sample Volume, dscf	76.226	76.772	80.357	
Isokinetic Variance	102.6	103.1	103.8	

TRACE METALS TEST RESULTS SUMMARY				
Plant: WEPCO - Pleasant Prairie Power Plant			**Source: Unit No. 2**	
Test Location	North Outlet Duct			
Test Run Number	1	2	3	
Date	09/12/01	09/12/01	09/12/01	
Time	0822-1036	1104-1316	1344-1556	
Analyte:	Concentration (ug/dscm)*			Average
Arsenic	0.463	0.460	0.439	0.454
Chromium	4.633	2.300	4.307	3.747
Lead	2.316	2.300	2.197	2.271
Mercury	11.744	11.523	9.642	10.970
Nickel	2.316	2.300	2.197	2.271
Selenium	9.266	9.200	8.789	9.085
Analyte:	Emission Rate (lbs/hr)			Average
Arsenic	<0.001	<0.001	<0.001	<0.001
Chromium	0.006	<0.003	0.005	<0.005
Lead	<0.003	<0.003	<0.003	<0.003
Mercury	0.014	0.014	0.012	0.013
Nickel	<0.003	<0.003	<0.003	<0.003
Selenium	<0.011	<0.011	<0.011	<0.011
Dscfm	324,386	325,145	338,121	329,217
Vmstd	76.226	76.772	80.357	77.785

* Maximum Possible Concentrations

EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS



Job: WEPCO
Pleasant Prairie, Wisconsin

Date: September 12, 2001

Area: 180 Square Feet

Unit No: 2 ESP North Outlet

No. Test Ports: 7

Length: 24 Feet

Tests Points per Port: 4

Width: 7.5 Feet

APPENDIX E
PART 2

ATTACHMENT A
PROCESS OPERATING DATA

DOE/NETL Mercury Reduction Demonstration
Wisconsin Electric-Pleasant Prairie Power Plant
Unit 2 Baseline Test September 10-14, 2001

DATE	TIME	Gross Load (Mw) 2MP007	Coal Feed (Klb/hr) 2CV902	Coal Btu (Btu/lb) 2BY376	ESP Inlet Temp (°F) 2BA017	ESP Outlet Temp (°F) 2BA027	Main Steam Flow (KLb/hr) 2MS027	Main Steam Temp. (oF) 2MS013	Boiler Percent O_2 Average 2BA078	Air Heater %O_2 Point A 2BA311	Air Heater %O_2 Point B 2BA312	Air Heater %O_2 Point C 2BA313	Air Heater %O_2 Point D 2BA314	Stack SO_2 (ppm) 0BA080	U2 Duct NO_x (ppm) 2BA079	2-3/2-4 Duct Opacity (Percent) 2BA309	2-1/2-2 Duct Opacity (Percent) 2BA308	6 min. Avg. Stack Opacity (Percent) 2BA308	U2 Duct Percent CO_2 2BA081	SO3 Converter Outlet Temp (oF) 2PE065	SO3 Burner Outlet Temp (oF) 2PE066	SO3 Air Htr. Outlet Temp (oF) 2PE067
09/10/2001	14:35:56	568	714	8471	283	297	3,926	956	2.4	2.8	2.5	2.2	2.2	257	264	8.9	6.4	4.6	11.8	834.4	812.4	640.7
09/10/2001	14:40:56	574	714	8471	282	296	3,962	956	2.4	2.6	2.5	2.3	2.3	262	265	9.2	6.6	5.2	11.8	834.1	812.1	640.4
09/10/2001	14:45:57	568	690	8471	281	296	3,909	958	2.5	2.7	2.6	2.4	2.3	255	264	9.1	7.0	5.7	11.7	833.8	812.1	641.9
09/10/2001	14:50:57	580	747	8471	280	296	3,995	960	2.5	2.7	2.6	2.4	2.4	257	272	9.1	7.0	5.7	11.9	833.5	812.4	641.6
09/10/2001	14:55:57	550	675	8471	278	295	3,813	951	2.8	3.2	2.8	2.6	2.6	258	268	9.3	7.1	5.7	11.9	833.5	812.1	640.1
09/10/2001	15:00:57	565	681	8471	278	295	3,903	953	2.6	2.9	2.8	2.4	2.4	260	-666	8.9	6.7	4.9	-666.0	833.2	812.7	646.0
09/10/2001	15:05:57	574	729	8471	279	294	3,948	958	2.4	2.4	2.4	2.3	2.4	261	-666	9.1	7.0	5.1	-666.0	832.9	812.7	643.7
09/10/2001	15:10:57	574	720	8471	277	293	3,934	957	2.6	2.8	2.8	2.5	2.5	257	-666	8.8	7.3	5.9	-666.0	832.6	812.7	641.3
09/10/2001	15:15:57	577	717	8471	276	292	3,969	959	2.4	2.6	2.6	2.2	2.1	259	-666	8.9	7.6	5.7	-666.0	832.6	812.7	640.4
09/10/2001	15:20:57	565	732	8471	276	291	3,907	954	2.6	2.8	2.7	2.5	2.5	259	-666	8.9	7.6	5.6	-666.0	832.9	812.7	639.6
09/10/2001	15:25:57	578	714	8471	275	291	3,976	956	2.4	2.5	2.4	2.2	2.3	260	-666	8.9	7.2	5.8	-666.0	833.2	811.8	638.7
09/10/2001	15:30:57	587	708	8471	275	290	4,031	956	2.6	2.7	2.6	2.5	2.5	266	-666	8.6	7.7	5.6	-666.0	832.9	812.7	639.8
09/10/2001	15:35:57	586	735	8471	276	290	4,026	957	2.3	2.6	2.6	2.2	2.0	262	-666	8.4	7.5	5.7	-666.0	833.2	812.4	637.8
09/10/2001	15:40:57	592	768	8471	276	289	4,076	956	2.4	2.4	2.4	2.4	2.4	263	-666	8.4	6.9	5.5	-666.0	833.2	812.4	636.9
09/10/2001	15:45:57	592	771	8471	277	289	4,080	956	2.3	2.4	2.4	2.1	2.2	263	-666	8.4	7.5	5.9	-666.0	833.2	812.1	635.4
09/10/2001	15:50:57	595	705	8471	276	289	4,093	955	2.4	2.7	2.4	2.3	2.3	266	-666	8.4	7.5	5.9	-666.0	833.5	811.8	636.9
09/10/2001	15:55:57	593	762	8471	278	289	4,082	956	2.3	2.4	2.3	2.2	2.3	270	-666	8.2	7.2	5.6	-666.0	833.2	812.4	636.0
09/10/2001	16:00:57	589	750	8471	279	289	4,059	956	2.3	2.5	2.4	2.2	2.1	274	-666	8.4	7.2	5.4	-666.0	833.8	812.1	634.6
09/10/2001	16:05:57	605	735	8471	280	290	4,174	952	2.1	2.2	2.1	2.0	2.1	271	-666	8.2	7.2	5.4	-666.0	833.8	812.7	637.5
09/10/2001	16:10:58	608	741	8471	281	290	4,200	950	2.2	2.4	2.3	2.1	2.2	276	-666	8.1	7.1	5.2	-666.0	833.5	812.1	635.4
09/10/2001	16:15:58	608	747	8471	281	290	4,203	951	2.2	2.4	2.3	2.1	2.1	275	-666	8.3	7.1	5.1	-666.0	833.5	812.1	636.3
09/10/2001	16:20:58	604	738	8471	282	291	4,180	953	2.3	2.5	2.4	2.2	2.2	272	-666	8.3	7.1	5.0	-666.0	833.5	812.4	635.7
09/10/2001	16:25:58	604	798	8471	283	291	4,153	959	2.1	2.2	2.2	2.0	2.0	274	-666	8.3	6.9	5.7	-666.0	833.5	812.1	635.2
09/10/2001	16:30:58	595	741	8471	282	291	4,113	956	2.2	2.3	2.2	2.1	2.1	273	-666	8.4	6.5	5.5	-666.0	833.8	812.1	634.6
09/10/2001	16:35:58	601	714	8471	282	292	4,164	953	2.0	2.2	2.0	1.8	2.0	274	-666	8.2	6.2	5.0	-666.0	834.1	812.7	638.7
09/10/2001	16:40:58	608	747	8471	284	293	4,196	958	2.1	2.2	2.2	2.0	2.0	277	-666	8.2	6.4	5.4	-666.0	833.8	812.7	635.7
09/10/2001	16:45:58	600	729	8471	284	293	4,143	955	2.4	2.6	2.5	2.4	2.4	270	-666	8.8	6.6	5.3	-666.0	833.8	812.1	634.0
09/10/2001	16:50:58	597	750	8471	283	294	4,122	957	2.1	2.3	2.2	2.0	2.1	277	-666	8.8	6.6	5.3	-666.0	833.8	812.1	634.9
09/10/2001	16:55:58	588	732	8471	283	293	4,056	960	2.3	2.4	2.3	2.2	2.3	278	-666	8.8	6.5	5.5	-666.0	834.1	811.8	635.7
09/10/2001	17:00:58	602	738	8471	284	294	4,146	957	2.3	2.3	2.3	2.2	2.3	276	-666	8.7	6.4	5.2	-666.0	833.8	812.4	636.3
09/10/2001	17:05:58	608	759	8471	284	294	4,177	961	2.2	2.3	2.2	2.0	2.2	274	-666	9.1	6.5	5.3	-666.0	833.5	812.1	636.0
Test 1 Average		**588**	**732**	**8471**	**280**	**292**	**4055**	**956**	**2**	**3**	**2**	**2**	**2**	**267**	**-516**	**9**	**7**	**5**	**-557**	**833**	**812**	**638**

DOE/NETL Mercury Reduction Demonstration
Wisconsin Electric-Pleasant Prairie Power Plant
Unit 2 Baseline Test September 10-14, 2001

DATE	TIME	Gross Load (Mw) 2MP007	Coal Feed (Klb/hr) 2CV902	Coal Btu (Btu/lb) 2BY376	ESP Inlet Temp (°F) 2BA017	ESP Outlet Temp (°F) 2BA027	Main Steam Flow (KLb/hr) 2MS027	Main Steam Temp. (oF) 2MS013	Boiler Percent O_2 Average 2BA078	Air Heater %O_2 Point A 2BA311	Air Heater %O_2 Point B 2BA312	Air Heater %O_2 Point C 2BA313	Air Heater %O_2 Point D 2BA314	Stack SO_2 (ppm) 0BA080	U2 Duct NO_x (ppm) 2BA079	2-3/2-4 Duct Opacity (Percent) 2BA309	2-1/2-2 Duct Opacity (Percent) 2BA308	6 min. Avg. Stack Opacity (Percent) 2BA308	U2 Duct Percent CO_2 2BA081	SO3 Converter Outlet Temp (oF) 2PE065	SO3 Burner Outlet Temp (oF) 2PE066	SO3 Air Htr. Outlet Temp (oF) 2PE067
9/11/01	9:31:10	624	753	8471	280	292	4,290	955	1.8	2.1	2.2	1.5	1.5	291	258	8.8	6.7	5.2	12.3	834.7	812.7	632.2
9/11/01	9:36:10	619	789	8471	280	292	4,254	955	2.2	2.1	2.3	2.1	2.1	286	263	8.7	6.6	4.4	12.1	835.0	812.7	631.9
9/11/01	9:41:10	617	777	8471	280	292	4,253	951	2.3	2.4	2.3	2.2	2.2	289	253	8.7	6.5	4.5	12.5	835.0	813.0	631.9
9/11/01	9:46:10	623	768	8471	280	292	4,265	962	1.7	1.7	1.9	1.6	1.7	292	262	8.7	6.6	4.5	12.4	834.7	812.7	631.6
9/11/01	9:51:10	621	777	8471	281	292	4,254	960	2.0	2.3	2.2	1.6	1.7	289	258	8.7	6.6	4.4	12.3	835.0	812.7	631.6
9/11/01	9:56:10	623	753	8471	281	292	4,283	954	2.0	2.1	2.0	1.9	2.0	286	255	8.7	6.6	4.4	12.5	835.0	812.4	632.2
9/11/01	10:01:10	618	801	8471	282	292	4,259	950	2.2	2.2	2.3	1.9	2.2	292	257	8.4	6.5	4.4	12.3	835.0	812.7	631.9
9/11/01	10:06:10	621	786	8471	283	292	4,266	958	2.0	2.4	2.4	1.7	1.7	285	262	8.8	6.7	4.4	12.3	835.0	812.4	631.1
9/11/01	10:11:10	623	771	8471	283	292	4,270	959	1.8	2.1	2.0	1.5	1.6	285	259	8.5	6.5	4.7	12.2	834.7	812.7	631.3
9/11/01	10:16:11	621	759	8471	283	292	4,269	956	2.1	2.3	2.2	1.9	2.0	290	258	8.4	6.5	4.3	12.4	835.0	812.7	631.6
9/11/01	10:21:11	623	762	8471	284	293	4,272	956	1.9	2.1	2.0	1.7	2.0	287	-666	8.4	6.5	4.7	-666.0	835.0	812.1	630.8
9/11/01	10:26:11	621	774	8471	284	293	4,276	952	2.2	2.3	2.2	2.0	2.1	288	-666	8.5	6.6	4.8	-666.0	835.3	812.7	633.1
9/11/01	10:31:11	623	753	8471	284	293	4,274	955	2.2	2.4	2.3	2.0	2.1	288	-666	8.7	6.6	4.6	-666.0	835.0	812.4	631.3
9/11/01	10:36:11	623	777	8471	286	293	4,277	956	2.0	2.1	2.1	1.9	2.1	287	-666	8.7	6.6	4.5	-666.0	835.0	812.4	632.2
9/11/01	10:41:11	622	771	8471	286	294	4,270	956	2.0	2.2	2.1	1.8	1.9	290	-666	8.9	6.7	4.6	-666.0	835.0	812.4	631.9
9/11/01	10:46:11	622	768	8471	287	294	4,265	957	2.2	2.4	2.3	2.0	2.2	286	-666	8.8	7.1	4.6	-666.0	834.7	812.4	632.2
9/11/01	10:51:11	620	792	8471	287	294	4,254	955	2.3	2.6	2.4	2.1	2.2	287	-666	8.8	7.1	4.6	-666.0	835.3	812.1	631.6
9/11/01	10:56:11	622	783	8471	288	294	4,255	960	2.2	2.3	2.3	2.0	2.1	288	-1	8.8	6.9	4.6	-1.0	835.3	812.4	635.4
9/11/01	11:01:11	625	768	8471	288	294	4,271	960	2.0	2.2	2.2	1.8	2.0	289	-1	8.8	6.7	4.8	-1.0	834.7	812.7	634.9
9/11/01	11:06:11	622	765	8471	289	294	4,257	956	2.1	2.4	2.2	1.8	2.0	284	-1	8.7	6.7	4.6	-1.0	834.7	812.7	633.4
9/11/01	11:11:11	622	780	8471	290	294	4,260	957	2.2	2.3	2.2	2.0	2.2	283	-1	8.9	7.3	5.5	-1.0	834.7	812.4	632.8
9/11/01	11:16:11	623	753	8471	291	295	4,268	956	2.2	2.3	2.2	2.0	2.2	290	-1	9.2	7.0	5.2	-1.0	835.0	812.4	631.3
9/11/01	11:21:11	623	777	8471	291	295	4,265	958	2.0	2.2	2.2	1.8	1.9	290	-1	9.1	7.0	5.1	-1.0	835.0	812.1	631.6
9/11/01	11:26:11	621	789	8471	291	295	4,244	957	2.2	2.4	2.3	1.9	2.1	286	-1	9.3	7.1	5.1	-1.0	835.0	812.1	631.9
9/11/01	11:31:11	622	783	8471	292	296	4,263	958	2.2	2.4	2.3	2.1	2.2	284	-1	9.4	7.2	5.5	-1.0	835.0	812.4	632.5
9/11/01	11:36:12	626	780	8471	292	296	4,280	961	2.2	2.2	2.3	2.1	2.1	289	-1	9.6	6.6	5.4	-1.0	835.0	812.4	631.9
9/11/01	11:41:12	625	771	8471	293	296	4,283	955	2.1	2.4	2.2	1.9	2.0	290	-1	9.3	6.6	5.3	-1.0	835.0	812.4	631.3
9/11/01	11:46:12	621	780	8471	294	297	4,271	951	2.3	2.4	2.3	2.1	2.3	290	-1	9.2	6.7	5.2	-1.0	835.0	812.1	630.2
9/11/01	11:51:12	620	786	8471	294	297	4,280	951	2.1	2.2	2.1	1.9	2.0	285	-1	9.2	6.7	5.2	-1.0	835.0	812.4	632.5
9/11 Average		**622**	**774**	**8471**	**286**	**294**	**4267**	**956**	**2.1**	**2.3**	**2.2**	**1.9**	**2.0**	**288**	**-72**	**8.8**	**6.7**	**4.8**	**-156.9**	**834.9**	**812.5**	**632.1**

DATE	TIME (CDT)	Gross Load (Mw) 2MP007	Coal Feed (Klb/hr) 2CV902	Coal Btu (Btu/lb) 2BY376	ESP Inlet Temp (°F) 2BA017	ESP Outlet Temp (°F) 2BA027	Main Steam Flow (KLb/hr) 2MS027	Main Steam Temp. (oF) 2MS013	Boiler Percent O_2 Average 2BA078	Air Heater %O_2 Point A 2BA311	Air Heater %O_2 Point B 2BA312	Air Heater %O_2 Point C 2BA313	Air Heater %O_2 Point D 2BA314	Stack SO_2 (ppm) 0BA080	U2 Duct NO_x (ppm) 2BA079	2-3/2-4 Duct Opacity (Percent) 2BA309	2-1/2-2 Duct Opacity (Percent) 2BA308	6 min. Avg. Stack Opacity (Percent) 2BA308	U2 Duct Percent CO_2 2BA081	SO3 Converter Outlet Temp (oF) 2PE065	SO3 Burner Outlet Temp (oF) 2PE066	SO3 Air Htr. Outlet Temp (oF) 2PE067
11/12/2001	13:30:03	621	738	8471	295	298	4,230	950	2.1	2.1	2.0	2.0	2.1	293	296	9.3	7.6	6.3	13.1	732.7	643.4	320.2
11/12/2001	13:35:02	620	735	8471	295	298	4,241	949	2.4	2.3	2.3	2.4	2.6	309	293	9.3	7.6	6.5	13.2	738.0	573.3	231.7
11/12/2001	13:40:02	618	741	8471	295	298	4,243	946	2.5	2.3	2.3	2.5	2.7	304	297	9.5	7.7	7.1	13.2	729.8	521.5	186.3
11/12/2001	13:45:03	617	771	8471	295	298	4,213	951	2.5	2.5	2.5	2.5	2.6	292	304	9.9	8.2	7.0	13.1	711.3	480.8	162.9
11/12/2001	13:50:03	617	771	8471	295	298	4,208	953	2.3	2.3	2.2	2.3	2.5	296	305	10.2	8.6	7.0	13.0	677.1	461.7	232.9
11/12/2001	13:55:02	622	714	8471	295	298	4,252	946	2.3	2.4	2.3	2.3	2.4	300	292	10.1	8.3	7.1	13.4	637.8	508.9	427.1
11/12/2001	14:00:03	621	744	8471	296	298	4,248	947	2.2	2.1	2.0	2.3	2.5	305	295	10.1	8.2	6.9	13.2	599.4	580.1	513.9
11/12/2001	14:05:03	619	738	8471	296	299	4,226	949	2.3	2.2	2.1	2.3	2.5	293	301	10.1	8.2	6.8	13.1	570.7	615.5	552.0
11/12/2001	14:10:01	618	732	8471	297	299	4,229	947	2.4	2.5	2.3	2.4	2.4	293	297	10.3	8.5	7.0	13.2	555.5	613.2	573.6
11/12/2001	14:15:03	621	768	8471	297	299	4,220	957	2.2	2.2	2.0	2.2	2.4	291	308	10.2	8.7	7.5	13.0	551.4	615.2	587.1
11/12/2001	14:20:03	619	744	8471	297	299	4,221	950	2.5	2.5	2.3	2.4	2.6	293	299	10.3	8.4	7.4	13.1	555.5	619.9	596.2
11/12/2001	14:25:03	621	747	8471	297	299	4,229	952	2.3	2.3	2.2	2.2	2.4	299	302	10.4	8.8	7.0	13.0	566.3	625.2	602.6
11/12/2001	14:30:03	621	735	8471	298	300	4,247	947	2.2	2.3	2.1	2.1	2.3	293	294	10.2	8.4	6.6	13.3	579.5	630.2	607.6
11/12/2001	14:35:03	621	750	8471	298	299	4,241	945	2.2	2.3	2.1	2.1	2.3	288	291	10.2	8.4	7.4	13.2	590.3	635.4	611.1
11/12/2001	14:40:02	622	729	8471	298	300	4,246	949	2.1	2.0	1.9	2.0	2.3	298	293	10.4	8.8	6.9	13.1	599.1	639.6	613.5
11/12/2001	14:45:03	618	750	8471	298	300	4,216	951	2.4	2.4	2.3	2.3	2.5	293	300	10.4	8.6	7.0	12.8	606.2	647.5	615.8
11/12/2001	14:50:03	619	723	8471	298	300	4,229	948	2.3	2.3	2.2	2.3	2.4	301	297	10.7	8.9	7.0	13.2	613.2	672.7	617.9
11/12/2001	14:55:02	617	774	8471	298	300	4,222	948	2.4	2.5	2.3	2.3	2.4	293	298	10.7	8.8	6.3	13.1	622.0	709.0	619.3
11/12/2001	15:00:03	620	744	8471	298	300	4,230	948	2.2	2.1	2.1	2.3	2.5	288	298	10.6	8.8	6.4	13.1	637.5	745.3	621.1
11/12/2001	15:05:02	620	744	8471	298	300	4,227	950	2.2	2.2	2.2	2.1	2.3	291	296	10.6	8.7	6.4	13.1	661.5	767.9	624.0
11/12/2001	15:10:03	620	756	8471	298	301	4,242	947	2.3	2.3	2.2	2.3	2.4	290	300	10.0	8.4	6.3	13.1	686.1	782.5	626.4
11/12/2001	15:15:03	621	735	8471	298	301	4,240	949	2.4	2.4	2.3	2.3	2.5	285	292	9.0	7.2	6.3	13.2	706.3	793.9	627.0
11/12/2001	15:20:02	619	759	8471	299	301	4,226	950	2.3	2.3	2.2	2.3	2.5	283	297	8.8	7.0	6.3	13.0	722.2	800.7	618.2
11/12/2001	15:25:01	618	747	8471	299	301	4,232	947	2.4	2.3	2.3	2.4	2.6	285	300	8.6	6.8	5.7	13.0	735.1	804.8	609.7
11/12/2001	15:30:01	619	753	8471	300	301	4,248	943	2.3	2.3	2.2	2.2	2.3	289	295	8.8	6.7	5.7	13.1	747.4	806.5	602.6
11/12/2001	15:35:02	617	732	8471	299	302	4,248	942	2.3	2.3	2.2	2.2	2.4	287	292	8.8	6.7	5.8	13.2	759.4	808.6	596.8
11/12/2001	15:40:02	619	744	8471	300	302	4,252	945	2.2	2.2	2.2	2.1	2.2	289	291	8.4	6.9	5.7	13.0	771.1	809.2	587.7
11/12/2001	15:45:02	618	747	8471	301	302	4,246	949	2.2	2.0	2.0	2.2	2.4	287	283	8.9	7.0	5.7	13.0	782.2	809.2	585.9
Test 1 Avergae		**619**	**745**	**8471**	**297**	**300**	**4234**	**948**	**2.3**	**2.3**	**2.2**	**2.3**	**2.4**	**293**	**297**	**9.8**	**8.0**	**6.6**	**13.1**	**658.7**	**668.6**	**527.5**

DATE	TIME (CDT)	Gross Load (Mw) 2MP007	Coal Feed (Klb/hr) 2CV902	Coal Btu (Btu/lb) 2BY376	ESP Inlet Temp (°F) 2BA017	ESP Outlet Temp (°F) 2BA027	Main Steam Flow (KLb/hr) 2MS027	Main Steam Temp. (oF) 2MS013	Boiler Percent O_2 Average 2BA078	Air Heater %O_2 Point A 2BA311	Air Heater %O_2 Point B 2BA312	Air Heater %O_2 Point C 2BA313	Air Heater %O_2 Point D 2BA314	Stack SO_2 (ppm) 0BA080	U2 Duct NO_x (ppm) 2BA079	2-3/2-4 Duct Opacity (Percent) 2BA309	2-1/2-2 Duct Opacity (Percent) 2BA308	6 min. Avg. Stack Opacity (Percent) 2BA308	U2 Duct Percent CO_2 2BA081	SO3 Converter Outlet Temp (oF) 2PE065	SO3 Burner Outlet Temp (oF) 2PE066	SO3 Air Htr. Outlet Temp (oF) 2PE067
11/13/2001	8:10:01	615	753	8471	279	289	4,222	956	2.3	2.5	2.4	2.2	2.3	313	288	7.5	5.9	5.2	12.9	840.2	811.8	601.5
11/13/2001	8:15:02	616	732	8471	279	289	4,215	956	2.2	2.5	2.3	2.0	2.1	308	281	7.5	5.9	5.3	13.0	840.2	812.4	605.0
11/13/2001	8:20:01	617	732	8471	279	289	4,225	956	2.3	2.5	2.4	2.0	2.2	308	287	7.5	6.1	5.4	12.8	839.9	812.4	603.2
11/13/2001	8:25:02	617	711	8471	279	288	4,233	954	2.3	2.4	2.3	2.1	2.4	311	278	7.4	5.9	5.7	13.0	839.9	812.4	604.1
11/13/2001	8:30:01	618	741	8471	280	288	4,237	952	2.3	2.5	2.3	2.1	2.2	311	283	7.5	5.8	5.4	13.0	839.9	812.4	602.1
11/13/2001	8:35:02	614	732	8471	281	288	4,202	953	2.4	2.7	2.4	2.1	2.3	306	285	7.5	5.7	5.1	13.0	839.6	812.1	603.8
11/13/2001	8:40:01	615	756	8471	282	288	4,198	960	2.4	2.4	2.4	2.3	2.4	307	285	7.5	5.7	5.8	13.1	839.9	812.1	605.9
11/13/2001	8:45:02	619	747	8471	282	289	4,218	960	2.4	2.5	2.5	2.2	2.3	310	289	7.5	5.9	5.5	12.9	839.6	812.7	605.3
11/13/2001	8:50:02	618	744	8471	283	289	4,226	956	2.4	2.6	2.4	2.2	2.4	307	289	7.4	6.0	5.5	12.8	839.6	812.7	604.1
11/13/2001	8:55:02	622	741	8471	284	290	4,252	956	2.0	2.1	2.0	1.9	2.2	309	283	7.4	6.0	5.5	13.0	839.6	812.4	603.8
11/13/2001	9:00:02	620	735	8471	285	290	4,237	957	2.3	2.5	2.4	2.1	2.3	303	285	7.4	5.9	5.3	12.9	839.6	812.1	603.2
11/13/2001	9:05:02	616	756	8471	286	290	4,202	957	2.4	2.8	2.5	2.1	2.2	310	296	7.4	5.9	5.5	12.7	839.6	812.1	605.6
11/13/2001	9:10:03	616	759	8471	287	291	4,204	957	2.4	2.6	2.5	2.2	2.3	302	295	7.6	6.1	4.9	12.9	839.6	812.7	607.3
11/13/2001	9:15:03	620	732	8471	287	291	4,238	953	2.3	2.5	2.3	2.1	2.3	311	292	7.6	6.1	5.3	13.0	839.4	813.0	604.7
11/13/2001	9:20:02	623	738	8471	288	291	4,249	955	2.1	2.2	2.1	2.0	2.1	308	290	7.5	6.0	5.3	13.1	839.6	813.0	603.5
11/13/2001	9:25:02	621	735	8471	288	292	4,237	957	2.2	2.4	2.3	2.0	2.2	307	289	7.5	6.1	5.0	12.9	839.6	813.3	599.7
11/13/2001	9:30:02	618	750	8471	289	292	4,219	956	2.3	2.6	2.5	2.1	2.2	312	294	7.5	6.0	5.1	12.9	839.6	812.7	599.1
11/13/2001	9:35:02	621	726	8471	289	292	4,236	954	2.2	2.4	2.2	2.1	2.3	308	294	7.5	6.0	4.8	13.1	840.2	812.7	598.8
11/13/2001	9:40:02	617	738	8471	289	293	4,213	952	2.6	2.8	2.7	2.5	2.6	305	297	7.7	5.9	5.2	13.1	839.9	812.7	597.9
11/13/2001	9:45:03	620	747	8471	290	293	4,221	959	2.3	2.4	2.2	2.2	2.4	308	294	7.6	5.9	4.9	13.0	840.2	812.7	596.8
11/13/2001	9:50:02	621	747	8471	290	293	4,230	958	2.2	2.4	2.3	2.1	2.2	303	299	7.7	6.2	5.0	12.9	840.2	812.7	595.6
11/13/2001	9:55:03	619	741	8471	290	293	4,214	954	2.3	2.5	2.3	2.1	2.4	309	297	7.6	6.2	5.2	13.1	840.5	812.1	595.0
11/13/2001	10:00:03	622	750	8471	290	293	4,229	959	2.3	2.3	2.3	2.2	2.4	303	298	7.7	6.4	4.8	12.8	841.1	812.4	595.6
11/13/2001	10:05:03	624	729	8471	290	294	4,257	955	2.1	2.3	2.2	1.9	2.1	309	302	7.7	6.3	5.3	12.9	841.1	812.1	595.3
11/13/2001	10:10:02	620	750	8471	291	294	4,240	950	2.2	2.3	2.2	2.1	2.3	306	297	7.7	6.1	4.8	12.8	841.1	812.4	593.8
11/13/2001	10:15:02	619	753	8471	292	295	4,236	950	2.2	2.3	2.3	2.0	2.2	300	292	7.7	6.3	5.1	12.9	841.4	812.1	594.1
11/13/2001	10:20:02	616	756	8471	293	294	4,210	953	2.4	2.5	2.5	2.2	2.4	310	300	7.8	6.5	5.1	12.6	841.4	812.1	595.6
11/13/2001	10:25:02	619	744	8471	292	295	4,237	949	2.3	2.2	2.3	2.2	2.3	311	300	7.7	6.5	4.9	12.9	841.7	812.4	595.9
11/13/2001	10:30:03	620	744	8471	292	295	4,249	952	2.3	2.4	2.3	2.1	2.2	299	289	7.6	6.3	5.0	13.1	841.4	812.7	595.6
11/13/2001	10:35:03	621	750	8471	292	295	4,257	954	2.2	2.3	2.3	2.1	2.2	308	288	7.7	6.3	5.2	12.9	841.4	812.7	594.1
11/13/2001	10:40:02	618	726	8471	292	295	4,242	952	2.4	2.5	2.3	2.4	2.5	309	292	7.7	6.1	5.0	12.9	841.4	812.4	593.8
Test 2 Average		**619**	**742**	**8471**	**287**	**292**	**4228**	**955**	**2.3**	**2.4**	**2.3**	**2.1**	**2.3**	**307**	**291**	**7.6**	**6.1**	**5.2**	**12.9**	**840.3**	**812.5**	**600.0**

DATE	TIME (CDT)	Gross Load (Mw) 2MP007	Coal Feed (Klb/hr) 2CV902	Coal Btu (Btu/lb) 2BY376	ESP Inlet Temp (°F) 2BA017	ESP Outlet Temp (°F) 2BA027	Main Steam Flow (KLb/hr) 2MS027	Main Steam Temp. (oF) 2MS013	Boiler Percent O_2 Average 2BA078	Air Heater $\%O_2$ Point A 2BA311	Air Heater $\%O_2$ Point B 2BA312	Air Heater $\%O_2$ Point C 2BA313	Air Heater $\%O_2$ Point D 2BA314	Stack SO_2 (ppm) 0BA080	U2 Duct NO_x (ppm) 2BA079	2-3/2-4 Duct Opacity (Percent) 2BA309	2-1/2-2 Duct Opacity (Percent) 2BA308	6 min. Avg. Stack Opacity (Percent) 2BA308	U2 Duct Percent CO_2 2BA081	SO3 Converter Outlet Temp (oF) 2PE065	SO3 Burner Outlet Temp (oF) 2PE066	SO3 Air Htr. Outlet Temp (oF) 2PE067
11/13/2001	11:20:03	617	744	8471	290	296	4,221	955	2.4	2.7	2.5	2.1	2.3	309	295	7.7	6.4	5.1	12.9	841.4	811.8	595.0
11/13/2001	11:25:03	617	735	8471	290	296	4,216	954	2.5	2.7	2.5	2.3	2.4	309	302	7.7	6.2	5.2	12.9	841.7	812.7	596.2
11/13/2001	11:30:03	615	750	8471	290	296	4,199	955	2.5	2.7	2.6	2.3	2.4	304	300	7.8	6.2	4.9	12.9	841.7	812.4	594.4
11/13/2001	11:35:02	619	741	8471	290	296	4,224	957	2.3	2.3	2.3	2.1	2.3	310	302	7.8	6.2	5.1	12.8	841.7	812.4	593.8
11/13/2001	11:40:03	621	738	8471	290	296	4,231	958	2.3	2.6	2.3	2.0	2.2	303	295	7.6	6.1	4.8	13.1	841.7	812.7	593.6
11/13/2001	11:45:02	621	720	8471	290	296	4,240	954	2.3	2.4	2.2	2.2	2.4	306	296	7.8	5.9	5.4	12.9	841.7	812.4	591.8
11/13/2001	11:50:03	617	735	8471	291	296	4,219	953	2.5	2.7	2.5	2.3	2.4	299	298	7.5	6.2	5.4	13.0	842.3	812.7	590.6
11/13/2001	11:55:02	619	756	8471	291	296	4,205	959	2.4	2.7	2.5	2.1	2.2	311	306	7.7	6.5	5.2	12.7	842.3	812.1	593.8
11/13/2001	12:00:03	621	720	8471	292	296	4,240	954	2.5	2.6	2.5	2.4	2.4	314	298	7.7	6.2	5.1	13.0	842.3	812.7	597.7
11/13/2001	12:05:02	619	741	8471	292	297	4,230	952	2.3	2.6	2.4	2.1	2.2	307	303	7.7	6.2	5.2	12.9	842.0	812.7	595.0
11/13/2001	12:10:02	619	750	8471	293	297	4,215	956	2.3	2.4	2.3	2.1	2.2	307	305	7.8	6.3	5.2	12.9	842.0	812.1	593.8
11/13/2001	12:15:01	624	744	8471	293	297	4,235	959	2.2	2.4	2.2	2.0	2.1	303	302	7.8	6.4	5.1	12.9	842.0	812.4	596.2
11/13/2001	12:20:02	620	747	8471	293	297	4,222	953	2.2	2.5	2.3	2.0	2.2	302	302	7.8	6.3	5.1	12.8	842.3	812.7	595.9
11/13/2001	12:25:02	620	747	8471	294	297	4,224	955	2.4	2.5	2.4	2.2	2.3	309	307	7.8	6.3	5.5	13.0	842.0	812.7	594.1
11/13/2001	12:30:02	619	753	8471	294	297	4,214	954	2.4	2.6	2.5	2.2	2.4	307	302	7.7	6.4	5.3	13.0	841.7	812.4	594.7
11/13/2001	12:35:02	620	753	8471	294	297	4,210	957	2.3	2.4	2.4	2.0	2.2	304	306	7.8	6.3	5.7	12.8	842.0	812.4	595.6
11/13/2001	12:40:01	622	729	8471	295	297	4,236	954	2.3	2.4	2.2	2.1	2.3	307	301	7.8	6.5	5.7	13.0	841.7	812.7	597.7
11/13/2001	12:45:02	624	744	8471	295	298	4,253	953	2.1	2.3	2.2	1.9	1.9	302	300	7.7	6.0	5.4	13.0	842.0	812.7	595.9
11/13/2001	12:50:01	619	738	8471	296	298	4,230	949	2.4	2.6	2.4	2.3	2.4	306	303	7.7	6.0	5.5	13.0	842.0	813.0	594.7
11/13/2001	12:55:02	621	732	8471	296	298	4,225	955	2.4	2.5	2.5	2.3	2.3	314	304	7.6	6.3	5.4	12.9	842.3	812.7	593.6
11/13/2001	13:00:02	618	738	8471	296	298	4,219	952	2.5	2.5	2.6	2.3	2.4	319	302	7.5	6.2	5.5	12.9	842.3	812.4	592.7
11/13/2001	13:05:02	619	747	8471	298	299	4,209	957	2.4	2.6	2.4	2.3	2.3	307	305	7.5	6.3	5.8	12.9	842.3	812.4	593.8
11/13/2001	13:10:02	620	768	8471	298	299	4,216	957	2.5	2.8	2.7	2.2	2.3	305	306	7.5	6.5	5.8	12.6	842.6	812.4	594.7
11/13/2001	13:15:02	623	738	8471	298	299	4,241	956	2.2	2.2	2.2	2.2	2.2	302	297	7.4	6.4	6.2	12.9	842.6	812.4	595.3
11/13/2001	13:20:02	620	747	8471	297	300	4,226	953	2.4	2.6	2.4	2.2	2.4	301	296	7.4	6.4	6.2	12.8	842.6	812.7	594.1
11/13/2001	13:25:02	623	735	8471	295	299	4,250	954	2.3	2.4	2.4	2.1	2.2	298	296	7.5	6.4	5.6	12.9	842.6	812.4	593.6
11/13/2001	13:30:02	623	735	8471	293	299	4,246	955	2.3	2.7	2.4	2.0	2.0	316	301	7.4	6.3	6.1	12.8	842.3	812.7	594.4
11/13/2001	13:35:02	623	723	8471	291	299	4,259	952	2.3	2.4	2.4	2.2	2.3	301	293	7.4	6.3	5.7	12.9	842.3	813.3	593.0
11/13/2001	13:40:02	616	774	8471	290	298	4,211	953	2.5	2.6	2.5	2.3	2.4	310	301	7.3	6.1	6.0	12.7	842.6	812.7	591.8
11/13/2001	13:45:02	621	744	8471	290	298	4,248	951	2.4	2.6	2.6	2.1	2.2	303	292	7.4	6.3	6.2	13.0	842.6	812.4	591.5
Test 3 Average		**620**	**742**	**8471**	**293**	**297**	**4227**	**954**	**2.3**	**2.5**	**2.4**	**2.2**	**2.3**	**306**	**300**	**7.6**	**6.3**	**5.5**	**12.9**	**842.1**	**812.5**	**594.3**

APPENDIX E
PART 2

ATTACHMENT B
CALCULATIONS

SUMMARY OF RESULTS CALCULATIONS

$$Vm\ (std) = 17.647 \times Vm \times \left[\frac{P_{bar} + \frac{DH}{13.6}}{(460 + Tm)} \right] \times Y$$

$$Vw\ (std) = 0.0471 \times Vlc$$

Vlc = water + silica net

$$Bws = \left[\frac{Vw\ (std)}{Vw\ (std) + Vm\ (std)} \right]$$

$$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (100 - \%CO_2 - \%O_2)]$$

$$MS = Md \times (1 - Bws) + (18 \times Bws)$$

$$Vs = \sqrt{\frac{(Ts + 460)}{Ms \times Ps}} \times \sqrt{DP} \times Cp \times 85.49$$

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

$$Acfm = Vs \times Area\ (of\ stack\ or\ duct) \times 60$$

$$Dscfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)} \right] \times (1 - Bws)$$

$$Scfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)} \right]$$

$$Scfh = Scfm \times 60 \frac{min}{hr}$$

CALCULATION FORMULAS PARTICULATES

1. $V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right) \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right) = K_1 V_m Y \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$

2. $V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2 V_{lc}$

3. $B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$

4a. $C_a = \frac{m_a}{V_a \rho_a}$

4b. $W_a = C_a V_{aw} \rho_a$

5. $C_S = (15.43 \text{ grains/gram})\ (m_n / V_{m(std)})$

6. $C_{acf} = 15.43 K_i \left(\frac{m_n P_s}{V_{w(std)} + V_{m(std)}\ T_s}\right)$

7. $\%EA = \left(\frac{\%O_2 - (0.5\ \%CO}{0.264\ \%N_2 - (\%O_2 - 0.5\ \%CO)}\right) \times 100$

8. $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$

9. $M_s = M_d(1 - B_{ws}) + 18.0 B_{ws}$

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. $E \text{ (emission rate, lbs/hr)} = Q_{std}(C_s / 7000 \text{ grains/lb})$

14. $IKV = \frac{T_s V_{m(std)} P_{std}}{T_{std} v_s \theta A_n P_s 60(1 - B_{ws})} = K_4 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$

NOMENCLATURE - PARTICULATES

A = Cross-sectional area of stack or duct, ft^2
A_n = Cross-sectional area of nozzle, ft^2
B_{ws} = Water vapor in gas stream, proportion 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, dimensionless
C_s = Concentration of particulate matter in gas stream, dry basis, corrected to standard conditions, gr/dscf
IKV = Isokinetic sampling variance, must be $.90 \leq IKV \leq 1.10$
M_d = Dry molecular weight of gas, lb/lb-mole
m_n = Total amount of particulate matter collected, grams
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, in. Hg
P_g = Static pressure of gas, in. Hg (in. H_2O/13.6)
P_s = Absolute pressure of gas, in. Hg = $P_{bar} + P_g$
P_{std} = Standard absolute pressure, 29.92 in. Hg
Q_{acfm} = Actual volumetric gas flow rate, acfm
Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, dscf/hr
R = Ideal gas constant, 21.85 in. Hg-ft^3/°R-lb-mole
T_m = Absolute dry gas meter temperature, °R
T_s = Absolute gas temperature, °R
T_{std} = Standard absolute temperature, 528°R
V_a = Volume of acetone blank, ml
V_{aw} = Volume of acetone used in wash, ml
V_{lc} = 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
W_a = Weight of residue in acetone wash, grams
Y = Dry gas meter calibration factor
ΔH = Average pressure differential across the orifice meter, in. H_2O
Δp = Velocity head of gas, in. H_2O
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 = 17.64 °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
0.28 = Molecular weight of N_2 or CO, divided by 100
0.32 = Molecular weight of O_2 divided by 100
0.44 = Molecular weight of CO_2 divided by 100
13.6 = Specific gravity of mercury (Hg)

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:

1. $C = C_s/7000$ where, C = pollutant concentration, lb/dscf
   c_s = pollutant concentration, grains/dscf

2. 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

3. If an integrated gas sample is taken during the test and analyzed for $\%CO_2$ or $\%O_2$, dry basis by volume, with an Orsat 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; and, for example, for subbituminous and bituminous coals:

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.

4. If fuel sample increments are taken and composited during the test and an ultimate analysis is performed and the GCV is determined, then

$$F_c = \frac{321 \times 10^3 (\%C)}{GCV} \quad \text{where, \%C = carbon content by weight expressed as percent}$$

$$F = \frac{[3.64\,(\%H) + 1.53\,(\%C) + 0.57\,(\%S) + 0.14\,(\%N) - 0.46\,(\%O_2)]}{GVC} \times 10^6$$

where, H, C, S, N, and O are content by weight of hydrogen, carbon, sulfur, nitrogen, and oxygen (expressed as percent) respectively.

5. If fuels other than subbituminous and bituminous coals are fired, other F-factors than those above will apply; and, if combinations of different fuels are fired, the F-factors must be prorated according to the fraction of the total heat input derived from each type of fuel.

MERCURY CALCULATIONS

Determination of Speciated Mercury

Concentration

$$\frac{\text{ug of Mercury detected} \times \dfrac{10^{-6}\,\text{g}}{\text{ug}}}{453.6\ \text{g/lb}} = \text{lbs Mercury/sample}$$

$$\frac{\text{lbs Mercury/sample}}{\text{Vm(std)}} = \text{lbs Mercury/dscf}$$

Emission Rates

$$\text{lbs Mercury/hr} = \text{lbs/dscf} \times \text{dscf/min} \times 60\ \text{min/hr}$$

$$\text{lbs Mercury}/10^{12}\,\text{Btu} = \text{lbs/dscf} \times F_d\,\text{Factor}(\text{dscf}/10^{6}\,\text{Btu}) \times \frac{20.9\%}{20.9\% - O_2\%} \times 10^{6}$$

Mercury Fractions

Elemental Mercury Catch – mercury collected in the acidified hydrogen peroxide (HNO_3-H_2O_2) and potassium permanganate (H_2SO_4-$KMnO_4$) impinger solutions.

Oxidized Mercury Catch – mercury collected in the aqueous potassium chloride (KCl) impinger solution.

Particle-bound Mercury Catch – mercury associated with the particulate matter collected in the front half of the sampling train.

Determination of Mercury Available from Coal

$$\text{lbs Mercury/hr} = \frac{\text{ug Mercury}}{\text{g Coal}}(\text{dry}) \times \frac{10^{-6}\,\text{g}}{\text{ug}} \times \frac{\text{lbs Coal (wet)}}{\text{hr}} \times (1 - B_{ws})\ \text{moisture corr.}$$

$$\text{lbs Mercury}/10^{12}\,\text{Btu} = \frac{\text{lbs Mercury}}{\text{hr}} \div \frac{10^{12}\,\text{Btu}}{\text{hr}}$$

APPENDIX E
PART 2

ATTACHMENT C
RAW FIELD DATA AND
CALIBRATION DATA SHEETS

MOSTARDI PLATT ASSOCIATES, INC.
TEST SUPPORT DATA

TEST RUN NO. 1 Ontario Hydro

COMPANY:	Wisconsin Electric Power	THIMBLE NO:	161
		TARE WT:	
PLANT:	Pleasant Prairie	FILTER NO:	—
		TARE WT:	—
TEST LOCATION:	Unit 2 - North Inlet Duct	BAROMETRIC PRESSURE in. Hg:	29.30
CLIENT:	ADA	FLUE PRESSURE in. H_2O:	-15.50
OPERATOR:	T Barr	FLUE PRESSURE in. Hg ABS:	28.160
DATE:	9-10-01	PROBE LENGTH:	9 ft.
CONTROL BOX:	E31	PROBE LINER MATERIAL:	Teflon
POT. NO.:	E31	NOZZLE IDENTIFICATION NO:	N/A
METER NO.:	E31	CALIBRATED NOZZLE DIAMETER:	0.195
METER CALIBRATION FACTOR:	1.004	LEAK CHECK:	PRE: 0.00 POST: 0.00 @ 15/15 in. Hg
PITOT ID NO.:	660A	DUCT SHAPE:	Rectangular
		DIAMETER:	
PITOT TUBE COEFFICIENT:	0.836	DUCT AREA:	204.00 sq. ft. L 8.5' W 24'
PORT LENGTH:	30 in.	DISTURBANCE UPSTREAM:	
		DOWNSTREAM:	
PORT SIZE:	6 (Horizontal) in.	TEST LENGTH:	120 min
PORT TYPE:	Flange	MINUTES PER POINT:	5
		TOTAL NUMBER OF TRAVERSE POINTS:	24
		GAS ANALYSIS (ORSAT/FYRITE):	ORSAT circled
		CO_2:	15.0
		O_2:	4.0

IMPINGER H_2O (impinger wt.)		SILICA GEL: (Impinger wt.)	
FINAL:	538.3 ml/gm	FINAL WT:	792.7 gm
INITIAL:	4817.7 ml/gm	INITIAL WT:	771.1 gm
GAIN:	220.6 ml/gm	WT. GAIN:	21.6 gm

TOTAL H_2O COLLECTED: 242.2

DESCRIPTION OF IMPINGER H_2O:

SILICA GEL EXHAUSTED?:

IMPINGERS RECOVERED BY:

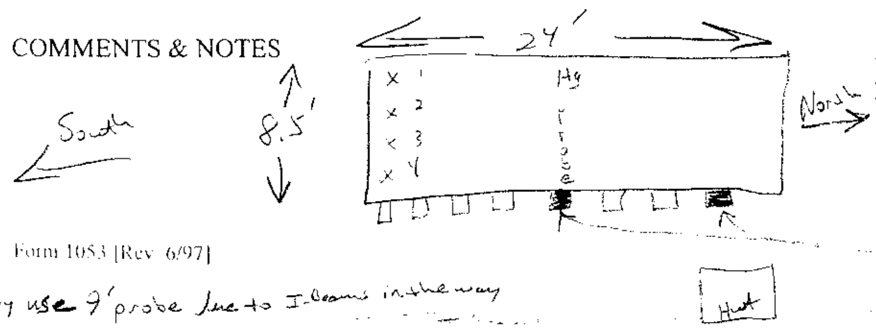
SILICA GEL WEIGHED BY:

PITOT LEAK CHECK: PRE 0.00 ✓ POST ✓

ΔH@ 24"

SAMPLES REMOVED FROM SITE BY:

COMMENTS & NOTES



For computer data entry: Supervisor, please complete.

Do you want to enter a fuel analysis? Y ☐ N ☐

What value do you want to use? F = 9,780 F_c = 1,800 Other =

Circle to indicate "Yes" or add other value if not given.

Couldn't do

Form 1053 [Rev 6/97]

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Only use 9' probe due to I-beams in the way

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT Wisconsin Power - Pleasant Prairie
TEST RUN NO. 1 -
TEST LOCATION Unit 2 - North Inlet Duct .873

DATE 9-10-01 .525 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	~~.906~~ Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	~~.535~~ Meter Rate cfm	Pump Vacuum in. Hg	x 5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
outh 1-1	1.30	1.140	1445	65.252	1.18	266	73	74	.610	4	3.050	248	N/A	≤68
2	0.67	.819	1450	68.30	0.61	261	74	73	.438	4	2.190 68.302	249		Fully
3	1.40	1.183	1455	70.49	1.27	261	74	74	.633	5	3.165 70.492	253		Iced
4	1.40	1.183	1500	73.66	1.27	260	75	74	.633	5	3.165 73.657	254		
		(4.355)	1505	76.834	(4.33)	(1048)		(591)			76.822			
2-1	1.70	1.304	1508	77.002	1.54	275	76	74	.698	5	3.488	252		
2	1.70	1.304	1513	80.49	1.54	278	76	74	.698	5	3.488 80.490	250		
3	1.80	1.342	1518	83.98	1.57	278	76	74	.704	5	3.522 83.978	250		
4	1.20	1.095	1523	87.50	1.05	277	77	74	.575	5	2.876 87.500	252		
		(5.045)	1528	90.379	(5.70)	(1108)		(601)			90.376			
3-1	2.0	1.414	1531	90.462	1.75	280	76	74	.742	7	3.712	249		
2	1.80	1.342	1536	94.17	1.57	282	77	74	.704	7	3.522 94.174	251		
3	1.70	1.304	1541	97.70	1.48	283	77	74	.685	7	3.423 97.696	250		
4	1.20	1.095	1546	101.12	1.05	282	77	74	.575	6	2.876 101.119	251		
		(5.155)	1551	104.001	(5.85)	(1127)		(603)			103.995			
4-1	1.80	1.342	1555	104.096	1.57	285	76	75	.704	8	3.522	253		
2	1.70	1.304	1600	107.62	1.48	287	77	74	.685	8	3.423 107.618	253		
3	0.90	.949	1605	111.04	0.79	289	77	75	.498	8	2.490 111.041	252		
4	1.00	1.000	1610	113.53	0.87	290	77	75	.525	9	2.625 113.531	252		
		(4.595)	1615	116.162	(4.71)	(1151)		(606)			116.156			
5-	Mercury Equip in port													
6-1	1.90	1.378	1619	116.215	1.66	293	76	75	.724	11	3.618	250		
2	1.70	1.304	1624	119.83	1.48	296	76	74	.685	13	3.423 119.833	250		
3	1.70	1.304	1629	123.26	1.418	299	76	75	.685	13	3.423 123.256	249		
4	1.10	1.049	1634	126.68	0.96	300	76	75	.551	13	2.753 126.679	248		
		(5.035)	1639	129.428	(5.58)	(1188)		(603)			129.432			

Form 1026 [Rev. 5/97]

MOSTARDI-PLATT ASSOCIATES, INC.
TEST SUPPORT DATA

TEST RUN NO. 2 - Ontario Hydro

COMPANY: Wisconsin Electric Power Company
PLANT: Pleasant Prairie
TEST LOCATION: Unit 2 North Inlet Duct
CLIENT: ADA
OPERATOR: T Barr
DATE: 9-11-01
CONTROL BOX: E-31 POT. NO.: E-31
METER NO.: E-31
METER CALIBRATION FACTOR: 1.004
PITOT ID NO.: 660A
PITOT TUBE COEFFICIENT: 0.836
PORT LENGTH: 30 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O
FINAL: 5020.8 ml/gm
INITIAL: 4776.1 ml/gm
GAIN: 244.7 ml/gm

SILICA GEL:
FINAL WT: 737.3 gm
INITIAL WT: 717.2 gm
WT. GAIN: 20.1 gm

TOTAL H_2O COLLECTED: 264.7
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: TARE WT:
FILTER NO: 164 TARE WT: 3.1765
BAROMETRIC PRESSURE in. Hg: 29.45
FLUE PRESSURE in. H_2O: -15.50
FLUE PRESSURE in. Hg ABS: 28.310
PROBE LENGTH: 9.5 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO: N/A
CALIBRATED NOZZLE DIAMETER: 0.195
LEAK CHECK: PRE: 0.004 POST: .004 @ 15/15 in. Hg
DUCT SHAPE: Rectangular DIAMETER:
DUCT AREA: 204.000 sq. ft. L 8.5' W 24'
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: 120 min
MINUTES PER POINT: 5
TOTAL NUMBER OF TRAVERSE POINTS: 24
GAS ANALYSIS (ORSAT/FYRITE): (ORSAT circled)
CO_2: 15.0
O_2: 4.0

PITOT LEAK CHECK: PRE 0.00 ✓ POST ✓
ΔH@ 24"
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other =
Circle to indicate "Yes" or add other value if not given.

Form 1053 [Rev 6/97]

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT Wisconsin Electric Power - Pleasant Prairie
TEST RUN NO. 1
TEST LOCATION Inlet - Unit 2

DATE 9-10-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	.873 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.525 Meter Rate cfm	Pump Vacuum in. Hg	x5 Notes		Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
7-1	1.7	1.304	1643	129.496	1.48	305	75	74	.685	12	3.423		250	N/A	<68°
2	1.5	1.225	1648	132.92	1.31	307	76	74	.643	14	3.215	132.919	248		FULL
3	1.2	1.095	1653	136.13	1.05	307	77	75	.575	14	2.876	136.134	249		Iced
4	1.4	1.183	1658	139.01	1.22	308	77	75	.621	14	3.106	139.010	251		
		(4.807)	1703	142.119	(5.06)	(1228)		(603)				142.116			
both 8-	Mercury Equip Hut in way														
		(1.208)		(76.400)	(1.301)	(285.4)		(75.1)							

ACFM - 1,011,509
DSCFM - 584,710
Ft/sec. - 82.64

FIELD TEST DATA SHEET FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT WEPCO- Pleasant Prairie
TEST RUN NO. 2
TEST LOCATION Unit 2 North Inlet

DATE 9-11-01 PAGE 1 OF 2

1.210 .841 .505

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	.857 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.515 Meter Rate cfm	Pump Vacuum in. Hg	× 5 Notes		Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
1-1	1.4	1.183	935	44.125	1.18	262	66	65	.598	6	2.988		246	N/A	≤68
2	1.8	1.342	940	47.11	1.51	266	70	66	.678	6	3.388	47.113	248		[illegible]
3	1.7	1.304	945	50.50	1.46	265	72	67	.671	6	3.357	50.501	248		[illegible]
4	1.3	1.140	950	53.86	1.11	269	76	66	.587	6	2.936	53.858	246		
		(4.966)	955	56.801	(5.26)	(1062)		(548)				56.794			
2-1	2.0	1.414	1000	56.865	1.71	274	74	70	.728	8	3.642		248		
2	1.7	1.304	1005	60.539	1.46	276	76	70	.671	8	3.357	60.536	250		
3	1.7	1.304	1010	63.89	1.46	280	78	72	.671	8	3.357	63.894	249		
4	1.5	1.225	1015	67.25	1.29	280	78	73	.631	8	3.154	67.251	250		
		(5.247)	1020	70.412	(5.92)	(1110)		(591)				70.405			
3-1	1.8	1.342	1023	70.496	1.54	287	79	73	.691	9	3.455		249		
2	2.0	1.414	1028	73.95	1.71	292	81	75	.728	9	3.642	73.951	251		
3	1.5	1.225	1033	77.59	1.29	295	79	73	.631	8	3.154	77.593	251		
4	1.5	1.225	1038	80.75	1.29	297	79	73	.631	8	3.154	80.747	252		
		(5.266)	1043	83.904	(5.83)	(1171)		(612)				83.901			
4-1	1.7	1.304	1045	83.959	1.46	303	80	74	.671	10	3.357		250		
2	1.8	1.342	1050	87.32	1.54	305	80	75	.691	11	3.455	87.316	251		
3	1.0	1.000	1055	90.77	.86	305	81	75	.515	11	2.575	90.771	248		
4	1.0	1.000	1100	93.35	.86	305	81	75	.515	11	2.575	93.346	247		
		(4.646)	1105	95.923	(4.72)	(1218)		(621)				95.921			
5-	Mercury	(ADA)	Equipment												
6-1	2.0	1.414	1108	96.005	1.71	303	79	76	.728	12	3.640		249		
2	1.7	1.304	1113	99.65	1.46	306	80	76	.671	12	3.357	99.647	251		
3	1.7	1.304	1118	103.00	1.46	307	80	77	.671	13	3.357	103.004	253		
4	1.5	1.225	1123	106.36	1.29	306	81	78	.631	13	3.154	106.361			
		(5.247)	1128	109.519	(5.92)	(1222)		(627)				109.515			

−outh

Form 1026 [Rev. 5/27]

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT WEPCO- Pleasant Prairie
TEST RUN NO. 2
TEST LOCATION Unit 2 North Inlet

DATE 9-11-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	.857 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.515 Meter Rate cfm	Pump Vacuum in. Hg	x5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
7-1	1.80	1.342	1131	109.576	1.54	305	81	78	.691	14	3.455	251	N/A	≤68°F
2	1.40	1.183	1136	113.03	1.20	307	81	77	.609	14	3.047 113.031	248		Full
3	1.40	1.183	1141	116.08	1.20	307	81	77	.609	14	3.047 116.078	248		Iced
4	1.70	1.304	1146	119.13	1.46	307	81	77	.671	14	3.357 119.125	249		
		(5.012)	1151	122.480	(5.40)	(1226)		(633)			122.482			
orth 8-	ADA	Mercury	Equipment	Hut										
		(1.264)		(77.990)	(1.377)	(292.0)		(75.7)						

Form 1026 (Rev. 5/27)

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MOSTARDI-PLATT ASSOCIATES, INC.
TEST SUPPORT DATA

TEST RUN NO. 3 - Ontario Hydro

COMPANY: Wisconsin Electric Power Company
PLANT: Pleasant Prairie
TEST LOCATION: Unit 2 North Inlet
CLIENT: ADA
OPERATOR: T Barr
DATE: 9-11-01
CONTROL BOX: E31 POT. NO.: E31
METER NO.: E31
METER CALIBRATION FACTOR: 1.004
PITOT ID NO.: 660A
PITOT TUBE COEFFICIENT: 0.836
PORT LENGTH: 30 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O		SILICA GEL:	
FINAL:	5129.7 ml/gm	FINAL WT:	682.7 gm
INITIAL:	4877.4 ml/gm	INITIAL WT:	672.7 gm
GAIN:	252.3 ml/gm	WT. GAIN:	15.0 gm

TOTAL H_2O COLLECTED: 267.3
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: TARE WT:
FILTER NO: 163 TARE WT: 3.0609
BAROMETRIC PRESSURE in. Hg: 29.45
FLUE PRESSURE in. H_2O: -15.50
FLUE PRESSURE in. Hg ABS: 28.310
PROBE LENGTH: 9.5 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO: N/A
CALIBRATED NOZZLE DIAMETER: 0.195
LEAK CHECK: PRE: .008 POST: .006 @ 15/15 in. Hg
DUCT SHAPE: Rectangular DIAMETER:
DUCT AREA: 204.00 sq. ft. L 8.5' W 24'
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: 120 min
MINUTES PER POINT: 5
TOTAL NUMBER OF TRAVERSE POINTS: 24
GAS ANALYSIS (ORSAT/FYRITE): (ORSAT circled)
CO_2: 15.0
O_2: 4.0

PITOT LEAK CHECK: PRE ✓ POST ✓
ΔH@
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other =
Circle to indicate "Yes" or add other value if not given.

Form 1053 [Rev 6/97]

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT WEPCO- Plesant Prairie
TEST RUN NO. 3
TEST LOCATION Unit 2 North Inlet

DATE 9-11-01 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	.857 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.515 Meter Rate cfm	Pump Vacuum in. Hg	×5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
North 1-1	1.8	1.342	1253	24.930	1.54	306	75	74	.691	6	3.455	244	N/A	<68°F
2	1.6	1.265	1258	28.39	1.37	308	76	74	.651	6	3.257 28.385	245		Fully
3	1.1	1.049	1303	31.64	.94	308	77	75	.540	6	2.701 31.642	245		Ice
4	1.7	1.304	1308	34.34	1.46	307	79	77	.671	6	3.357 34.343	244		
		(4.96)	1313	37.704	(5.31)	(1229)		(607)			37.700			
2-1	2.0	1.414	1316	37.786	1.71	303	76	76	.728	8	3.642	246		
2	1.6	1.265	1321	40.870	1.37	304	78	77	.651	7	3.257 41.428	246		
3	1.8	1.342	1326	43.955	1.54	297	80	78	.691	8	3.456 44.685	247		
4	1.5	1.225	1331	48.14	1.29	295	82	78	.631	8	3.154 48.141	247		
		(5.246)	1336	51.301	(5.61)	(1199)		(627)			51.295			
3-1	1.7	1.304	1340	51.380	1.46	295	83	78	.671	9	3.357	247		
2	1.7	1.304	1345	54.74	1.46	293	83	78	.671	9	3.357 54.737	249		
3	.90	.949	1350	58.02	.77	296	83	79	.489	10	2.443 58.094	248		
4	1.10	1.049	1355	60.54	.94	295	83	78	.540	10	2.701 60.557	248		
		(4.606)	1400	63.243	(4.63)	(1179)		(645)			63.238			
4-1	2.0	1.414	1403	63.281	1.71	284	82	76	.728	10	3.642	247		
2	1.8	1.342	1408	66.92	1.54	285	82	77	.691	10	3.456 66.923	248		
3	1.7	1.304	1413	70.38	1.46	283	81	79	.671	10	3.357 70.379	248		
4	1.2	1.095	1418	73.74	1.03	283	81	78	.564	9	2.821 73.736	248		
		(5.155)	1423	76.563	(5.74)	(1135)		(636)			76.557			
5-	ADA	Mercury Equipment												
6-1	1.9	1.378	1426	76.621	1.63	276	80	78	.710	10	3.549	246		
2	1.6	1.265	1431	80.17	1.37	277	80	78	.651	10	3.257 80.170	247		
3	1.6	1.265	1436	83.43	1.37	278	80	78	.651	10	3.257 83.422			
4	1.7	1.304	1441	86.68	1.46	278	80	78	.671	10	3.357 86.684			
		(5.212)	1446	90.044	(5.83)	(1109)		(632)			90.041			

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT WEPCO - Pleasant Prairie
TEST RUN NO. 3
TEST LOCATION Unit 2 North Inlet

DATE 9-11-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	.857 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.515 Meter Rate cfm	Pump Vacuum in. Hg	x5 Notes		Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
South 7-1	1.30	1.140	1450	90.075	1.11	264	79	78	.587	13	2.936		246	N/A	<68°F
2	.61	.781	1455	93.01	.52	266	79	78	.402	13	2.011	93.011	248		Fully
3	1.40	1.183	1500	95.02	1.20	266	79	78	.609	14	3.047	95.022	248		Iced
4	1.70	1.304	1505	98.07	1.46	265	79	78	.671	14	3.357	98.065	247		
		(4.408)	1510	101.426	(4.29)	(1061)		(628)				101.426			
8-	ADA Mercury Equipment														
		1.233		76.211	1.321	288.0		78.6							

Form 1026 [Rev. 5/97]

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MOSTARDI-PLATT ASSOCIATES, INC.
TEST SUPPORT DATA

TEST RUN NO. 5 Hydro

COMPANY:
PLANT:
TEST LOCATION:
CLIENT: ADA
OPERATOR:
DATE: 10
CONTROL BOX: POT. NO.:
METER NO.:
METER CALIBRATION FACTOR:
PITOT ID NO.:
PITOT TUBE COEFFICIENT: 0
PORT LENGTH: in.
PORT SIZE: (Horizontal) in.
PORT TYPE:

IMPINGER H_2O (imp. wt.)
FINAL: 4981.1 ml/gm
INITIAL: 4747.5 ml/gm
GAIN: 233.6 ml/gm

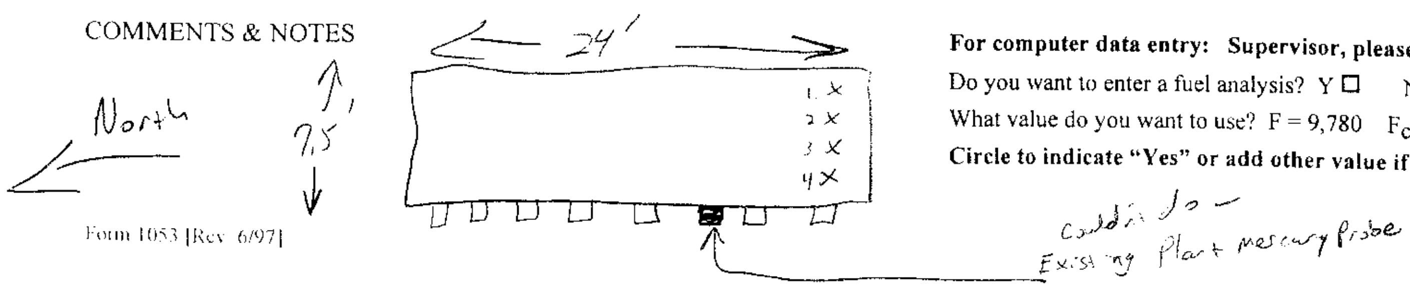
SILICA GEL: (imp. wt.)
FINAL WT: 742.6 gm
INITIAL WT: 723.3 gm
WT. GAIN: 19.3 gm

TOTAL H_2O COLLECTED: 252.9
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

THIMBLE NO: TARE WT:
FILTER NO: TARE WT:
BAROMETRIC PRESSURE in. Hg:
FLUE PRESSURE in. H_2O:
FLUE PRESSURE in. Hg ABS:
PROBE LENGTH: 9 ft.
PROBE LINER MATERIAL:
NOZZLE IDENTIFICATION NO:
CALIBRATED NOZZLE DIAMETER:
LEAK CHECK: PRE: POST: @ in. Hg
DUCT SHAPE: DIAMETER:
DUCT AREA: sq. ft. L 7.5' W 24'
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: min
MINUTES PER POINT:
TOTAL NUMBER OF TRAVERSE POINTS:
GAS ANALYSIS (ORSAT/FYRITE):
CO_2:
O_2:

PITOT LEAK CHECK: PRE POST
ΔH@
SAMPLES REMOVED FROM SITE BY:

COMMENTS & NOTES



For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other =
Circle to indicate "Yes" or add other value if not given.

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT [illegible]
TEST RUN NO. 1 [illegible]
TEST LOCATION [illegible]

DATE 1/10 [illegible] PAGE 1 OF [illegible]

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	Meter Rate cfm	Pump Vacuum in. Hg	Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
1-1	[illegible]	[illegible]	1435	91.525	.75	[illegible]	77	76	[illegible]	3.5	[illegible]	[illegible]	[illegible]	
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	278	77	76	[illegible]	4	[illegible]	225	[illegible]	[illegible]
3	[illegible]	[illegible]	1444	[illegible]	1.25	[illegible]	80	77	.11	5	[illegible]	[illegible]	[illegible]	
4	[illegible]	[illegible]	[illegible]	[illegible]	1	297	81	77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	1453	101.610	[illegible]	[illegible]	[illegible]				[illegible]			
				[illegible]										
2-1	.86	[illegible]	1154	[illegible]	1	[illegible]	[illegible]			[illegible]	[illegible]			
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	
4		[illegible]	[illegible]	[illegible]	1.4	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	265	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				110.678	[illegible]	[illegible]	
				[illegible]							113.278			
3-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	290	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
2	[illegible]	[illegible]	[illegible]	[illegible]	1.3	293	84	78		[illegible]	[illegible]	260	[illegible]	
3	.86	[illegible]	[illegible]	[illegible]	1.2	292	[illegible]	[illegible]	[illegible]	5	[illegible]	[illegible]	[illegible]	
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	290	86	[illegible]		5	[illegible]		[illegible]	
		[illegible]	1159	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]			
				[illegible]										
4-1	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
2	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	86	79		6	[illegible]	[illegible]	[illegible]	
3	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	87	80		6	[illegible]	[illegible]	[illegible]	
4	[illegible]	[illegible]	[illegible]	[illegible]	1.5	287	87	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	289.5	82.75				[illegible]			
				[illegible]							137.3?3			

Form 1026 [Rev. 5/27]

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FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT [illegible]
TEST RUN NO. 1 [illegible]
TEST LOCATION [illegible]

DATE [illegible] 10 [illegible] PAGE 2 OF [illegible]

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	Meter Rate cfm	Pump Vacuum in. Hg	Notes (x 4, 5)	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
5-1	[illegible]	[illegible]	1555	[illegible]	1.4	282	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	
[illegible]		.77	[illegible]	[illegible]	1.1	281	86	80		5	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	1600	[illegible]	1.2	282	86	80		5	[illegible] 145.[illegible]	260	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible].8	1.2	290	87	[illegible]		5	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	28[illegible]					[illegible]			
				[illegible]										
6-1	[illegible]	[illegible]	[illegible]	[illegible]	1	273	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	16:30	[illegible]	1.2	277	86	80	[illegible]	6	[illegible] 152.[illegible]	251	[illegible]	
[illegible]	[illegible]	.81	1621	[illegible]	1.2	277	[illegible]	80	[illegible]	6	[illegible] 155.380	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5	282	86	80		6	[illegible] 158.[illegible]	[illegible]	[illegible]	
		[illegible]	1630	161.75	[illegible]	[illegible]	([illegible])				[illegible]			
				[illegible]										
[illegible]	[illegible]	[illegible]	1651	[illegible]	1.1	275	85	[illegible]	[illegible]	4	[illegible]	232	271	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.21	278	[illegible]				[illegible]	240	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.2	277					[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]		
		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]				[illegible]			
	[illegible]			[illegible]	1.2018	285.7	[illegible]	[illegible]						
						245.4								
							[illegible]							

ACFM — 550,712
DSCFM — 317,118
Ft/sec. — 50.992

Form 1026 [Rev. 8/27]

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MOSTARDI-PLATT ASSOCIATES, INC.
TEST SUPPORT DATA

TEST RUN NO. ______

COMPANY: ______
PLANT: ______
TEST LOCATION: ______
CLIENT: ADA
OPERATOR: ______
DATE: ______
CONTROL BOX: ______ POT. NO.: ______
METER NO.: ______
METER CALIBRATION FACTOR: ______
PITOT ID NO.: ______
PITOT TUBE COEFFICIENT: 0
PORT LENGTH: ______ in.
PORT SIZE: ______ in.
PORT TYPE: ______

IMPINGER H_2O
FINAL: 5096.5 ml/gm
INITIAL: 4851.5 ml/gm
GAIN: 245.0 ml/gm

SILICA GEL:
FINAL WT: 804.1 gm
INITIAL WT: 784.7 gm
WT. GAIN: 19.4 gm

TOTAL H_2O COLLECTED: 264.4
DESCRIPTION OF IMPINGER H_2O: ______
SILICA GEL EXHAUSTED?: ______
IMPINGERS RECOVERED BY: ______
SILICA GEL WEIGHED BY: ______

COMMENTS & NOTES

THIMBLE NO: — TARE WT: —
FILTER NO: ______ TARE WT: ______
BAROMETRIC PRESSURE in. Hg: ______
FLUE PRESSURE in. H_2O: ______
FLUE PRESSURE in. Hg ABS: ______
PROBE LENGTH: ______ ft.
PROBE LINER MATERIAL: ______
NOZZLE IDENTIFICATION NO: —
CALIBRATED NOZZLE DIAMETER: ______
LEAK CHECK: PRE: ______ POST: .002 @ 10 in. Hg
DUCT SHAPE: ______ DIAMETER: ______
DUCT AREA: ______ sq. ft. L ______ W ______
DISTURBANCE UPSTREAM: ______ DOWNSTREAM: ______
TEST LENGTH: ______ min
MINUTES PER POINT: ______
TOTAL NUMBER OF TRAVERSE POINTS: ______
GAS ANALYSIS (ORSAT/FYRITE): ______
CO_2: 13.7
O_2: 5.3

PITOT LEAK CHECK: PRE 6" ✓ POST ✓
ΔH@ ______
SAMPLES REMOVED FROM SITE BY: ______

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other = ______
Circle to indicate "Yes" or add other value if not given.

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT ____________
TEST RUN NO. ____________
TEST LOCATION ____________

DATE ____________ PAGE ______ OF ______

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	Meter Rate cfm	Pump Vacuum in. Hg	Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
	.56	.748		530.297	1.3	276	72	70	.617	5	2.775	232	239	
	.54	.735		533.014	1.2	275	74	70	.606	5	2.725 533.017	258	240	
	.43	.656		535.73	.95	270	75	71	.540	5	2.432 535.742	230	241	
		.704288813		538.265	(1.1125)	(274)	(71.625)				538.[illegible]			
				(10.538)										
	.45	.671	951	539.259	1.0	275	76	72	.553	5	2.488	264	238	
	.6	.775	955:30	541.79	1.3	278	77	72	.638	5	2.873 541.[illegible]	238	240	
	.63	.794	1000	544.623	1.4	278	78	73	.654	5	2.944 544.620	236	240	
	.57	.735	1004:30	547.528	1.2	265	78	73	.606	5	2.725 547.564	225	231	
		.743497345	1009	550.37	(1.225)	(274)	(74.875)				550.289			
				(11.111)										
	.53	.728	1011	550.857	1.3	282	78	74	.600	5	2.700	230	238	
	.53	.728	1015:30	553.65	1.2	286	79	74	.600	5	2.700 553.557	270	239	
	.6	.775	1020	556.38	1.3	286	80	75	.638	5	2.873 556.257	271	239	
	.66	.812	1024:30	559.143	1.4	283	80	75	.670	5	3.013 559.130	271	237	
		.76108	1029	562.0	(1.3)	(284.25)	(76.875)				562.143			
				(11.143)										
	.66	.812	1031	562.313	1.4	291	80	76	.670	5	3.013	270	239	
	.63	.794	1035:30	565.14	1.6	295	81	76	.654	6	2.944 565.326	262	236	
	.61	.781	1040	568.11	1.5	295	81	76	.644	6	2.897 568.270	272	237	
	.64	.800	1044:30	571.1	1.6	287	82	78	.659	6	2.967 571.167	261	225	
		.796789	1049	574.12	(1.525)	(292)	(78.75)				574.134			
				(11.807)										

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT ______________________
TEST RUN NO. ______________________
TEST LOCATION ______________________

DATE ____________ PAGE ________ OF ________

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	2.143 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.8292 Meter Rate cfm	Pump Vacuum in. Hg	Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
	.67	.819	1050	574.460	1.5	288	82	77	.675	6	3.036	268	226	
	.74	.860	1054:30	577.5	1.6	299	83	78	.709	6	3.191 577.496	270	224	
	.67	.794	1059	580.5	1.4	300	83	78	.654	6	2.944 580.687	270	225	
	.57	.755	1103:30	583.44	1.3	291	83	78	.622	6	2.800 583.60[illegible]	270	22[illegible]	
		.8069	1108	586.29	(1.45)	(294.5)	(80.25)				586.431			
				(11.83)										
	.54	.735	1109	586.520	1.2	294	83	79	.606	6	2.725	232	248	
	.69	.831	1113:30	589.28	1.5	299	84	79	.685	6	3.081 589.245	228	247	
	.75	.866	1118	592.24	1.6	302	84	79	.714	6	3.212 592.526	230	249	
	.53	.728	1122:30	595.43	1.4	300	84	79	.6	6	2.700 595.538	220	25[illegible]	
		.789886	1127	598.15	(1.425)	(298.75)	(81.375)				598.238			
				(11.63)										
	.38	.616	1128	598.52	.85	294	84	80	.508	5	2.286	237	245	
	.52	.721	1132:30	600.88	1.2	301	84	80	.594	5	2.675 600.806	250	248	
	.63	.794	1137	603.588	1.3	304	84	79	.654	5	2.944 603.481	250	246	
	.44	.663	1141:30	606.41	.9	297	84	80	.547		2.46 606.425			
		.69866	1146	608.9	1.0625	(299)	(81.875)				608.885			
				(10.38)										
		(.7573)		78.439	(1.3)	288.07	77.946							
						747.741	537.616							

North

Form 1026 [Rev. 5/27]

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MOSTARDI-PLATT ASSOCIATES, INC.
TEST SUPPORT DATA

TEST RUN NO. 3 Ontario Hg

COMPANY: WEPCO
PLANT: Pleasant Prairie
TEST LOCATION: Unit 2 North Outlet Duct
CLIENT: ADA
OPERATOR: Greg Rock
DATE: 9-11-01
CONTROL BOX: E-25 POT. NO.: E-25
METER NO.: E-25
METER CALIBRATION FACTOR: .99
PITOT ID NO.: 300A
PITOT TUBE COEFFICIENT: .840
PORT LENGTH: 24 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O		SILICA GEL:	
FINAL:	482.8 ml/gm	FINAL WT:	720.7 gm
INITIAL:	4567.5 ml/gm	INITIAL WT:	701.4 gm
GAIN:	258.3 ml/gm	WT. GAIN:	19.3 gm

TOTAL H_2O COLLECTED: 277.6
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: TARE WT:
FILTER NO: 168 TARE WT: 3.1520
BAROMETRIC PRESSURE in. Hg: 29.45
FLUE PRESSURE in. H_2O: -16
FLUE PRESSURE in. Hg ABS: 28.273
PROBE LENGTH: 9 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO:
CALIBRATED NOZZLE DIAMETER: .245
LEAK CHECK: PRE: .006 POST: .009 @ 10/6 in. Hg
DUCT SHAPE: Rectangular DIAMETER: 7.5 x 24
DUCT AREA: 180 sq. ft. L W
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: 126 min
MINUTES PER POINT: 4.5
TOTAL NUMBER OF TRAVERSE POINTS: 28
GAS ANALYSIS (ORSAT/FYRITE): ORSAT
CO_2: 13.9
O_2: 5.2

PITOT LEAK CHECK: PRE 4.6 POST ✓
ΔH@
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other =
Circle to indicate "Yes" or add other value if not given.

Form 1053 [Rev. 6/97]

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT Wepco: Pleasant Prairie (Ontario Hg)
TEST RUN NO. 3
TEST LOCATION Unit 2 North outlet Duct

DATE 9-11-01 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	2.174 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.8378 Meter Rate cfm	Pump Vacuum in. Hg	x4.5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
1-1	.40	.632	1310	612.520	.87	306	79	79	.53	4	2.385	270	227	Fully
2	.51	.714	1314:30	614.89	1.3	309	80	79	.598	5	2.693 614.905	258	227	Iced
3	.62	.787	1319	617.68	1.3	311	81	79	.660	5	2.969 617.598	255	228	58
4	.45	.671	1323:30	620.48	1.3	302	81	79	.562	5	2.53 620.567	262	227	
		.701204889	1328	623.33	1.1925	307	79.625				623.097			
				10.81										
2-1	.50	.707	1329	623.53	1.0	304	81	79	.593	4	2.666	229	226	
2	.71	.843	1333:30	626.03	1.6	308	81	78	.706	5	3.178 626.196	228	228	
3	.75	.866	1338	628.98	2	310	82	78	.726	5	3.266 629.374	228	227	
4	.45	.671	1342:30	632.35	1.6	295	82	78	.562	5	2.53 632.640	228	227	
		.771642	1347	635.383	1.55	304.25	79.875				635.17			
				11.853										
3-1	.66	.812	1348	635.876	1.4	303	81	78	.681	5	3.064	230	226	
2	.80	.894	1352:30	638.71	2	307	81	78	.750	6	3.373 638.94	230	225	
3	.67	.819	1357	642.06	1.6	308	81	78	.686	6	3.087 642.313	237	225	
4	.60	.775	1401:30	645.28	1.3	302	81	78	.649	6	2.921 645.400	240	225	
		.825	1406	648.266	1.575	305	79.5				648.321			
				12.39										
4-1	.7	.837	1429	649.386	1.6	296	77	77	.701	5	3.155	230	244	
2	.72	.849	1433:30	652.43	1.6	302	78	77	.711	5	3.2 652.541	231	247	
3	.65	.806	1438	655.57	1.6	303	79	77	.676	5	3.040 655.741	232	247	
4	.67	.819	1442:30	658.65	1.8	297	79	77	.686	6	3.087 658.781	230	244	
		.827487	1447	661.93	1.65	299.5	77.625				661.868			
				12.544										
		3.12537		47.597	5.9675	1215.75	316.625							

North Port START

[illegible] →

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

MOSTARDI-PLATT ASSOCIATES, INC

PROJECT Wepco: Pleasant Prairie (Ontario Hg)
TEST RUN NO. 3
TEST LOCATION Unit 2 North outlet Duct

DATE 9-11-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	2.174 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.838 Meter Rate cfm	.838 Pump Vacuum in. Hg	x4.5 Notes		Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
5-1	.64	.800	1448	662.397	1.4	289	79	77	.670	5			230	258	Fully
2	.57	.755	1452:30	665.28	1.4	292	80	76	.633	5	2.847	665.414	228	252	Iced
3	.64	.800	1457	668.27	1.5	290	80	77	.670	5	3.017	668.261	228	252	38
4	.68	.825	1501:30	671.3	1.5	288	80	77	.691	5	3.11	671.278		252	
		.7949	1506	674.33	1.45	289.75	78.25					674.388			
				11.933											
6-1	.51	.714	1507	674.569	1.1	276	79	77	.598	5	2.693		233	251	
2	.67	.819	1511:30	677.28	1.5	284	80	77	.686	5	3.097	677.262	234	253	
3	.70	.837	1516	680.01	1.6	283	80	77	.701	5	3.155	680.349	231	252	
4	.65	.806	1520:30	683.16	1.7	279	80	77	.676	5	3.040	683.504	230	253	
		.79389	1525	686.15	1.475	280.5	78.375					686.544			
				11.581											
7-1	.48	.693	1526	686.308	1.4	278	79	77	.581	5	2.613		231	253	
2	.58	.762	1530:30	689.300	1.2	281	80	77	.638	5	2.872	688.921	230	251	
3	.58	.762	1535	689.05	1.2	281	80	77	.638	5	2.872	691.793	230	251	
4	.52	.721	1539:30	694.7	1.1	281	80	77	.604	5	2.719	694.665	228	251	
		.73427	1544	697.294	1.225	280.25	78.375					697.384			
				10.986											
		.77834		82.097	1.4415	295.179	78.804								
						754.849	538.474								

GE MOSTARDI PLATT
TEST SUPPORT DATA

Ontario Hydro

TEST RUN NO. |

COMPANY: Wepco

PLANT: Pleasant Prarie

TEST LOCATION: Inlet – Unit 2

CLIENT: ~~ADA~~ –

OPERATOR: MRE

DATE: 11-12-01

CONTROL BOX: E14 POT. NO.: E-14

METER NO.: E14

METER CALIBRATION FACTOR: 1.002

PITOT ID NO.: 429 A

PITOT TUBE COEFFICIENT: 0.829

PORT LENGTH: 30 in.

PORT SIZE: 6 in.

PORT TYPE: Flange

IMPINGER H_2O

FINAL: 4936.0 ml/gm

INITIAL: 4740.3 ml/gm

GAIN: ml/gm

SILICA GEL:

FINAL WT: 783.3 gm

INITIAL WT: ~~[illegible]~~ gm

WT. GAIN: 765.4 gm

TOTAL H_2O COLLECTED:

DESCRIPTION OF IMPINGER H_2O:

SILICA GEL EXHAUSTED?:

IMPINGERS RECOVERED BY:

SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: 170 TARE WT: 3.0744

FILTER NO: — TARE WT: —

BAROMETRIC PRESSURE in. Hg: 29.52

FLUE PRESSURE in. H_2O: –15.5

FLUE PRESSURE in. Hg ABS: 28.38

PROBE LENGTH: 9 ft.

PROBE LINER MATERIAL: Teflon

NOZZLE IDENTIFICATION NO: N/A

CALIBRATED NOZZLE DIAMETER: 0.190

LEAK CHECK: PRE: 0.008 POST: 0.002 @ 15/18 in. Hg

DUCT SHAPE: Circular DIAMETER:

DUCT AREA: 204 sq. ft. L 8.5 W 24

DISTURBANCE UPSTREAM: DOWNSTREAM:

TEST LENGTH: 120 min min

MINUTES PER POINT: 5

TOTAL NUMBER OF TRAVERSE POINTS: 24

GAS ANALYSIS (ORSAT/FYRITE):

CO_2: 14.8

O_2: 5.3

PITOT LEAK CHECK: PRE ✓ POST ✓

ΔH@

SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.

Do you want to enter a fuel analysis? Y ☐ N ☐

What value do you want to use? F = 9,780 F_c = 1,800 Other =

Circle to indicate "Yes" or add other value if not given.

Form 1053

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT Wepco – P4
TEST RUN NO. 1 – Ontario Hydro
TEST LOCATION Inlet – Unit 2

DATE 11-12-01 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	Orifice (H) in. H_2O ($K_1 \times \Delta P$, 0.752)	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	Meter Rate cfm ($K \times \sqrt{\Delta P}$, 0.474)	Pump Vacuum in. Hg	Notes (× 5; cfm × 5)	Notes	Probe Temp. °F	Line Filter ~~Holder~~ Temp. °F	Impinger Outlet Temp. °F
1-1	0.73	0.85	1330	29.25	0.55	270	59	61	0.403	4	2.02		250	223	Fully
2	1.9	1.38	1335	31.23	1.43	273	59	61	0.654	5	3.27	31.27	254	225	Iced
3	1.3	1.14	1340	34.49	0.98	272	60	62	0.540	5	2.70	34.54	256	224	
4	1.7	1.30	1345	37.19	1.28	275	60	64	0.616	5	3.08	37.24	252	224	
			1350	40.02								40.32			
2-1	2.1	1.45	1351	40.22	1.58	281	60	65	0.687	6	3.44		247	223	
2	2.3	1.52	1356	43.55	1.73	283	61	67	0.719	6	3.59	43.76	248	223	
3	1.0	1.0	1401	47.20	0.75	283	63	67	0.474	6	2.37	47.35	253	225	
4	1.9	1.38	1406	49.83	1.43	281	62	67	0.654	6	3.27	49.72	255	227	
			1411	52.80								52.99			
3-1	2.0	1.41	1412	53.07	1.50	280	62	67	0.670	6	3.35		253	231	
2	2.0	1.41	1417	56.29	1.50	285	63	68	0.670	6	3.35	56.34	252	231	
3	1.1	1.05	1422	59.58	0.83	288	63	68	0.497	6	2.49	59.69	260	231	
4	0.95	0.98	1427	62.30	0.71	287	64	68	0.462	6	2.31	62.18	259	232	
			1432	64.40								64.49			
4-1	0.83	0.91	1433	64.66	0.62	291	64	66	0.432	5	2.16		251	236	
2	1.0	1.0	1438	66.68	0.75	293	64	67	0.477	5	2.37	66.65	252	236	
3	0.83	0.91	1443	69.13	0.62	296	65	67	0.432	5	2.16	69.02	257	229	
4	0.90	0.95	1448	71.23	0.68	295	64	66	0.450	5	2.25	71.18	259	227	
			1453	73.31								73.42			
6-1	2.2	1.48	1458	73.50	1.65	294	64	66	0.702	6	3.51		258	229	
2	2.0	1.41	1503	76.87	1.50	295	64	66	0.670	6	3.35	76.93	258	228	
3	1.2	1.10	1508	80.33	0.90	299	65	68	0.520	6	2.60	80.28	257	230	
4	1.7	1.30	1513	82.80	1.28	305	65	69	0.616	6	3.08	82.88	256	227	
			1518	85.61								85.91			

Form 1026

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT Wepco - P4
TEST RUN NO. 1 - Ontario Hydro
TEST LOCATION Inlet - Unit 2

DATE 11-12-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	0.752 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	0.474 Meter Rate cfm	Pump Vacuum in. Hg	×5 Notes		Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
N 7-1	1.8	1.34	1519	86.03	1.35	307	65	69	0.635	8	3.18		258	229	
-2	1.6	1.27	1524	89.02	1.20	310	66	70	0.600	8	3.00	89.14	255	227	Fully
-3	1.6	1.27	1529	92.63	1.20	316	64	67	0.600	7	3.00	92.14	255	226	
-4	1.9	1.38	1534	95.15	1.43	318	64	67	0.653	8	3.27	95.14	257	223	Iced
			15.39	98.53								98.41			
Avg.	1.52	1.23		69.28	1.14	291	63	66	0.583				255	228	

Form 1027

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GE MOSTARDI PLATT
TEST SUPPORT DATA

TEST RUN NO. 2

COMPANY: Wepco
PLANT: Pleasant Prairie
TEST LOCATION: Inlet – Unit 2
CLIENT: ADA / WEPCO
OPERATOR: MRE
DATE: 11-13-01
CONTROL BOX: E14 POT. NO.: E-14
METER NO.: E14
METER CALIBRATION FACTOR: 1.002
PITOT ID NO.: 429A
PITOT TUBE COEFFICIENT: 0.829
PORT LENGTH: 30 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O

FINAL: 5094.2 ml/gm
INITIAL: 4898.6 ml/gm
GAIN: ______ ml/gm

SILICA GEL:

FINAL WT: 778.6 gm
INITIAL WT: 758.0 gm
WT. GAIN: ______ gm

TOTAL H_2O COLLECTED:
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: 169 TARE WT: 3.1354
FILTER NO: — TARE WT:
BAROMETRIC PRESSURE in. Hg: 29.33
FLUE PRESSURE in. H_2O: −17
FLUE PRESSURE in. Hg ABS: 28.08
PROBE LENGTH: 9 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO: N/A
CALIBRATED NOZZLE DIAMETER: 0.190
LEAK CHECK: PRE: 0.003 POST: 0.005 @ 15 in. Hg
DUCT SHAPE: Circular DIAMETER:
DUCT AREA: 204 sq. ft. L 8.5 W 24
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: 120 min min
MINUTES PER POINT: 5
TOTAL NUMBER OF TRAVERSE POINTS: 24
GAS ANALYSIS (ORSAT/FYRITE):
CO_2: 14.9
O_2: 4.2

PITOT LEAK CHECK: PRE ✓ POST ✓
ΔH@
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other =
Circle to indicate "Yes" or add other value if not given.

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT Wepco
TEST RUN NO. 2
TEST LOCATION Inlet

DATE 11-13-01 PAGE 1 OF 2

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Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft³	x0.751 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	x0.476 Meter Rate cfm	Pump Vacuum in. Hg	X5 Notes	Notes	Probe Temp. °F	Line ~~Filter Holder~~ Temp. °F	Impinger Outlet Temp. °F
1-1	0.90	0.95	0835	0.73	0.68	263	53	54	0.45	5	2.26		255	233	Fully
-2	1.8	1.34	0840	3.08	1.35	265	54	55	0.64	5	3.19	2.99	256	234	
-3	1.3	1.14	0845	6.03	0.98	266	55	58	0.54	5	2.71	6.18	258	233	Iced
-4	2.0	1.41	0850	8.95	1.50	266	55	60	0.67	5	3.37	8.89	258	236	
			0855	12.13								12.26			
2-1	1.7	1.30	0856	12.33	1.28	265	56	61	0.62	5	3.10		256	230	
-2	2.2	1.48	0901	15.44	1.65	269	57	63	0.71	5	3.53	15.36	256	233	
-3	1.1	1.05	0906	18.80	0.83	273	57	64	0.50	6	2.50	18.89	255	233	
-4	1.7	1.30	0911	21.52	1.28	274	55	63	0.62	6	3.10	21.39	257	235	
			0916	24.49								24.49			
3-1	1.9	1.38	0917	24.57	1.43	276	56	63	0.66	6	3.30		258	233	
-2	2.0	1.41	0922	27.70	1.50	280	58	65	0.67	6	3.37	27.79	254	229	
-3	1.0	1.0	0927	31.19	0.75	283	58	66	0.48	6	2.38	31.16	255	228	
-4	1.0	1.0	0932	33.58	0.75	283	60	65	0.48	6	2.38	33.54	260	228	
			0937	36.00								35.92			
4-1	1.9	1.38	0938	36.06	1.43	284	59	66	0.66	7	3.30		261	227	
-2	1.2	1.10	0943	39.19	0.90	289	59	65	0.52	7	2.61	39.22	255	230	
-3	0.66	0.81	0948	41.95	0.50	288	60	66	0.39	7	1.93	41.83	255	230	
-4	0.90	0.95	0953	44.88	0.68	288	60	66	0.45	7	2.26	43.76	257	233	
			0958	46.01								46.02			
6-1	2.0	1.41	0959	46.13	1.50	286	60	67	0.67	7	3.37		261	232	
-2	2.0	1.41	1004	49.45	1.50	285	59	65	0.67	7	3.37	49.39	263	233	
-3	1.3	1.14	1009	52.90	0.98	303	60	66	0.54	8	2.71	52.76	258	225	
-4	1.5	1.23	1014	55.43	1.13	303	62	66	0.58	8	2.92	55.47	259	227	
			1019	58.22								58.39			

Form 1026

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FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT Wepco
TEST RUN NO. 2
TEST LOCATION Inlet

DATE 11-13-01 PAGE 2 OF 2

N

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	x0.951 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	x0.476 Meter Rate cfm	Pump Vacuum in. Hg	x5 Notes	Notes	Probe Temp. °F	Line ~~Filter Holder~~ Temp. °F	Impinger Outlet Temp. °F
7-1	1.8	1.34	1020	58.42	1.35	302	61	65	0.64	8	3.19		262	225	
-2	1.5	1.23	1025	61.43	1.13	309	61	66	0.58	8	2.92	61.58	257	224	Fully
-3	1.5	1.23	1030	64.66	1.13	309	61	66	0.58	9	2.92	64.50	260	227	
-4	1.9	1.38	1035	67.39	1.43	311	62	66	0.66	9	3.28	67.42	255	233	Iced
			1040	71.03								70.70			
	1.5	1.24													
				70.00		284	60.9								

Form 1026

GE MOSTARDI PLATT
TEST SUPPORT DATA

TEST RUN NO. 3 - Ontario Hydro

COMPANY: Wepco
PLANT: Pleasant Pairie
TEST LOCATION: Inlet - Unit 2
CLIENT: ADA / WEPCO
OPERATOR: MRE
DATE: 11-13-01
CONTROL BOX: E14 POT. NO.: E14
METER NO.: E14
METER CALIBRATION FACTOR: 1.002
PITOT ID NO.: 429A
PITOT TUBE COEFFICIENT: 0.829
PORT LENGTH: 30 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O
FINAL: 5064.9 ml/gm
INITIAL: 4858.3 ml/gm
GAIN: ______ ml/gm

SILICA GEL:
FINAL WT: 791.1 gm
INITIAL WT: 773.8 gm
WT. GAIN: ______ gm

TOTAL H_2O COLLECTED:
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: 188 TARE WT: 3.0534
FILTER NO: ______ TARE WT: ______
BAROMETRIC PRESSURE in. Hg: 29.33
FLUE PRESSURE in. H_2O: -17
FLUE PRESSURE in. Hg ABS: 28.08
PROBE LENGTH: 9 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO: N/A
CALIBRATED NOZZLE DIAMETER: 0.190
LEAK CHECK: PRE: 0.002 POST: 0.002 @ 12" in. Hg
DUCT SHAPE: Circular DIAMETER: ______
DUCT AREA: 204 sq. ft. L 8.5 W 24
DISTURBANCE UPSTREAM: ______ DOWNSTREAM: ______
TEST LENGTH: 120 min min
MINUTES PER POINT: 5
TOTAL NUMBER OF TRAVERSE POINTS: 24
GAS ANALYSIS (ORSAT/FYRITE):
CO_2: 14.9
O_2: 4.8

PITOT LEAK CHECK: PRE ✓ POST ✓
ΔH@ ______
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other = ______
Circle to indicate "Yes" or add other value if not given.

Form 1053

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT Wepco
TEST RUN NO. 3
TEST LOCATION Inlet

DATE 11-13-01 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	x0.742 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	x0.473 Meter Rate cfm	Pump Vacuum in. Hg	Notes x5	Notes	Probe Temp. °F	Line Filter Holder Temp. °F	Impinger Outlet Temp. °F
N 7-1	1.8	1.34	1120	71.36	1.34	309	60	65	0.64	6	3.17		256	233	
-2	1.5	1.23	1125	74.41	1.11	309	61	64	0.60	6	2.90	74.53	263	231	Fully
-3	1.6	1.27	1130	77.50	1.19	310	61	64	0.60	6	3.02	77.43	263	232	
-4	2.0	1.41	1135	80.56	1.48	308	62	66	0.67	6	3.35	80.42	261	231	Iced
			1140	83.80								83.77			
6-1	2.2	1.48	1141	83.92	1.63	307	62	66	0.70	6	3.51		261	230	
-2	2.1	1.45	1146	87.27	1.56	308	63	67	0.69	7	3.43	87.28	262	232	
-3	1.3	1.14	1151	90.62	0.97	305	62	67	0.54	7	2.70	90.71	258	232	
-4	1.7	1.30	1156	93.53	1.26	306	63	66	0.62	7	3.08	93.41	259	234	
			1201	96.39								96.49			
4-1	1.9	1.38	1202	96.52	1.41	305	62	66	0.65	7	3.26		260	234	
-2	1.1	1.05	1207	99.89	0.82	306	63	66	0.50	7	2.48	99.75	262	234	
-3	0.75	0.87	1212	102.33	0.56	302	62	66	0.41	6	2.05	102.23	258	230	
-4	0.83	0.91	1217	104.37	0.62	300	62	66	0.43	6	2.16	104.28	260	231	
	(1.565)	(1.251)	1222	106.39		(306.25)		(63.84)				106.44			
3-1	2.0	1.41	1223	106.43	1.48	300	61	65	0.67	6	3.35		262	232	
-2	2.0	1.41	1228	109.97	1.48	295	62	65	0.67	6	3.35	109.79	257	229	
-3	1.3	1.14	1233	113.20	0.97	295	62	66	0.54	6	2.70	113.14	256	229	
-4	0.91	0.95	1238	115.92	0.68	289	62	67	0.45	7	2.26	115.84	260	230	
			1243	118.07								118.10			
2-1	2.2	1.48	1244	118.15	1.63	288	63	67	0.70	7	3.51		261	234	
-2	2.4	1.55	1249	121.75	1.78	282	62	66	0.73	8	3.66	121.61	256	233	
-3	1.2	1.10	1254	125.33	0.89	281	62	66	0.52	8	2.59	125.27	257	230	
-4	1.9	1.38	1259	127.97	1.41	282	62	66	0.65	8	3.26	127.86	257	231	
			1304	131.35								131.12			

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT Wepco
TEST RUN NO. 3
TEST LOCATION Inlet

DATE 11-13-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	x0.742 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	x0.473 Meter Rate cfm	Pump Vacuum in. Hg	x5 Notes		Probe Temp. °F	Line ~~Filter Holder~~ Temp. °F	Impinger Outlet Temp. °F
5 1-1	0.93	0.96	1305	131.43	0.69	279	62	66	0.46	8	2.28	131.43	258	235	
-2	2.0	1.41	1310	133.55	1.48	274	62	66	0.67	8	3.35	133.40	255	234	Fully
-3	1.0	1.00	1315	136.62	0.74	273	63	66	0.47	8	2.37	136.75	255	235	
-4	1.3	1.14	1320	139.15	0.97	273	63	66	0.54	8	2.70	139.12	256	232	Iced
	1.595	1.263	1325	141.96		284.25	64.00					141.82			
Avg	1.58	1.26		69.89		295.25	63.96								

for Hg

GE MOSTARDI PLATT
TEST SUPPORT DATA

TEST RUN NO. 1 Ontario method 29

COMPANY: Wisconsin Electric Power Company
PLANT: Pleasant Prairie Power Plant
TEST LOCATION: Unit 2 North Outlet Duct
CLIENT: ADA
OPERATOR: Greg Rock
DATE: 11-12-01
CONTROL BOX: E-5' POT. NO.: E-5'
METER NO.: E-5'
METER CALIBRATION FACTOR: .998
PITOT ID NO.: 287B
PITOT TUBE COEFFICIENT: .837
PORT LENGTH: 24 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O		SILICA GEL:	
FINAL:	5028.0 ml/gm	FINAL WT:	775.4 gm
INITIAL:	4846.2 ml/gm	INITIAL WT:	758.6 gm
GAIN:	181.8 ml/gm	WT. GAIN:	16.8 gm

TOTAL H_2O COLLECTED: 198.6
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: 181 TARE WT: 3-3044
FILTER NO: — TARE WT: —
BAROMETRIC PRESSURE in. Hg: 29.52
FLUE PRESSURE in. H_2O: -17.5
FLUE PRESSURE in. Hg ABS: 28.2322 8815
PROBE LENGTH: 8.5 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO: Mercury Set A #8
CALIBRATED NOZZLE DIAMETER: .245
LEAK CHECK: PRE: .015 POST: .010 @ 8/10 in. Hg
DUCT SHAPE: Rectangular DIAMETER:
DUCT AREA: sq. ft. L 24' W 7.5'
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: 126 min
MINUTES PER POINT: 4.5
TOTAL NUMBER OF TRAVERSE POINTS: 28
GAS ANALYSIS (ORSAT/FYRITE): ORSAT
CO_2: 13.8 / 13.8 / 13.8
O_2: 5.2

PITOT LEAK CHECK: PRE Good 6" POST Good 4"
ΔH@
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other =
Circle to indicate "Yes" or add other value if not given.

Form 1053

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT WEPCO Pleasant Prairie
TEST RUN NO. 1 Ontario M29 Hg
TEST LOCATION Unit 2 North Outlet Duct

DATE 11-12-01 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	1.949 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.787 Meter Rate cfm	Pump Vacuum in. Hg	× 4.5 Notes		Probe Temp. °F	Heated Line ~~Filter Holder~~ Temp. °F	Impinger Outlet Temp. °F
1-1	.55	.742	1330	710.428	1.1	280	64	61	.584	7	2.626		257	239	Fully
2	.64	.800	1334:30	713.18	1.2	280	66	61	.630	7	2.833	713.057	258	237	Iced
3	.57	.755	1339	715.8	1.1	278	68	62	.594	7	2.674	715.887	257	241	<68
4	.50	.707	1343:30	718.39	1.0	277	69	62	.556	7	2.504	718.561	271	243	
	.7509	27518	1348	720.73	1.1	278.75	64.125					721.065			
				10.302											
2-1	.50	.707	1349	721.15	1.0	281	71	63	.556	7	2.504		250	249	
2	.66	.812	1353:30	723.57	1.3	282	71	63	.639	7	2.877	723.654	255	250	
3	.70	.837	1358	726.40	1.7	281	73	64	.658	7	2.963	726.531	254	251	
4	.58	.762	1402:30	729.456	1.2	280	74	64	.599	7	2.697	729.494	253	251	
	.7794369	99	1407	731.96	1.3	281	67.875					732.191			
				10.81											
3-1	.67	.819	1409	732.464	1.3	292	74	65	.644	7	2.899		254	252	
2	.56	.748	1413:30	735.15	1.4	291	72	65	.589	7	2.650	735.362	257	249	
3	.65	.806	1418	737.93	1.5	289	74	66	.634	7	2.855	738.012	254	247	
4	.66	.812	1422:30	740.75	1.3	287	74	66	.639	8	2.877	740.867	255	247	
	.79637409	2	1427	743.600	1.375	289.75	69.5					743.744			
				11.136											
4-1	.75	.866	1429	744.100	1.5	300	74	67	.682	8	3.067		251	235	
2	.68	.825	1433:30	747.0	1.5	300	74	67	.649	8	2.920	747.167	254	225	
3	.62	.787	1438	749.900	1.5	299	75	67	.62	8	2.789	750.087	252	230	
4	.62	.787	1442:30	752.75	1.5	299	75	67	.62	8	2.789	752.876	250	232	
	.816362	026	1447	755.71	1.5	299.5						755.665			
				11.61											

Form 1026

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FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT WEPCO : Pleasant Prairie
TEST RUN NO. 1 Ontario m29 4a
TEST LOCATION Unit 2 North Outlet Duct

DATE 11-12-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	1.949 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.787 Meter Rate cfm	Pump Vacuum in. Hg	x4.5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
5-1	.74	.860	1449	755.972	1.5	303	73	68	.677	8	3.047	250	234	Fully
2	.79	.889	1453:30	758.85	1.7	304	74	68	.700	8	3.148 759.019	257	235	Iced
3	.64	.800	1458	762.0	1.5	304	75	68	.630	8	2.833 762.167	248	237	[illegible]
4	.58	.762	1502:30	765.15	1.2	304	75	68	.599	8	2.697 765.000	248	238	
	.82765	.732	1507	767.895	1.475	303.75	71.125				767.697			
				11.923										
6-1	.59	.768	1508	768.200	1.2	302	74	68	.605	7	2.720	247	238	
2	.73	.854	1512:30	770.73	1.6	304	75	68	.672	8	3.026 770.920	249	237	
3	.72	.849	1517	773.59	1.8	306	75	68	.668	8	3.005 773.946	251	237	
4	.48	.693	1521:30	776.75	.9	305	75	69	.545	8	2.454 776.951	249	238	
	.79096	.5852	1526	779.300	1.375	304.25	71.5				779.405			
				11.1										
7-1	.45	.671	1527	779.523	.9	303	73	68	.528	7	2.376	252	241	
2	.54	.735	1531:30	781.85	1.1	305	74	69	.578	7	2.602 781.899	250	242	
3	.65	.806	1536	784.3	1.6	307	74	69	.634	8	2.855 784.501	248	235	
4	.45	.671	1540:30	787.3	.9	307	75	69	.528	8	2.376 787.356	247	234	
			1545	789.69		305.5					789.732			
				10.167										
					1.32	294.64		69.4						
		0.783		77.048										
						754.313		529.4						

GE MOSTARDI PLATT
TEST SUPPORT DATA

TEST RUN NO. 2 Ontario Method Hg

COMPANY: Wisconsin Electric Power Company (WEPCO)
PLANT: Pleasant Prairie Power Plant (P4)
TEST LOCATION: Unit 2 North Outlet Duct
CLIENT: WEPCO & A.D.A
OPERATOR: J. Rock
DATE: 11-13-01
CONTROL BOX: E-5' POT. NO.: E-5'
METER NO.: E-5'
METER CALIBRATION FACTOR: .998
PITOT ID NO.: 287B
PITOT TUBE COEFFICIENT: .837
PORT LENGTH: 24 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O

FINAL: 5001.5 ml/gm (gm circled)
INITIAL: 4772.1 ml/gm (gm circled)
GAIN: ______ ml/gm (gm circled)

SILICA GEL:

FINAL WT: 790.7 gm
INITIAL WT: 774.9 gm (gm circled)
WT. GAIN: ______ gm

TOTAL H_2O COLLECTED:
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: 189 TARE WT: 3.5922
FILTER NO: — TARE WT: —
BAROMETRIC PRESSURE in. Hg: 29.33
FLUE PRESSURE in. H_2O: -17
FLUE PRESSURE in. Hg ABS: 28.0790802l
PROBE LENGTH: 8.5 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO: Mercury Set A #8 = .245
CALIBRATED NOZZLE DIAMETER: .245
LEAK CHECK: PRE: .015 POST: .020 @ 5 / 11 in. Hg
DUCT SHAPE: Rectangular DIAMETER:
DUCT AREA: 180 sq. ft. L 24 W 7.5
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: 126 min
MINUTES PER POINT: 4.5
TOTAL NUMBER OF TRAVERSE POINTS: 28
GAS ANALYSIS (ORSAT/FYRITE): ORSAT
CO_2: 13.7
O_2: 5.3

PITOT LEAK CHECK: PRE 6" POST 5.2"
ΔH@
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other = ______
Circle to indicate "Yes" or add other value if not given.

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT WEPCO & A.D.A.
TEST RUN NO. 2 Ontario Method Hg
TEST LOCATION Unit 2 North Outlet Duct

DATE 11-13-01 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	2.019 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.801 Meter Rate cfm	Pump Vacuum in. Hg	4.5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
1-1	.48	.693	0810	791.088	1.0	273	55	54	.555	8	2.497	251	225	Fully
2	.63	.794	0814:30	793.593	1.5	272	58	54	.636	8	2.861 793.585	237	225	Iced
3	.65	.806	0819	796.4	1.4	271	61	54	.646	8	2.906 796.446	253	225	<58
4	.57	.755	0823:30	799.25	1.4	269	63	55	.605		2.721 799.352	258	224	
	.7619387	33	0828	802.0	1.325	271.25	56.75				802.073			
				10.912										
2-1	.58	.762	0831	802.965	1.2	271	61	56	.610	8	2.745	265	235	
2	.62	.787	0835:30	805.648	1.4	271	64	56	.631	8	2.838 805.710	262	235	
3	.56	.748	0840	808.49	1.2	269	65	57	.599	8	2.697 808.548	270	237	
4	.48	.693	0844:30	811.08	1.3	269	66	58	.555	8	2.497 811.245	244	239	
	.7475324	74	0849	813.408	1.275	270	60.375				813.742			
				10.443										
3-1	.64	.800	0852	814.016	1.7	282	67	58	.641	9	2.884	260	240	
2	.55	.742	0856:30	817.13	1.1	282	68	59	.594	8	2.673 816.930	244	233	
3	.62	.787	0901	819.715	1.3	281	68	59	.631	8	2.838 819.603	248	237	
4	.63	.794	0905:30	822.54	1.3	279	69	60	.636	8	2.861 822.441	240	233	
	.780686	507	0910	825.319	1.35	281	63.5				825.302			
				11.273										
4-1	.69	.831	0912	825.979	1.4	291	68	60	.665	8	2.994	257	230	
2	.67	.819	0916:30	828.83	1.6	292	69	61	.656	8	2.950 828.973	253	230	
3	.60	.775	0921	832.06	1.2	291	70	61	.620	8	2.792 831.923	254	234	
4	.62	.787	0925:30	834.61	1.3	290	70	61	.631	8	2.838 834.715	246	235	
	.802798	78	0930	837.400	1.375	291	65				837.553			
				11.421										
				44.049										

Form 1026

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT WEPCO & A.D.A.
TEST RUN NO. 2 Ontario Method Hg
TEST LOCATION Unit 2 North outlet Duct

DATE 11-13-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	2.019 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.801 Meter Rate cfm	Pump Vacuum in. Hg	4.5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
5-1	.69	.831	0933	837.924	1.4	295	67	62	.665	9	2.994	251	233	Fully
2	.75	.866	0937:30	840.74	2.0	295	70	62	.694	10	3.122 840.918	244	235	Iced
3	.58	.762	0942	844.0	1.4	295	71	62	.610	10	2.745 844.040	252	236	58
4	.56	.748	0946:30	847.04	1.2	295	71	62	.599	9	2.697 846.785	248	235	
	.801649	144	0951	849.625	1.5	295	65.875				849.482			
				11.701										
6-1	.54	.735	0953	850.26	1.1	293	70	63	.589	8	2.649	254	241	
2	.68	.825	0957:30	852.78	1.4	295	71	63	.661	9	2.972 852.909	250	239	
3	.68	.825	1002	855.6	1.7	297	72	64	.661	9	2.972 855.881	258	238	
4	.52	.721	1006:30	858.6	1.5	298	73	64	.578	9	2.599 858.853	245	237	
	.776299	857	1011	861.555	1.425	295.75	67.5				861.452			
				11.295										
7-1	.42	.648	1013	861.980	.9	293	70	64	.519	7	2.336	252	240	
2	.52	.721	1017:30	864.22	1.5	296	72	64	.578	8	2.599 864.316	243	239	
3	.60	.775	1022	867.02	1.2	298	72	65	.620	8	2.792 866.915	244	230	
4	.43	.656	1026:30	869.85	.8	296	72	65	.525	8	2.364 869.707	249	230	
	.699882	11	1031	872.271	1.1	295.75	68				872.071			
				10.291										
							63.857							
	.767255	243		77.336	1.3357		523.527							
						285679								
				76.561		745.349								
				Std										

.98998201 × Vm · Vm std

Form 3026

GE MOSTARDI PLATT
TEST SUPPORT DATA

TEST RUN NO. 3 Ontario Method Hg

COMPANY: Wisconsin Electric Power Company
PLANT: Pleasant Prairie Power Plant (P4)
TEST LOCATION: Unit 2 North Outlet Duct
CLIENT: WEPCO & A.D.A
OPERATOR: G. Rock
DATE: 11-13-01
CONTROL BOX: E-51 POT. NO.: E-51
METER NO.: E-51
METER CALIBRATION FACTOR: .998
PITOT ID NO.: 287B
PITOT TUBE COEFFICIENT: .837
PORT LENGTH: 24 in.
PORT SIZE: 6 in.
PORT TYPE: Flange

IMPINGER H_2O
FINAL: 4983.6 ml/gm
INITIAL: 4748.9 ml/gm
GAIN: ml/gm

SILICA GEL:
FINAL WT: 724.6 gm
INITIAL WT: 709.5 gm
WT. GAIN: gm

TOTAL H_2O COLLECTED:
DESCRIPTION OF IMPINGER H_2O:
SILICA GEL EXHAUSTED?:
IMPINGERS RECOVERED BY:
SILICA GEL WEIGHED BY:

COMMENTS & NOTES

THIMBLE NO: 180 TARE WT: 3.2291
FILTER NO: TARE WT:
BAROMETRIC PRESSURE in. Hg: 29.33
FLUE PRESSURE in. H_2O: -17
FLUE PRESSURE in. Hg ABS: 28.079
PROBE LENGTH: 8.5 ft.
PROBE LINER MATERIAL: Teflon
NOZZLE IDENTIFICATION NO: Mercury Set A #8 = .245
CALIBRATED NOZZLE DIAMETER: .245
LEAK CHECK: PRE: .011 POST: 0.004 @ 11/12 in. Hg
DUCT SHAPE: Rectangular DIAMETER:
DUCT AREA: 180 sq. ft. L 7.5 W 24'
DISTURBANCE UPSTREAM: DOWNSTREAM:
TEST LENGTH: 126 min
MINUTES PER POINT: 4.5
TOTAL NUMBER OF TRAVERSE POINTS: 28
GAS ANALYSIS (ORSAT/FYRITE): ORSAT
CO_2: 13.9
O_2: 5.2

PITOT LEAK CHECK: PRE 4'' POST 3''
ΔH@
SAMPLES REMOVED FROM SITE BY:

For computer data entry: Supervisor, please complete.
Do you want to enter a fuel analysis? Y ☐ N ☐
What value do you want to use? F = 9,780 F_c = 1,800 Other =
Circle to indicate "Yes" or add other value if not given.

Form 1053

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT WEPCO + ADA (Pleasant Prairie Power Plant)
TEST RUN NO. 3 Ontario method Hg
TEST LOCATION Unit 2 North Outlet Duct

November 13th, 2001 A.D.
Tuesday

DATE 11-13-01 PAGE 1 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	2.019 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.801 Meter Rate cfm	Pump Vacuum in. Hg	4.5 Notes		Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
1-1	.44	.663	11:20:00	873.899	.9	297	64	63	.531	7	2.391		245	226	Fully
2	.52	.721	11:24:30	876.25	1.1	298	66	63	.578	8	2.599	876.290	249	223	Iced
3	.60	.775	11:29:00	878.68	1.5	299	69	63	.620	8	2.792	878.889	248	230	568
4	.43	.656	11:33:30	881.61	.95	299	70	64	.525	7	2.364	881.681	249	232	
	.7036939	33	11:38:00	884.000	1.1125	298.25	65.25					884.045			
				10.101											
2-1	.53	.728	11:41:00	884.982	1.1	296	70	64	.583	8	2.624		250	235	
2	.71	.843	11:45:30	887.64	1.6	299	72	64	.675	9	3.037	887.606	247	235	
3	.72	.849	11:50:00	890.69	1.6	300	73	65	.680	9	3.059	890.643	251	251	
4	.55	.742	11:54:30	893.69	1.3	300	73	65	.594	9	2.673	893.702	249	240	
	.7969344	88	11:59:00	896.55	1.4	298.75	68.25					896.375			
				11.568											
3-1	.52	.721	12:02:00	897.366	1.1	299	70	65	.578	8	2.599		249	224	
2	.64	.800	12:06:30	899.92	1.5	300	72	65	.641	9	2.884	899.965	250	225	
3	.49	.700	12:11:00	902.84	1.1	300	72	65	.561	8	2.523	902.849	248	234	
4	.50	.707	12:15:30	905.46	1	299	72	65	.566	7	2.549	905.372	250	236	
	.732054	259	12:20:00	907.88	1.175	299.5	68.25					907.921			
				10.514											
4-1	.70	.837	12:28:00	909.813	1.5	298	70	66	.670	8	3.016		248	232	
2	.70	.837	12:32:30	912.610	1.6	299	72	66	.670	9	3.016	912.829	252	231	
3	.60	.775	12:37:00	915.65	1.6	297	73	66	.620	9	2.792	915.845	251	231	
4	.63	.794	12:41:30	918.71	1.5	297	74	66	.636	9	2.861	918.637	254	232	
	.810410528		12:46:00	921.67	1.55	297.75	69.125					921.498			
				11.857											
				44.04											

North port
point
=
1st
of duct

FIELD TEST DATA SHEET
FOR ISOKINETIC SAMPLING

GE MOSTARDI PLATT

PROJECT WEPCO + ADA (Pleasant Prairie Power Plant)
TEST RUN NO. 3 Ontario Method Hg
TEST LOCATION Unit 2 North Outlet Duct
DATE 11-13-01 PAGE 2 OF 2

Port-Point No.	Velocity Head (P) in. H_2O	$\sqrt{P}$	Clock Time 24 hr.	Meter Volume (Vm) ft^3	2.019 Orifice (H) in. H_2O	Stack Temp (t_s) °F	Meter Temp. (t_m) Inlet °F	Meter Temp. (t_m) Outlet °F	.801 Meter Rate cfm	Pump Vacuum in. Hg	4.5 Notes	Probe Temp. °F	Filter Holder Temp. °F	Impinger Outlet Temp. °F
5-1	.65	.806	1249	922.393	1.5	292	72	66	.646	9	2.906	263	233	Full
2	.58	.762	1253:30	925.25	1.3	292	73	66	.610	9	2.745 925.299	252	230	Iced
3	.66	.812	1258	928.098	1.5	290	73	66	.651	9	2.928 928.044	249	228	568
4	.70	.837	130230	930.97	1.6	287	73	66	.670	9	3.016 930.972	252	227	
	(.804216732)		1307	933.965	(1.475)	(290.5)	(69.375)				933.938			
				(11.572)										
6-1	.60	.775	1309	934.605	1.3	282	72	66	.620	8	2.792	243	226	
2	.65	.806	131330	937.42	1.5	281	72	66	.646	9	2.906 937.397	251	225	
3	.58	.762	1318	940.35	1.3	280	72	66	.610	9	2.745 940.303	263	224	
4	.49	.700	132230	943.15	1.0	278	71	66	.561	8	2.523 943.048	255	223	
	(.760599938)		1327	945.7	(1.275)	(280.25)	(68.875)				945.571			
				(11.095)										
7-1	.50	.707	1329	946.195	1	282	70	65	.566	7	2.549	253	224	
2	.66	.812	133330	948.65	1.6	282	71	65	.651	9	2.928 948.744	251	224	
3	.71	.843	1338	951.62	1.6	280	70	65	.675	9	3.037 951.672	258	224	
4	.59	.768	134230	954.68	1.3	278	71	65	.615	9	2.759 954.709	250	224	
			1347	957.23							957.478			

CALIBRATION PROCEDURES

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.

Pitot tube assemblies are calibrated in accordance with Method 2, Section 4, against a standard hemispherical pitot utilizing a wind tunnel meeting the specification in Method 2, Section 4.1.2.

NOZZLES

The nozzles are measured according to Method 5, Section 5.1.

TEMPERATURE SENSING DEVICES

The potentiometer and thermocouples are calibrated against a mercury thermometer in a calibration well. Alternatively, readings are checked utilizing a NBS traceable millivolt source.

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.

PITOT TUBE CALIBRATION DATA

Type "S" Pitot Tube ID Number: 660 Size (OD): 1/4" Leak Check: Pass

Calibration Pitot Tube

Type: Hemispherical (std) Size (OD): 1/4" Cp(std) = 1.00 ID #: Dwyer 160-8

Calibration Date: 11/30/00 Performed By: Rich Russ

P_{std}, (in.) H_2O		A-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$ [a]**	**DEV. [b]**
0.25	0.25	0.36	0.833	0.002
0.55	0.55	0.79	0.834	0.001
0.85	0.85	1.22	0.835	0.001
1.00	1.00	1.43	0.836	0.001
2.00	2.00	2.86	0.836	0.001
3.00	3.00	4.27	0.838	0.003
		Average	0.836	0.001

P_{std}, (in.) H_2O		B-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$ [a]**	**DEV. [b]**
0.25	0.25	0.36	0.833	0.002
0.55	0.55	0.79	0.834	0.001
0.85	0.85	1.22	0.835	0.001
1.00	1.00	1.43	0.836	0.001
2.00	2.00	2.86	0.836	0.001
3.00	3.00	4.27	0.838	0.003
		Average	0.836	0.001

$\overline{C_p}(A) - \overline{C_p}(B) =$ 0.000
(must be ≤ 0.01)

[a] $C_{p(S)} = C_{p(std)} \sqrt{\frac{\Delta P_{std}}{\Delta P_s}}$

[b] $DEV = C_{p(S)} - \overline{C_p}$
(must be ≤ 0.01)

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? X yes ___ no

Pitot tube openings damaged? ___ yes (explain below) X no

α_1 = 3 ° (<10°), α_2 = 2 ° (<10°) z = A sin γ = 0.023 (in.); (<0.125 in.)

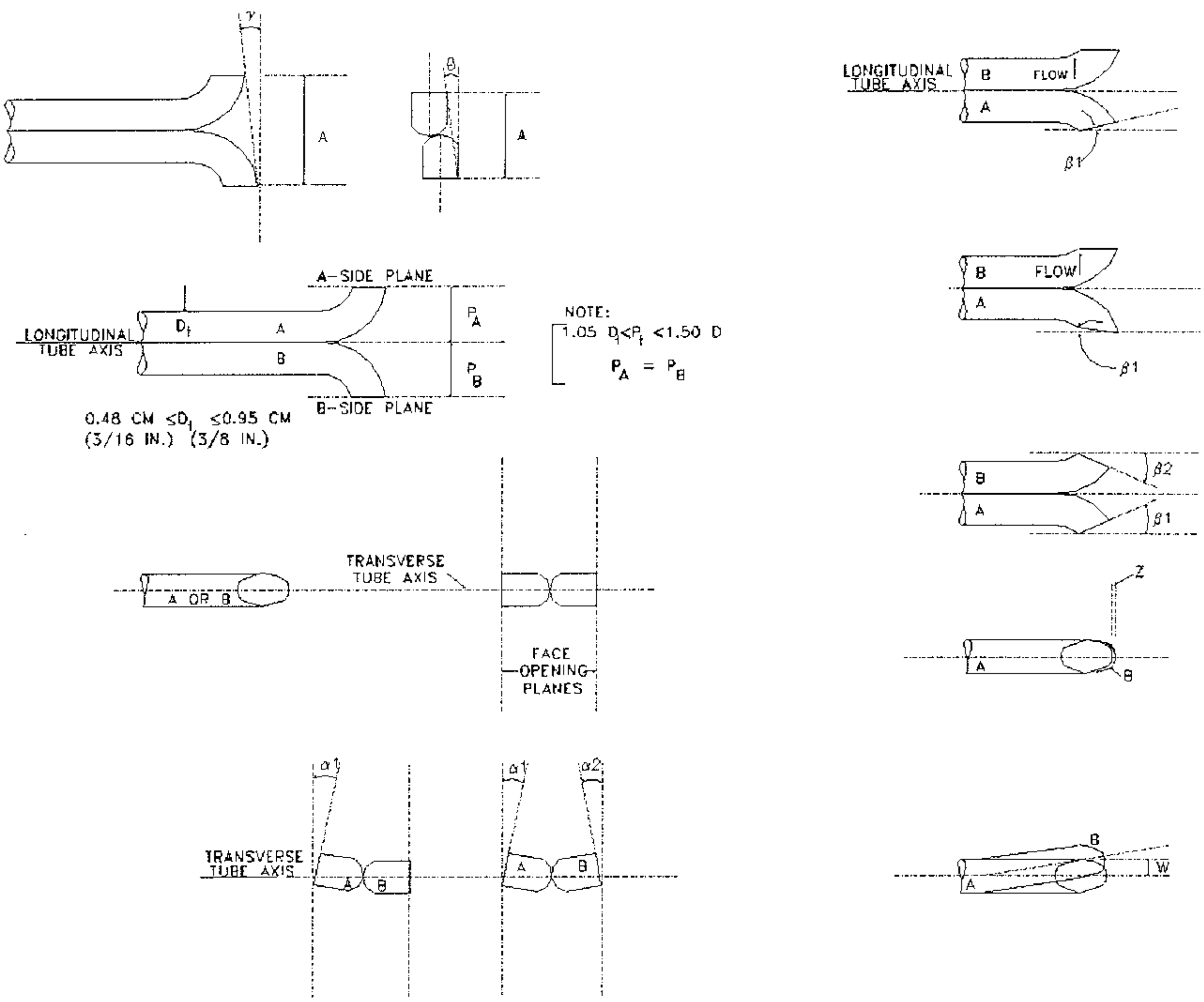
β_1 = 0 ° (<5°), β_2 = 0.5 ° (<5°) w = A sin θ = 0.006 (in.); (<0.03125 in.)

γ = 2 °, θ = 0.5 °, A = 0.666 (in.) P_A = 0.33 (in.), P_B = 0.33 (in.), D_t = 0.250 (in.)

Comments: ___

Calibration required? ___ yes X no

Pitot Tube No.: 660 Date: 12/04/2000 Name: Rich Russ



Pitot Tube Calibration Data

Calibration Pitot Tube: Type: Standard Size (OD): 0.25 Pitot ID #: 160-18

Type "S" Pitot Tube ID Numbe 390 Cp(std) = 0.99

Calibration Date: 4/4/96 Performed By: JAB

P_{std}, (in.) H_2O		A-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$[a]**	**DEV.[b]**
0.25	0.26	0.36	0.844	0.004
0.55	0.57	0.80	0.837	0.003
0.85	0.86	1.22	0.831	0.008
1.00	0.99	1.38	0.839	0.001
2.00	2.05	2.83	0.843	0.003
3.00	2.95	4.05	0.845	0.005
		Average	0.840	0.004

P_{std}, (in.) H_2O		B-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$[a]**	**DEV.[b]**
0.25	0.26	0.36	0.838	0.004
0.55	0.58	0.81	0.832	0.002
0.85	0.86	1.22	0.831	0.002
1.00	1.00	1.41	0.832	0.002
2.00	2.05	2.90	0.832	0.001
3.00	3.00	4.20	0.837	0.003
		Average	0.834	0.002

$\overline{C_p}(A) - \overline{C_p}(B) =$ 0.006 (must be $\leq$ 0.01)

[a] $C_{p(S)} = C_{p(std)}\sqrt{\frac{\Delta P_{std}}{\Delta P_s}}$

[b] $DEV = C_{p(S)} - \overline{C_p}$, (must be $\leq$ 0.01)

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? __x__ yes ______ no

Pitot tube openings damaged? ______ yes (explain below) __x__ no

α_1 = __1__ ° (<10°), α_2 = __2__ ° (<10°) $z = A \sin \gamma$ = __0.007__ (in.); (<0.125 in.)

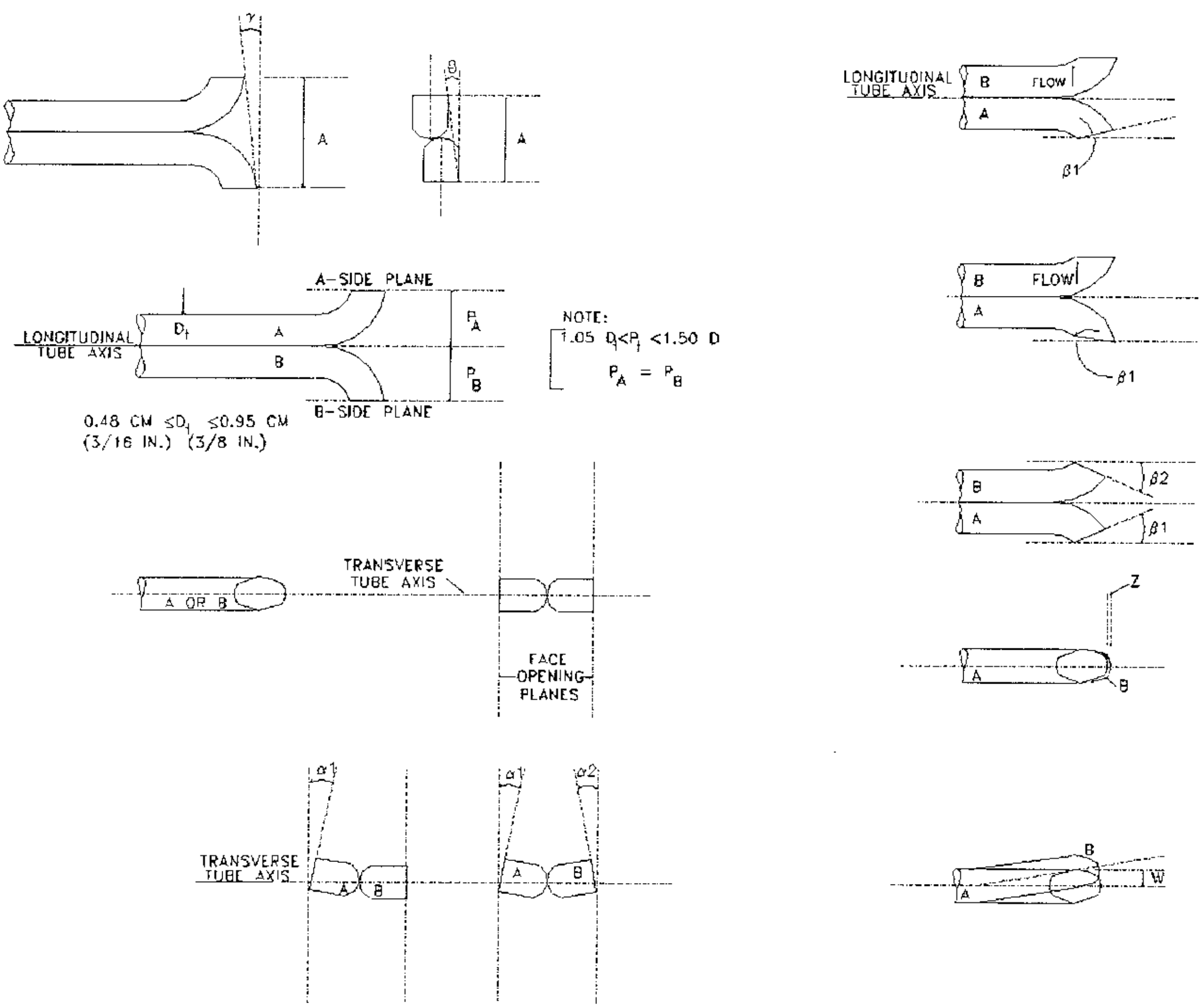
β_1 = __4.5__ ° (<5°), β_2 = __0__ ° (<5°) $w = A \sin \theta$ = __0.007__ (in.); (<0.03125 in.)

γ = __0.5__ °, θ = __0.5__ °, A = __0.770__ (in.) P_A = __0.39__ (in.), P_B = __0.39__ (in.), D_t = __0.250__ (in.)

Comments: ____

Calibration required? ______ yes ______ no

Pitot Tube No.: __390__ Date: __08/02/2000__ Name: __jph__



Pitot Tube Calibration Data

Calibration Pitot Tube: Type: Std. Hemi Size (OD): .250 " Pitot ID #: S-1

Type "S" Pitot Tube ID Numbe 287 A & B Cp(std) = 0.99

Calibration Date: 1/13/95 Performed By: MPS

P_{std}, (in.) H_2O		A-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$[a]**	**DEV.[b]**
0.25	0.32	0.45	0.835	0.001
0.55	0.53	0.74	0.838	0.002
0.85	0.83	1.15	0.841	0.005
1.00	1.35	1.90	0.834	0.002
2.00	2.40	3.40	0.832	0.004
3.00	3.25	4.55	0.837	0.001
		Average	0.836	0.002

P_{std}, (in.) H_2O		B-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$[a]**	**DEV.[b]**
0.25	0.33	0.46	0.839	0.002
0.55	0.53	0.74	0.838	0.001
0.85	0.83	1.15	0.839	0.002
1.00	1.35	1.90	0.834	0.002
2.00	2.40	3.40	0.832	0.005
3.00	3.30	4.60	0.839	0.002
		Average	0.837	0.002

$\overline{C_p}(A) - \overline{C_p}(B) =$ 0.000 (must be ≤ 0.01)

[a] $C_{p(S)} = C_{p(std)}\sqrt{\frac{\Delta P_{std}}{\Delta P_s}}$

[b] $DEV = C_{p(S)} - \overline{C_p}$, (must be ≤ 0.01)

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? X yes ______ no

Pitot tube openings damaged? ______ yes (explain below) x no

α_1 = 1 ° (<10°), α_2 = 2 ° (<10°) z = A sin γ = 0.039 (in.); (<0.125 in.)

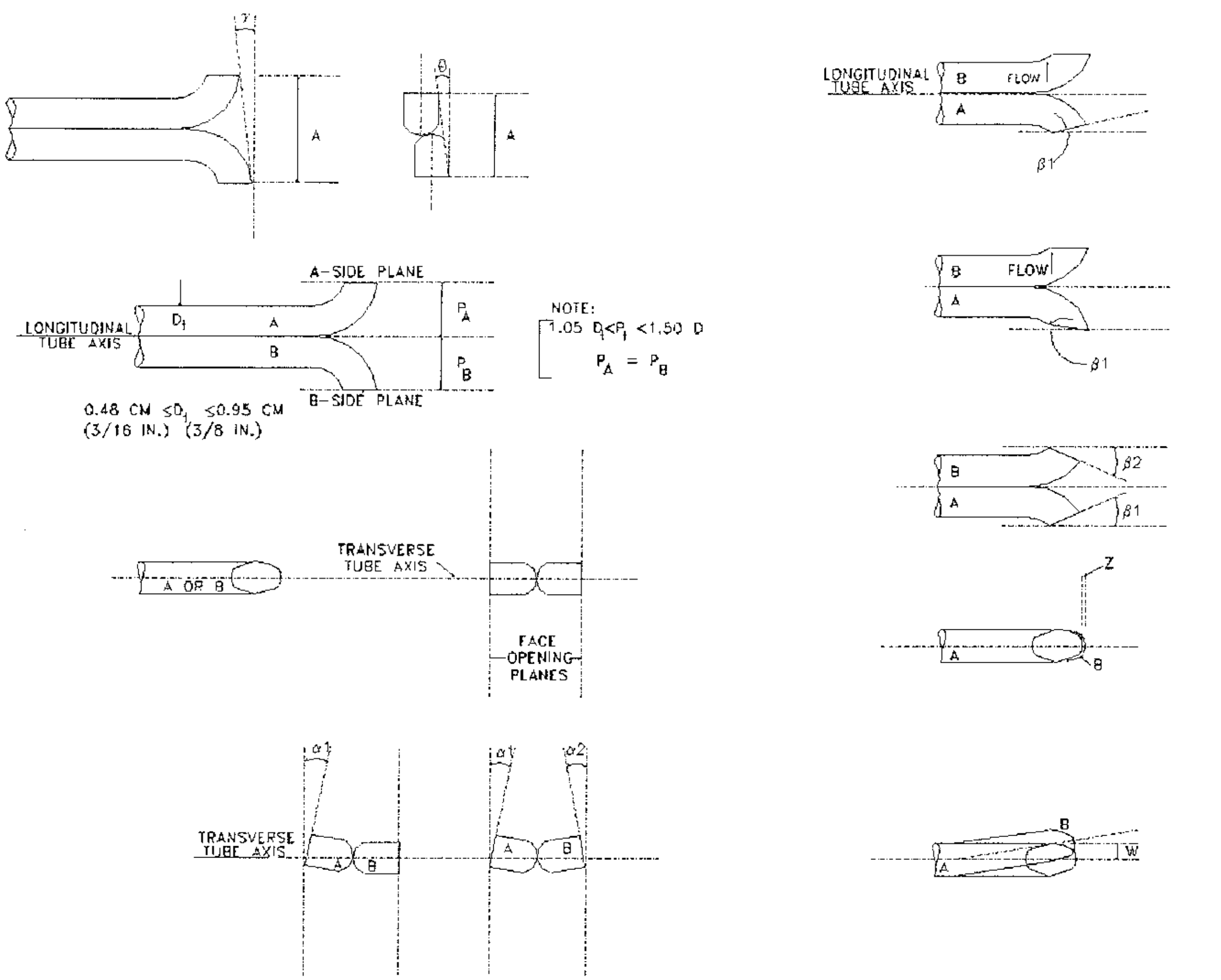
β_1 = 3 ° (<5°), β_2 = 2 ° (<5°) w = A sin θ = 0.000 (in.); (<0.03125 in.)

γ = 3 °, θ = 0 °, A = 0.747 (in.) P_A = 0.35 (in.), P_B = 0.39 (in.), D_t = 0.250 (in.)

Comments: ______

Calibration required? ______ yes X no

Pitot Tube No.: 287 Date: 01/12/2001 Name: DCR



Pitot Tube Calibration Data

Calibration Pitot Tube: Type: HEMI STD Size (OD): 1/4" Pitot ID #: 16018

Type "S" Pitot Tube ID Numbe 429 (1/4") Cp(std) = 0.99

Calibration Date: 12/4/1997 Performed By: M. McIntyre

P_{std}, (in.) H_2O		A-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$** [a]	**DEV.** [b]
0.25	0.27	0.39	0.829	0.000
0.55	0.55	0.78	0.828	0.001
0.85	0.85	1.20	0.831	0.002
1.00	1.05	1.50	0.828	0.000
2.00	2.00	2.85	0.829	0.001
3.00	3.00	4.30	0.827	0.002
		Average	0.829	0.001

P_{std}, (in.) H_2O		B-Side Calibration		
Set Value	**Read Value**	**P_s, (in.) H_2O**	**$C_{p(S)}$** [a]	**DEV.** [b]
0.25	0.26	0.37	0.830	0.001
0.55	0.55	0.78	0.830	0.001
0.85	0.85	1.20	0.831	0.002
1.00	1.05	1.50	0.828	0.001
2.00	2.00	2.85	0.829	0.000
3.00	3.00	4.30	0.827	0.002
		Average	0.829	0.001

$\overline{C_p}(A) - \overline{C_p}(B) =$ 0.001 (must be ≤ 0.01)

[a] $C_{p(S)} = C_{p(std)} \sqrt{\dfrac{\Delta P_{std}}{\Delta P_s}}$

[b] $DEV = C_{p(S)} - \overline{C_p}$, (must be ≤ 0.01)

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? X yes ______ no

Pitot tube openings damaged? ______ yes (explain below) X no

α_1 = 1.5 ° (<10°), α_2 = 3 ° (<10°) $z = A \sin\gamma$ = 0.014 (in.); (<0.125 in.)

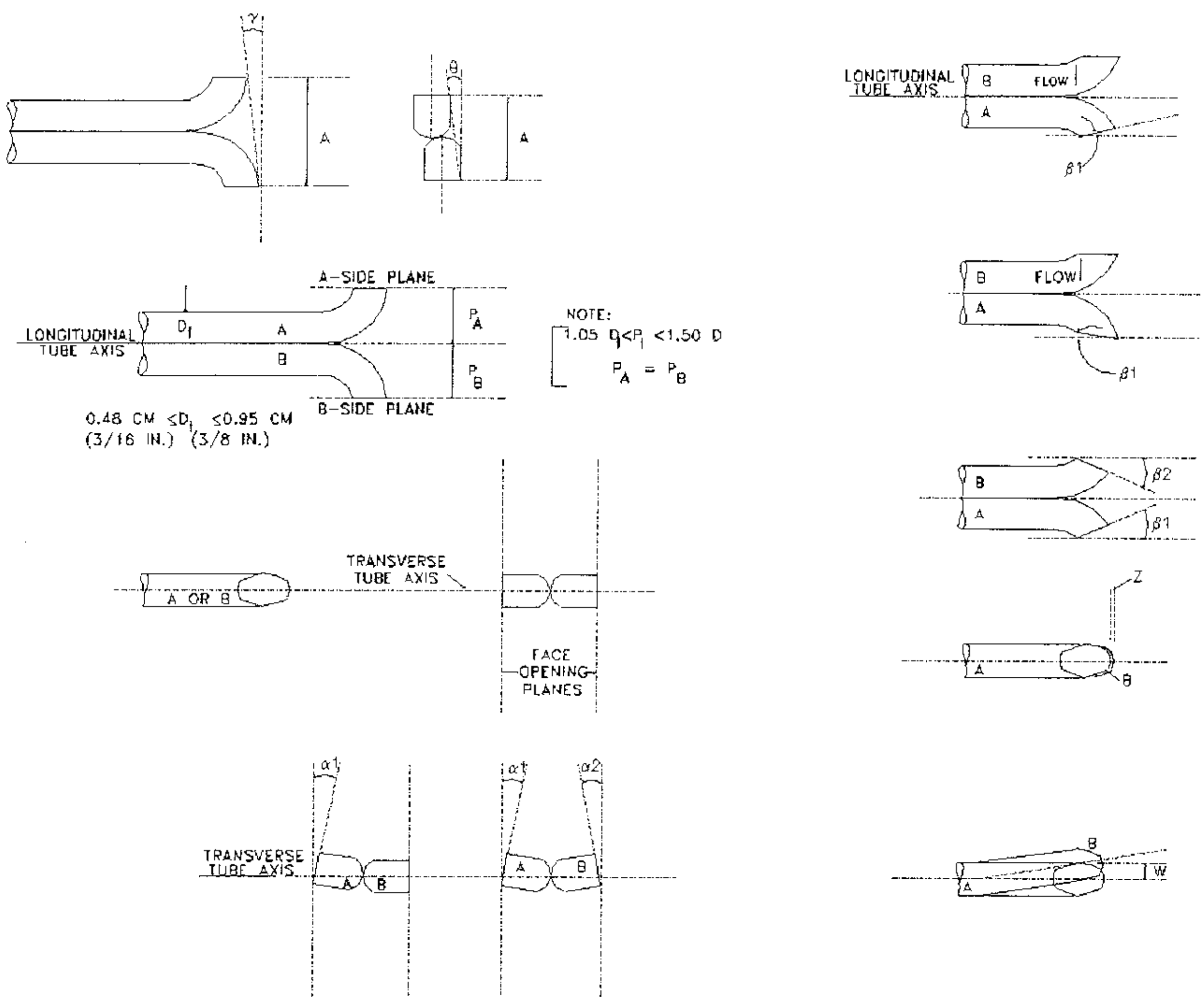
β_1 = 0.5 ° (<5°), β_2 = 1.5 ° (<5°) $w = A \sin\theta$ = 0.007 (in.); (<0.03125 in.)

γ = 1 °, θ = 0.5 °, A = 0.822 (in.) P_A = 0.41 (in.), P_B = 0.41 (in.), D_t = 0.250 (in.)

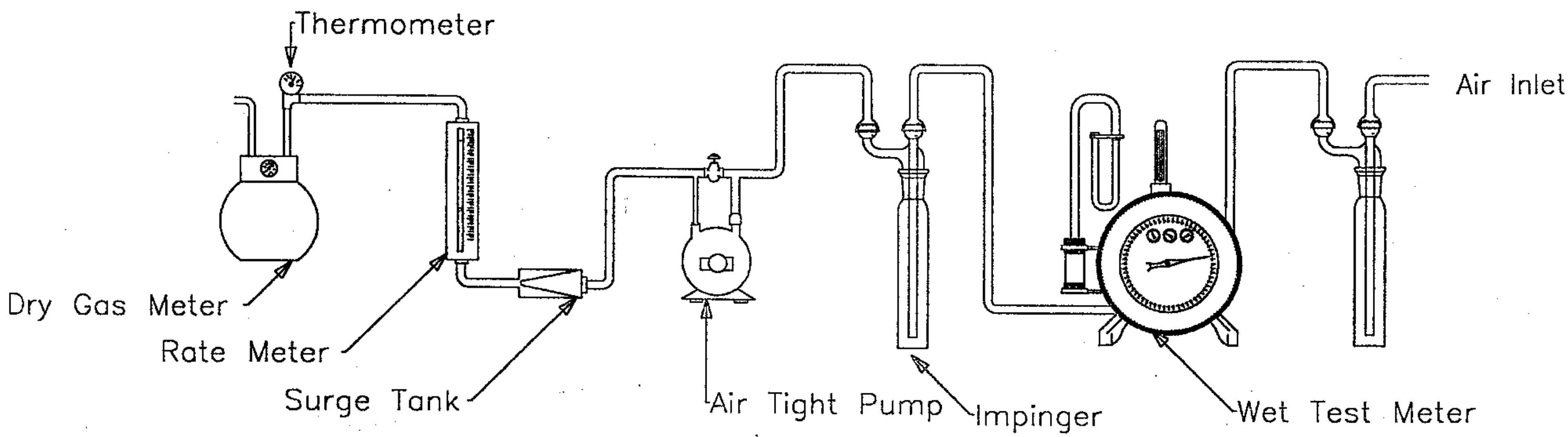
Comments: ______________________________

Calibration required? ______ yes X no

Pitot Tube No.: 429 Date: 03-16-00 Name: Rich Russ



Gas Meter Calibration Train



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[Rev. 02/01]

METER BOX CALIBRATION

Dry Gas Meter No.	E31	Date:	08-29-01
Standard Meter No.	3623852	Calibrated By:	Rich Russ
Standard Meter (Yr)	1.0014	Barometric Pressure :	29.28

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			9.072	12.824	80	83	80					
Inital			4.046	7.809	80	82	79					
Difference	1	0.20	5.026	5.015	80	82.5	79.5	81	19	23	1.004	1.735
Final			14.176	17.929	80	85	81					
Inital			9.163	12.914	80	83	81					
Difference	2	0.50	5.013	5.015	80	84	81	82.5	12	41	1.003	1.861
Final			103.976	107.738	80	84	79					
Inital			96.274	100.061	79	81	78					
Difference	3	0.70	7.702	7.677	79.5	82.5	78.5	80.5	16	13	1.003	1.808
Final			19.330	23.086	80	87	82					
Inital			14.316	18.070	80	85	81					
Difference	4	0.90	5.014	5.016	80	86	81.5	83.75	9	25	1.004	1.842
Final			24.549	28.313	81	89	83					
Inital			19.516	23.276	80	86	83					
Difference	5	1.20	5.033	5.037	80.5	87.5	83	85.25	8	18	1.005	1.892
Final			29.774	33.547	81	92	83					
Inital			24.745	28.511	81	88	83					
Difference	6	2.00	5.029	5.036	81	90	83	86.5	6	32	1.004	1.956
									Average		1.004	1.849

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM
(FOR K-TYPE THERMOCOUPLES)

EPA Control Module Number: E31 Name: Rich Russ

Ambient Temperature: 79 °F Date: 08-29-01

Omega Engineering Calibrator Model No. CL23A Serial No. T-216363

Date Of Calibration Verification: 04-12-00

Primary Standards Directly Traceable to
National Institute of Standards and Technology (NIST)

Reference[a] Source Temperature, (°F)	Test Thermometer Temperature, (°F)	Temperature Difference,[b] %
50	51	0.196
100	101	0.179
150	151	0.164
200	201	0.152
250	251	0.141
300	301	0.132
350	351	0.123
400	401	0.116
450	451	0.110
500	501	0.104
550	551	0.099
600	601	0.094
650	651	0.090
700	701	0.086
800	800	0.000
900	900	0.000
1000	1000	0.000
1100	1100	0.000
1200	1200	0.000

[a]Every (50°F) for each reference point.

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

VOLUME METERING SYSTEM FIELD AUDIT

Date: 08-29-01

Name: Rich Russ

EPA Control Module No.: E31

Ambient Temperature: 82 °F

Calibration (Y): 1.004

Barometric Pressure: 29.28 "Hg

Delta H: 1.849

Run No.	Time (Minutes)	Gas Meter Reading/Gas Meter Temperature (Cubic Feet)	Inlet (°F)	Outlet (°F)	Yc (Calculated)
1	0	41.722	87	84	1.011
	10	49.356	90	84	
	Vm=	7.634	Avg.= 86.25	546.25	
2	0	49.356	90	84	1.013
	10	56.985	92	85	
	Vm=	7.629	Avg.= 87.75	547.75	
3	0	56.985	92	85	1.013
	10	64.619	94	86	
	Vm=	7.634	Avg.= 89.25	549.25	

$$Yc = \frac{10}{Vm}\sqrt{\frac{0.319T}{Pbar}}$$

Limit: 0.97Y <Yc< 1.03Y

Limit: 0.974 <Yc< 1.034

METER BOX CALIBRATION

Dry Gas Meter No. E31
Standard Meter No. 3623853
Standard Meter (Yr) 1.0007

Date: 11-16-01
Calibrated By: TRJ
Barometric Pressure : 29.54

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			79.443	53.010	65	68	66					
Inital			74.440	47.989	65	67	66					
Difference	1	0.20	5.003	5.021	65	68	66	67	19	29	0.999	1.702
Final			113.308	86.835	67	70	68					
Inital			108.305	81.817	67	67	68					
Difference	2	0.50	5.003	5.018	67	69	68	68	12	32	0.998	1.769
Final			73.541	47.089	65	68	66					
Inital			68.521	42.054	65	67	66					
Difference	3	0.70	5.020	5.035	65	68	66	67	10	37	0.999	1.757
Final			103.457	76.968	67	71	68					
Inital			98.441	71.954	66	68	65					
Difference	4	0.90	5.016	5.014	67	70	67	68	9	34	1.001	1.843
Final			119.513	93.025	67	72	69					
Inital			114.433	87.959	67	70	68					
Difference	5	1.20	5.080	5.066	67	71	69	70	8	30	1.005	1.889
Final			92.934	66.445	66	73	68					
Inital			87.674	61.202	66	70	68					
Difference	6	2.00	5.260	5.243	66	72	68	70	6	58	1.005	1.965
									Average		1.001	1.821

METER BOX CALIBRATION

Dry Gas Meter No.	E43	Date:	08-28-01
Standard Meter No.	3623853	Calibrated By:	Rich Russ
Standard Meter (Yr)	1.0007	Barometric Pressure :	29.21

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			51.620	42.860	76	83	79					
Inital			46.545	37.759	76	83	79					
Difference	1	0.20	5.075	5.101	76	83	79	81	18	57	1.004	1.606
Final			57.456	48.721	77	85	80					
Inital			51.776	43.009	76	83	79					
Difference	2	0.50	5.680	5.712	76.5	84	79.5	81.75	13	49	1.003	1.705
Final			46.470	37.708	76	84	79					
Inital			41.435	32.645	76	83	78					
Difference	3	0.70	5.035	5.063	76	83.5	78.5	81	10	27	1.002	1.737
Final			62.745	54.034	77	87	81					
Inital			57.620	48.875	77	84	80					
Difference	4	0.90	5.125	5.159	77	85.5	80.5	83	9	29	1.002	1.775
Final			68.051	59.354	77	88	81					
Inital			62.851	54.136	77	85	81					
Difference	5	1.20	5.200	5.218	77	86.5	81	83.75	8	24	1.006	1.801
Final			73.309	64.651	77	90	82					
Inital			68.232	59.557	77	87	81					
Difference	6	2.00	5.077	5.094	77	88.5	81.5	85	6	27	1.006	1.852
									Average		1.004	1.746

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM
(FOR K-TYPE THERMOCOUPLES)

EPA Control Module Number: E43 Name: Rich Russ

Ambient Temperature: 75 °F Date: 08-28-01

Omega Engineering Calibrator Model No. CL23A Serial No. T-216363

Date Of Calibration Verification: 04-12-00

Primary Standards Directly Traceable to
National Institute of Standards and Technology (NIST)

Reference[a] Source Temperature, (°F)	Test Thermometer Temperature, (°F)	Temperature Difference,[b] %
50	51	0.196
100	101	0.179
150	151	0.164
200	201	0.152
250	251	0.141
300	301	0.132
350	351	0.123
400	401	0.116
450	451	0.110
500	501	0.104
550	551	0.099
600	601	0.094
650	651	0.090
700	701	0.086
800	801	0.079
900	901	0.074
1000	1001	0.068
1100	1101	0.064
1200	1201	0.060

[a]Every (50°F) for each reference point.

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

VOLUME METERING SYSTEM FIELD AUDIT

Date: 08-28-01

Name: Rich Russ

EPA Control Module No.: E43

Ambient Temperature: 77 °F

Calibration (Y): 1.004

Barometric Pressure: 29.21 "Hg

Delta H: 1.746

Run No.	Time (Minutes)	Gas Meter Reading/Gas Meter Temperature (Cubic Feet)	Inlet (°F)	Outlet (°F)	Yc (Calculated)
1	0	66.069	89	82	1.021
	10	73.634	91	83	
	Vm=	7.565	Avg.= 86.25	546.25	
2	0	73.634	91	83	1.018
	10	81.227	92	83	
	Vm=	7.593	Avg.= 87.25	547.25	
3	0	81.227	92	83	1.018
	10	88.825	93	84	
	Vm=	7.598	Avg.= 88.00	548.00	

$$Yc = \frac{10}{Vm}\sqrt{\frac{0.319T}{Pbar}}$$

Limit: 0.97Y <Yc< 1.03Y

Limit: 0.974 <Yc< 1.034

METER BOX CALIBRATION

Dry Gas Meter No.	E43	Date:	11-09-01
Standard Meter No.	3623851	Calibrated By:	TRJ
Standard Meter (Yr)	1.0033	Barometric Pressure :	29.46

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			96.351	31.160	64	66	65					
Inital			91.015	25.790	64	64	64					
Difference	1	0.20	5.336	5.370	64	65	65	65	20	25	0.995	1.648
Final			116.558	51.465	64	69	67					
Inital			110.549	45.411	64	68	66					
Difference	2	0.50	6.009	6.054	64	69	67	68	14	56	0.998	1.729
Final			88.826	23.596	62	67	63					
Inital			83.818	18.557	62	63	63					
Difference	3	0.70	5.008	5.039	62	65	63	64	10	38	0.996	1.765
Final			109.189	44.054	64	69	66					
Inital			104.183	39.011	64	65	66					
Difference	4	0.90	5.006	5.043	64	67	66	67	9	21	0.995	1.761
Final			121.767	56.697	64	71	67					
Inital			116.760	51.650	64	67	67					
Difference	5	1.20	5.007	5.047	64	69	67	68	8	19	0.997	1.851
Final			103.320	38.143	64	72	65					
Inital			97.728	32.541	64	68	65					
Difference	6	2.00	5.592	5.602	64	70	65	68	7	19	1.000	1.917
									Average		0.997	1.778

METER BOX CALIBRATION

Dry Gas Meter No.	E25	Date:	08-23-01
Standard Meter No.	3623853	Calibrated By:	Rich Russ
Standard Meter (Yr)	1.0007	Barometric Pressure :	29.23

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			87.056	72.929	78	84	80					
Inital			82.026	67.809	78	82	79					
Difference	1	0.20	5.030	5.120	78	83	79.5	81.25	19	35	0.988	1.757
Final			93.160	79.144	78	85	81					
Inital			87.208	73.082	78	83	80					
Difference	2	0.50	5.952	6.062	78	84	80.5	82.25	15	2	0.988	1.845
Final			81.909	67.684	78	83	79					
Inital			76.835	62.548	77	82	78					
Difference	3	0.70	5.074	5.136	77.5	82.5	78.5	80.5	10	48	0.992	1.837
Final			98.510	84.586	78	87	82					
Inital			93.339	79.325	78	85	81					
Difference	4	0.90	5.171	5.261	78	86	81.5	83.75	9	32	0.991	1.765
Final			103.894	90.079	78	88	82					
Inital			98.654	84.739	78	86	82					
Difference	5	1.20	5.240	5.340	78	87	82	84.5	8	38	0.990	1.877
Final			9.047	95.331	78	89	83					
Inital			4.022	90.209	78	87	83					
Difference	6	2.00	5.025	5.122	78	88	83	85.5	6	31	0.990	1.934
									Average		0.990	1.836

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM
(FOR K-TYPE THERMOCOUPLES)

EPA Control Module Number: E25 Name: Rich Russ

Ambient Temperature: 77 °F Date: 08-23-01

Omega Engineering Calibrator Model No. CL23A Serial No. T-216363

Date Of Calibration Verification: 04-12-00

Primary Standards Directly Traceable to
National Institute of Standards and Technology (NIST)

Reference[a] Source Temperature, (°F)	**Test Thermometer Temperature, (°F)**	**Temperature Difference,[b] %**
50	51	0.196
100	101	0.179
150	151	0.164
200	201	0.152
250	251	0.141
300	301	0.132
350	351	0.123
400	401	0.116
450	451	0.110
500	501	0.104
550	551	0.099
600	601	0.094
650	651	0.090
700	701	0.086
800	801	0.079
900	901	0.074
1000	1001	0.068
1100	1101	0.064
1200	1201	0.060

[a]Every (50°F) for each reference point.

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

VOLUME METERING SYSTEM FIELD AUDIT

Date: 08-23-01

Name: Rich Russ

EPA Control Module No.: E25

Ambient Temperature: 77 °F

Calibration (Y): 0.99

Barometric Pressure: 29.23 "Hg

Delta H: 1.836

Run No.	Time (Minutes)	Gas Meter Reading/Gas Meter Temperature (Cubic Feet)	Inlet (°F)	Outlet (°F)	Yc (Calculated)
1	0	4.115	90	84	0.988
	10	11.935	92	84	
	Vm=	7.820	Avg.= 87.50	547.50	
2	0	11.935	92	84	0.988
	10	19.764	93	85	
	Vm=	7.829	Avg.= 88.50	548.50	
3	0	19.764	93	85	0.990
	10	27.585	93	86	
	Vm=	7.821	Avg.= 89.25	549.25	

$$Yc = \frac{10}{Vm}\sqrt{\frac{0.319T}{Pbar}}$$

Limit: 0.97Y <Yc< 1.03Y

Limit: 0.960 <Yc< 1.020

METER BOX CALIBRATION

Dry Gas Meter No.	E25	Date:	10/21/2001
Standard Meter No.	2298907	Calibrated By:	D. Runyan
Standard Meter (Yr)	1.0022	Barometric Pressure :	29.39

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			35.151	101.172	64	83	80					
Inital			30.112	95.940	64	83	80					
Difference	1	0.20	5.039	5.232	64	83	80	81.5	20	0	0.995	1.722
Final			41.167	107.413	64	82	78					
Inital			35.151	101.172	64	83	80					
Difference	2	0.50	6.016	6.241	64	82.5	79	80.75	15	30	0.994	1.817
Final			47.027	13.483	64	83	79					
Inital			41.167	7.413	64	82	78					
Difference	3	0.70	5.860	6.070	64	82.5	78.5	80.5	13	0	0.994	1.886
Final			53.270	19.980	64	87	82					
Inital			47.027	13.483	64	85	81					
Difference	4	0.90	6.243	6.497	64	86	81.5	83.75	12	15	0.995	1.886
Final			59.483	26.425	66	88	82					
Inital			53.270	19.980	66	86	82					
Difference	5	1.20	6.213	6.445	66	87	82	84.5	10	45	0.995	1.968
Final			66.512	33.743	66	89	83					
Inital			59.483	26.425	66	87	83					
Difference	6	2.00	7.029	7.318	66	88	83	85.5	9	30	0.991	1.997
									Average		0.994	1.879

METER BOX CALIBRATION

Dry Gas Meter No.	E51	Date:	11-05-01
Standard Meter No.	3623853	Calibrated By:	TRJ
Standard Meter (Yr)	1.0007	Barometric Pressure :	29.75

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			25.285	54.422	64	67	65					
Inital			20.270	49.358	64	67	65					
Difference	1	0.20	5.015	5.064	64	67	65	66	19	45	0.994	1.724
Final			40.431	69.697	65	73	67					
Inital			35.355	64.571	64	72	66					
Difference	2	0.50	5.076	5.126	65	73	67	70	12	47	0.998	1.754
Final			12.856	41.903	64	67	64					
Inital			7.837	36.889	63	65	64					
Difference	3	0.70	5.019	5.014	64	66	64	65	10	41	1.002	1.763
Final			34.342	63.554	64	71	67					
Inital			29.078	58.238	64	70	66					
Difference	4	0.90	5.264	5.316	64	71	67	69	9	58	0.997	1.785
Final			46.118	75.420	65	79	71					
Inital			41.095	70.352	65	73	67					
Difference	5	1.20	5.023	5.068	65	76	69	73	8	24	1.002	1.850
Final			19.880	48.973	64	66	65					
Inital			14.845	43.917	64	66	65					
Difference	6	2.00	5.035	5.056	64	66	65	66	6	28	0.994	1.836
									Average		0.998	1.785

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM
(FOR K-TYPE THERMOCOUPLES)

EPA Control Module Number: E51 Name: TRJ

Ambient Temperature: 67 °F Date: 11-05-01

Omega Engineering Calibrator Model No. CL23A Serial No. T-216363

Date Of Calibration Verification: 04-12-00

Primary Standards Directly Traceable to
National Institute of Standards and Technology (NIST)

Reference[a] Source Temperature, (°F)	**Test Thermometer Temperature, (°F)**	**Temperature Difference,[b] %**
50	50	0.000
100	100	0.000
150	150	0.000
200	200	0.000
250	250	0.000
300	300	0.000
350	350	0.000
400	400	0.000
450	450	0.000
500	500	0.000
550	550	0.000
600	600	0.000
650	650	0.000
700	700	0.000
800	800	0.000
900	900	0.000
1000	1000	0.000
1100	1100	0.000
1200	1200	0.000

[a]Every (50°F) for each reference point.

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

VOLUME METERING SYSTEM FIELD AUDIT

Date: 11-05-01

Name: TRJ

EPA Control Module No.: E51

Ambient Temperature: 67 °F

Calibration (Y): 0.998

Barometric Pressure: 29.75 "Hg

Delta H: 1.785

Run No.	Time (Minutes)	Gas Meter Reading/Gas Meter Temperature (Cubic Feet)	Inlet (°F)	Outlet (°F)	Yc (Calculated)
1	0	77.101	70	67	0.993
	10	84.684	68	68	
	Vm=	7.583	Avg.= 68	528.25	
2	0	84.684	69	68	0.994
	10	92.254	68	67	
	Vm=	7.570	Avg.= 68	528.00	
3	0	92.254	69	68	0.991
	10	99.845	69	66	
	Vm=	7.591	Avg.= 68	528.00	

$$Yc = \frac{10}{Vm}\sqrt{\frac{0.319T}{Pbar}}$$

Limit: 0.97Y <Yc< 1.03Y

Limit: 0.968 <Yc< 1.028

METER BOX CALIBRATION

Dry Gas Meter No.	E51	Date:	01-03-02
Standard Meter No.	3623851	Calibrated By:	TRJ
Standard Meter (Yr)	1.0033	Barometric Pressure :	29.63

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			65.596	55.713	63	66	64					
Inital			60.590	50.688	63	64	64					
Difference	1	0.20	5.006	5.025	63	65	64	65	19	56	0.999	1.768
Final			101.668	91.868	64	69	65					
Inital			96.663	86.844	63	66	65					
Difference	2	0.50	5.005	5.024	64	68	65	66	12	43	1.000	1.797
Final			60.416	50.488	63	65	64					
Inital			55.414	45.446	63	64	64					
Difference	3	0.70	5.002	5.042	63	65	64	64	10	51	0.993	1.837
Final			96.337	86.518	63	70	65					
Inital			91.302	81.470	63	67	65					
Difference	4	0.90	5.035	5.048	63	69	65	67	9	44	1.002	1.867
Final			90.664	80.827	63	70	65					
Inital			85.584	75.725	63	69	65					
Difference	5	1.20	5.080	5.102	63	70	65	67	8	36	1.001	1.908
Final			78.654	68.759	63	71	65					
Inital			73.644	63.739	63	68	65					
Difference	6	2.00	5.010	5.020	63	70	65	67	6	43	1.001	1.994
									Average		0.999	1.862

METER BOX CALIBRATION

Dry Gas Meter No.	E14	Date:	11-07-01
Standard Meter No.	3623853	Calibrated By:	TRJ
Standard Meter (Yr)	1.0007	Barometric Pressure :	29.51

Formula Protection Password: MPA

Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry 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			75.128	78.634	66	68	67					
Inital			70.123	73.633	66	67	67					
Difference	1	0.20	5.005	5.001	66	68	67	67	19	42	1.003	1.746
Final			93.580	97.094	66	69	69					
Inital			88.564	92.075	68	68	68					
Difference	2	0.50	5.016	5.019	67	69	69	69	12	48	1.001	1.837
Final			68.772	72.270	66	67	67					
Inital			63.765	67.264	66	67	67					
Difference	3	0.70	5.007	5.006	66	67	67	67	11	1	1.000	1.910
Final			86.092	89.607	66	70	68					
Inital			81.072	84.581	66	69	68					
Difference	4	0.90	5.020	5.026	66	70	68	69	9	43	1.002	1.894
Final			98.988	102.494	67	71	69					
Inital			93.939	97.449	66	69	69					
Difference	5	1.20	5.049	5.045	67	70	69	70	8	23	1.003	1.859
Final			80.728	84.238	66	70	68					
Inital			75.697	79.218	66	67	68					
Difference	6	2.00	5.031	5.020	66	69	68	68	6	42	1.001	1.994
									Average		1.002	1.873

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM
(FOR K-TYPE THERMOCOUPLES)

EPA Control Module Number: E14 Name: TRJ

Ambient Temperature: 70 °F Date: 11-07-01

Omega Engineering Calibrator Model No. CL23A Serial No. T-216363

Date Of Calibration Verification: 04-12-00

Primary Standards Directly Traceable to
National Institute of Standards and Technology (NIST)

Reference[a] Source Temperature, (°F)	**Test Thermometer Temperature, (°F)**	**Temperature Difference,[b] %**
50	50	0.000
100	100	0.000
150	150	0.000
200	200	0.000
250	250	0.000
300	300	0.000
350	350	0.000
400	400	0.000
450	450	0.000
500	500	0.000
550	550	0.000
600	600	0.000
650	650	0.000
700	700	0.000
800	800	0.000
900	900	0.000
1000	1000	0.000
1100	1100	0.000
1200	1200	0.000

[a]Every (50°F) for each reference point.

$$\frac{(\text{Ref. Temp., °F} + 460) - (\text{Test Therm. Temp., °F} + 460)}{\text{Ref. Temp., °F} + 460} * 100 <= 1.5\ \%$$

VOLUME METERING SYSTEM FIELD AUDIT

Date: 11-07-01

Name: TRJ

EPA Control Module No.: E14

Ambient Temperature: 70 °F

Calibration (Y): 1.002

Barometric Pressure: 29.51 "Hg

Delta H: 1.873

Run No.	Time (Minutes)	Gas Meter Reading/Gas Meter Temperature (Cubic Feet)	Inlet (°F)	Outlet (°F)	Yc (Calculated)
1	0	6.467	72	69	1.026
	10	13.850	74	70	
	Vm=	7.383	Avg.= 71.25	531.25	
2	0	13.850	73	70	1.030
	10	21.221	76	75	
	Vm=	7.371	Avg.= 73.50	533.50	
3	0	21.221	73	70	1.024
	10	28.629	75	71	
	Vm=	7.408	Avg.= 72.25	532.25	

$$Yc = \frac{10}{Vm}\sqrt{\frac{0.319T}{Pbar}}$$

Limit: 0.97Y <Yc< 1.03Y

Limit: 0.972 <Yc< 1.032

METER BOX CALIBRATION

Dry Gas Meter No.	E14	Date:	12-10-01
Standard Meter No.	3623851	Calibrated By:	TRJ
Standard Meter (Yr)	1.0033	Barometric Pressure :	29.44

Formula Protection Password: MPA

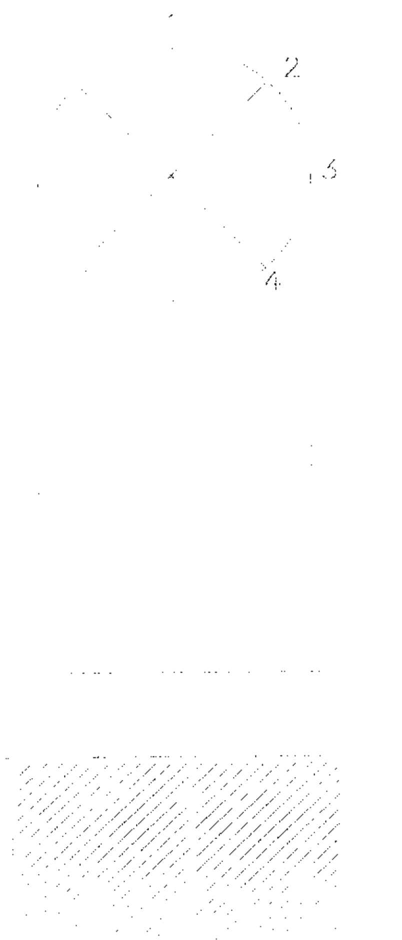
Run Number		Orifice Setting in H20 Chg (H)	Standard Meter Gas Volume Vr	Dry Meter Gas Volume Vd	Standard Meter Temp. F tr	Dry Gas Meter Inlet Temp. F tdi	Dry Gas Meter Outlet Temp. F tdo	Dry Gas Meter Avg. Temp. F td	Time Min.	Time Sec.	Y	Chg (H@)
Final			100.506	65.513	64	69	68					
Inital			95.488	60.510	64	68	67					
Difference	1	0.20	5.018	5.003	64	69	68	68	20	10	1.010	1.808
Final			24.136	89.013	62	62	61					
Inital			19.091	84.012	61	61	60					
Difference	2	0.50	5.045	5.001	62	62	61	61	13	16	1.007	1.942
Final			94.767	59.776	64	70	67					
Inital			89.749	54.771	63	70	67					
Difference	3	0.70	5.018	5.005	64	70	67	69	11	16	1.010	1.969
Final			17.430	82.372	66	70	69					
Inital			12.416	77.368	65	69	68					
Difference	4	0.90	5.014	5.004	66	70	69	69	9	56	1.006	1.984
Final			11.535	76.488	65	71	68					
Inital			6.428	71.407	65	69	68					
Difference	5	1.20	5.107	5.081	65	70	68	69	9	4	1.010	2.121
Final			6.198	71.178	65	70	68					
Inital			0.924	65.934	64	69	67					
Difference	6	2.00	5.274	5.244	65	70	68	69	7	12	1.008	2.088
									Average		1.009	1.985

Nozzle Calibration

Date: TB

Nozzle ID No.: N/A

Analyst: 09/10/2001



Pre Test		Post Test
0.196	1	√
0.195	2	√
0.195	3	√
0.194	4	√

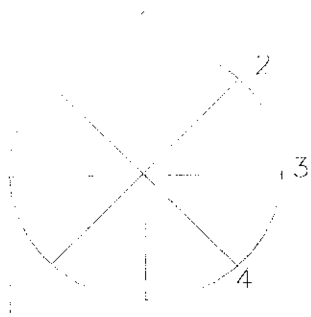
Average
0.195

Nozzle Calibration

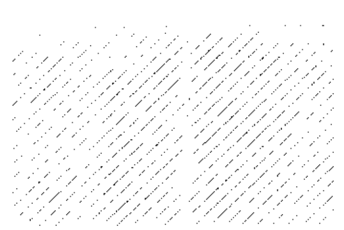
Date: GR

Nozzle ID No.: N/A

Analyst: 09/10/2001



	Pre Test		Post Test
	0.244	1	√
	0.245	2	√
	0.245	3	√
	0.244	4	√



Average
0.245

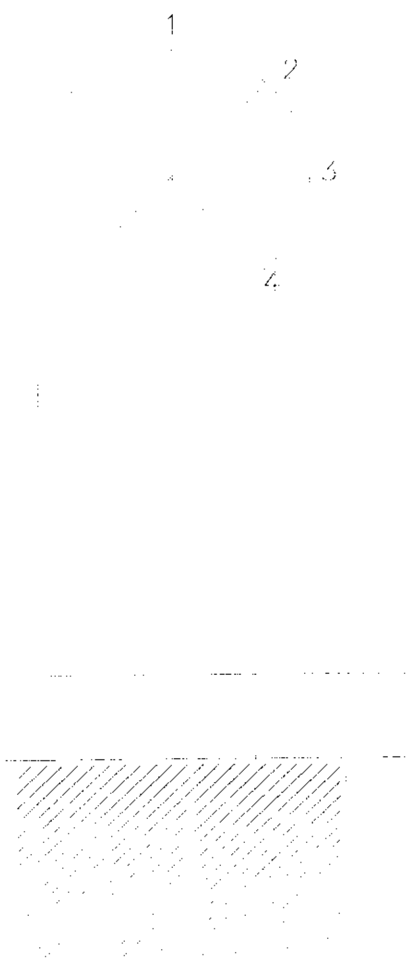
DWG-AN2 (indnozzl.xls)

Nozzle Calibration

Date: MRE

Nozzle ID No.: N/A

Analyst: 11/12/2001



Pre Test		Post Test
0.190	1	√
0.190	2	√
0.191	3	√
0.190	4	√

Average
0.190

APPENDIX E
PART 2

ATTACHMENT D
REDUCED FIELD DATA SHEETS

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G013706 **TEST RUN NO.:** 1 **TEST DATE:** 9/10/01

CUSTOMER:	Wisconsin Electric Power Company		**BAROMETRIC PRESSURE (Pb)**		29.3	**in. Hg.**
PLANT:	Pleasant Prairie Power Plant		**STATIC PRESSURE**		-15.5	**in. H2O**
TEST LOC.:	Unit 2 North Inlet Duct		**FLUE PRESSURE (Ps)**		28.16	**in. Hg. abs.**
CLIENT:	ADA Environmental Solutions, L.L.C.		**PROBE LENGTH:**		9	**ft.**
OPERATOR:	T. Barr		**PROBE LINER MATERIAL:**		Teflon	
CONTROL BOX:	E-31		**NOZZLE IDENTIFICATION NO.:**		N/A	
METER NO.:	E-31		**CALIBRATED NOZZLE DIAMETER:**		0.195	**in.**
METER CALIBRATION FACTOR:	1.004		**LEAK CHECK**	**PRE:**	0.000	**POST:** 0.000 @ 15 in. Hg.
PITOT ID NO.:	660A		**DUCT SHAPE:**	Circular	DIA.	Feet
				Rectangular	8.5 Feet	24 Feet
PITOT TUBE COEFFICIENT:	0.836		**DUCT AREA:**		204	**sq. ft.**
PORT LENGTH:	30	in.	**TEST LENGTH:**		120	**min.**
PORT SIZE:	6	in.	**MINUTES PER POINT:**		5	
PORT TYPE:	Flange		**TOTAL NUMBER OF TRAVERSE POINTS:**		24	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 9/10/01 Test Run 1

Location: Unit 2 North Inlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	1.30	1.140	14:45	65.25	1.18	266	73	74	4	3.048
1-2	0.67	0.819	14:50	68.30	0.61	261	74	73	4	2.190
1-3	1.40	1.183	14:55	70.49	1.27	261	74	74	5	3.170
1-4	1.40	1.183	15:00	73.66	1.27	260	75	74	5	3.174
			15:05	76.83						0.000
2-1	1.70	1.304	15:08	77.00	1.54	275	76	74	5	3.488
2-2	1.70	1.304	15:13	80.49	1.54	278	76	74	5	3.490
2-3	1.80	1.342	15:18	83.98	1.57	278	76	74	5	3.520
2-4	1.20	1.095	15:23	87.50	1.05	277	77	74	5	2.879
			15:28	90.38						0.000
3-1	2.00	1.414	15:31	90.46	1.75	280	76	74	7	3.708
3-2	1.80	1.342	15:36	94.17	1.57	282	77	74	7	3.530
3-3	1.70	1.304	15:41	97.70	1.48	283	77	74	7	3.420
3-4	1.20	1.095	15:46	101.12	1.05	282	77	74	6	2.881
			15:51	104.00						0.000
4-1	1.80	1.342	15:55	104.10	1.57	285	76	75	8	3.524
4-2	1.70	1.304	16:00	107.62	1.48	287	77	74	8	3.420
4-3	0.90	0.949	16:05	111.04	0.79	289	77	75	8	2.490
4-4	1.00	1.000	16:10	113.53	0.87	290	77	75	9	2.632
			16:15	116.16						0.000
6-1	1.90	1.378	16:19	116.22	1.66	293	76	75	11	3.615
6-2	1.70	1.304	16:24	119.83	1.48	296	76	74	13	3.430
6-3	1.70	1.304	16:29	123.26	1.48	299	76	75	13	3.420
6-4	1.10	1.049	16:34	126.68	0.96	300	76	75	13	2.748
			16:39	129.43						0.000
7-1	1.70	1.304	16:43	129.50	1.48	305	75	74	12	3.424
7-2	1.50	1.225	16:48	132.92	1.31	307	76	74	14	3.210
7-3	1.20	1.095	16:53	136.13	1.05	307	77	75	14	2.880
7-4	1.40	1.183	16:58	139.01	1.22	309	77	75	14	3.109
			17:03	142.12						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		1.207		76.400	1.30	285	76	74		#####
							75.15			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Company **Date:** 9/10/01 **Test Run:** 1
Location: Unit 2 North Inlet Duct

SILICA GEL FINAL WT.:	792.70	**grams**
SILICA GEL INITIAL WT.:	771.10	**grams**
DIFFERENCE:	21.60	
FINAL IMPINGER WATER:	5038.30	**mls.**
INITIAL IMPINGER WATER:	4817.70	**mls.**
DIFFERENCE:	220.60	
TOTAL WATER GAIN:	242.20	

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	3.319		0.000003319
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000003319
KCl:	4.800		0.000004800
		Oxidized Total:	0.000004800
HNO_3/H_2O_2:	0.580		0.000000580
$KMNO_4$:	23.500		0.000023500
		Elemental Total:	0.000024080

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	15.00			15.00
Oxygen:	4.00			4.00

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	Wisconsin Electric Power Company
Date:	9/10/01
Test Run:	1
Stack or Duct No.:	Unit 2 North Inlet Duct
Start Time:	14:45
Stop Time:	17:03

Pb:	29.30	Inches Hg
Static	-15.50	Inches H2O
Ps:	28.16	Inches Hg Abs.
Vlc:	242	ml + grams
Mn:	0.0000	gm
Test Time:	120	minutes
% O2:	4.00	%
% CO2:	15.00	%
% N2:	81.00	%
Delta H:	1.30	Inches H20
Cp:	0.836	Dimensionless - pitot
Tm:	75.15	°F
Sqrt P:	1.207	Inches H20
Ts:	285.42	°F
Vm:	76.400	Cubic Feet
Dn:	0.195	Inches - nozzle
As:	204.00	Sq. Feet
Yd:	1.004	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	74.355	cubic feet (dry)
Vwstd:	11.408	cubic feet (wet)
Bwo:	0.133	
Md:	30.560	lb/lb-mole (dry)
Ms:	28.889	lb/lb-mole (wet)
Excess Air (%)	23.010	
Vs:	82.555	fps
ACFM:	1010468.	
DSCFM:	584042.	
WSCFM:	673646	
%I:	104.4	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.:	G013706	TEST RUN NO.:	2	TEST DATE:	9/11/01

CUSTOMER:	Wisconsin Electric Power Company	BAROMETRIC PRESSURE (Pb)	29.45	in. Hg.
PLANT:	Pleasant Prairie Power Plant	STATIC PRESSURE	-15.5	in. H2O
TEST LOC.:	Unit 2 North Inlet Duct	FLUE PRESSURE (Ps)	28.31	in. Hg. abs.
CLIENT:	ADA Environmental Solutions, L.L.C.	PROBE LENGTH:	9.5	ft.
OPERATOR:	T. Barr	PROBE LINER MATERIAL:	Teflon	
CONTROL BOX:	E-31	NOZZLE IDENTIFICATION NO.:	N/A	
METER NO.:	E-31	CALIBRATED NOZZLE DIAMETER:	0.195	in.
METER CALIBRATION FACTOR:	1.004	LEAK CHECK PRE:	0.004	POST: 0.004 @ 15 in. Hg.
PITOT ID NO.:	660A	DUCT SHAPE: Circular DIA. / Rectangular	8.5 Feet	Feet / 24 Feet
PITOT TUBE COEFFICIENT:	0.836	DUCT AREA:	204	sq. ft.
PORT LENGTH:	30 in.	TEST LENGTH:	120	min.
PORT SIZE:	6 in.	MINUTES PER POINT:	5	
PORT TYPE:	Flange	TOTAL NUMBER OF TRAVERSE POINTS:		24

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 9/11/01 Test Run 2

Location: Unit 2 North Inlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	1.40	1.183	9:35	44.13	1.80	262	66	65	6	2.985
1-2	1.80	1.342	9:40	47.11	1.51	266	70	66	6	3.390
1-3	1.70	1.304	9:45	50.50	1.46	265	72	67	6	3.360
1-4	1.30	1.140	9:50	53.86	1.11	269	76	66	6	2.941
			9:55	56.80						0.000
2-1	2.00	1.414	10:00	56.90	1.71	274	74	70	8	3.644
2-2	1.70	1.304	10:05	60.54	1.46	276	76	70	8	3.351
2-3	1.70	1.304	10:10	63.89	1.46	280	78	72	8	3.360
2-4	1.50	1.225	10:15	67.25	1.29	280	78	73	8	3.162
			10:20	70.41						0.000
3-1	1.80	1.342	10:23	70.50	1.54	287	79	73	9	3.454
3-2	2.00	1.414	10:28	73.95	1.71	292	81	75	9	3.640
3-3	1.50	1.225	10:33	77.59	1.29	295	79	73	8	3.160
3-4	1.50	1.225	10:38	80.75	1.29	297	79	73	8	3.154
			10:43	83.90						0.000
4-1	1.70	1.304	10:45	83.96	1.46	303	80	74	10	3.361
4-2	1.80	1.342	10:50	87.32	1.54	305	80	75	11	3.450
4-3	1.00	1.000	10:55	90.77	0.86	305	81	75	11	2.580
4-4	1.00	1.000	11:00	93.35	0.86	305	81	75	11	2.573
			11:05	95.92						0.000
6-1	2.00	1.414	11:08	96.01	1.71	303	79	76	12	3.645
6-2	1.70	1.304	11:13	99.65	1.46	306	80	76	12	3.350
6-3	1.70	1.304	11:18	103.00	1.46	307	80	77	13	3.360
6-4	1.50	1.225	11:23	106.36	1.29	306	81	78	13	3.159
			11:28	109.52						0.000
7-1	1.80	1.342	11:31	109.58	1.54	305	81	78	14	3.454
7-2	1.40	1.183	11:36	113.03	1.20	307	81	77	14	3.050
7-3	1.40	1.183	11:41	116.08	1.20	307	81	77	14	3.050
7-4	1.70	1.304	11:46	119.13	1.46	307	81	77	14	3.357
			11:51	122.49						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		1.264		77.990	1.40	292	78	73		#####
							75.67			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Company **Date:** 9/11/01 **Test Run:** 2

Location: Unit 2 North Inlet Duct

SILICA GEL FINAL WT.:	737.30	grams
SILICA GEL INITIAL WT.:	717.20	grams
DIFFERENCE:	20.10	
FINAL IMPINGER WATER:	5020.80	mls.
INITIAL IMPINGER WATER:	4776.10	mls.
DIFFERENCE:	244.70	
TOTAL WATER GAIN:	264.80	

ITEM	MERCURY (UG)	=	NET WT. (G)
FILTER:	6.0288		0.000006029
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000006029
KCl:	4.910		0.000004910
		Oxidized Total:	0.000004910
HNO_3/H_2O_2:	0.466		0.000000466
$KMNO_4$:	25.800		0.000025800
		Elemental Total:	0.000026266

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	15.00			15.00
Oxygen:	4.00			4.00

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	9/11/01
Test Run:	2
Stack or Duct No.:	Unit 2 North Inlet Duct
Start Time:	9:35
Stop Time:	11:51

Pb:	29.45	Inches Hg
Static	-15.50	Inches H2O
Ps:	28.31	Inches Hg Abs.
Vlc:	265	ml + grams
Mn:	0.0000	gm
Test Time:	120	minutes
% O2:	4.00	%
% CO2:	15.00	%
% N2:	81.00	%
Delta H:	1.40	Inches H20
Cp:	0.836	Dimensionless - pitot
Tm:	75.67	°F
Sqrt P:	1.264	Inches H20
Ts:	292.04	°F
Vm:	77.990	Cubic Feet
Dn:	0.195	Inches - nozzle
As:	204.00	Sq. Feet
Yd:	1.004	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	76.235	cubic feet (dry)
Vwstd:	12.472	cubic feet (wet)
Bwo:	0.141	
Md:	30.560	lb/lb-mole (dry)
Ms:	28.794	lb/lb-mole (wet)
Excess Air (%)	23.010	
Vs:	86.737	fps
ACFM:	1061667.	
DSCFM:	606118.	
WSCFM:	705280	
%I:	103.2	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G013706 TEST RUN NO.: 3 TEST DATE: 9/11/01

CUSTOMER:	Wisconsin Electric Power Company		BAROMETRIC PRESSURE (Pb)		29.45	in. Hg.	
PLANT:	Pleasant Prairie Power Plant		STATIC PRESSURE		-15.5	in. H2O	
TEST LOC.:	Unit 2 North Inlet Duct		FLUE PRESSURE (Ps)		28.31	in. Hg. abs.	
CLIENT:	ADA Environmental Solutions, L.L.C.		PROBE LENGTH:		9.5	ft.	
OPERATOR:	T. Barr		PROBE LINER MATERIAL:		Teflon		
CONTROL BOX:	E-31		NOZZLE IDENTIFICATION NO.:		N/A		
METER NO.:	E-31		CALIBRATED NOZZLE DIAMETER:		0.195	in.	
METER CALIBRATION FACTOR:		1.004	LEAK CHECK	PRE:	0.008	POST:	0.006 @ 15 in. Hg.
PITOT ID NO.:	660A		DUCT SHAPE:	Circular	DIA.		Feet
				Rectangular	8.5 Feet		24 Feet
PITOT TUBE COEFFICIENT:	0.836		DUCT AREA:		204	sq. ft.	
PORT LENGTH:	30	in.	TEST LENGTH:		120	min.	
PORT SIZE:	6	in.	MINUTES PER POINT:		5		
PORT TYPE:	Flange		TOTAL NUMBER OF TRAVERSE POINTS:			24	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 9/11/01 Test Run 3

Location: Unit 2 North Inlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	1.80	1.342	12:53	24.93	1.54	306	75	74	6	3.460
1-2	1.60	1.265	12:58	28.39	1.37	308	76	74	6	3.250
1-3	1.10	1.049	13:03	31.64	0.94	308	77	75	6	2.700
1-4	1.70	1.304	13:08	34.34	1.46	307	79	77	6	3.364
			13:13	37.70						0.000
2-1	2.00	1.414	13:16	37.79	1.71	303	78	76	8	3.084
2-2	1.60	1.265	13:21	40.87	1.37	304	78	77	7	3.085
2-3	1.80	1.342	13:26	43.96	1.54	297	80	78	8	4.185
2-4	1.50	1.225	13:31	48.14	1.29	295	82	78	8	3.161
			13:36	51.30						0.000
3-1	1.70	1.304	13:40	51.38	1.46	295	83	78	9	3.360
3-2	1.70	1.304	13:45	54.74	1.46	293	83	78	9	3.350
3-3	0.90	0.949	13:50	58.09	0.77	296	83	79	10	2.450
3-4	1.10	1.049	13:55	60.54	0.94	295	83	78	10	2.703
			14:00	63.24						0.000
4-1	2.00	1.414	14:03	63.28	1.71	284	82	76	10	3.639
4-2	1.80	1.342	14:08	66.92	1.54	285	82	77	10	3.460
4-3	1.70	1.304	14:13	70.38	1.46	283	81	79	10	3.360
4-4	1.20	1.095	14:18	73.74	1.03	283	81	78	9	2.823
			14:23	76.56						0.000
6-1	1.90	1.378	14:26	76.62	1.63	276	80	78	10	3.549
6-2	1.60	1.265	14:31	80.17	1.37	277	80	78	10	3.260
6-3	1.60	1.265	14:36	83.43	1.37	278	80	78	10	3.250
6-4	1.70	1.304	14:41	86.68	1.46	278	80	78	10	3.364
			14:46	90.04						0.000
7-1	1.30	1.140	14:50	90.08	1.11	264	79	78	13	2.935
7-2	0.61	0.781	14:55	93.01	0.52	266	79	78	13	2.010
7-3	1.40	1.183	15:00	95.02	1.20	266	79	78	14	3.050
7-4	1.70	1.304	15:05	98.07	1.46	265	79	78	14	3.359
			15:10	101.43						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		1.233		76.211	1.32	288	80	77		#####
							78.65			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Company **Date:** 9/11/01 **Test Run:** 3
Location: Unit 2 North Inlet Duct

SILICA GEL FINAL WT.:	687.70	grams
SILICA GEL INITIAL WT.:	672.70	grams
DIFFERENCE:	15.00	
FINAL IMPINGER WATER:	5129.70	mls.
INITIAL IMPINGER WATER:	4877.40	mls.
DIFFERENCE:	252.30	
TOTAL WATER GAIN:	267.30	

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	2.3840		0.000002384
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000002384
KCl:	5.150		0.000005150
		Oxidized Total:	0.000005150
HNO_3/H_2O_2:	0.279		0.000000279
$KMNO_4$:	21.800		0.000021800
		Elemental Total:	0.000022079

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	15.00			15.00
Oxygen:	4.00			4.00

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	9/11/01
Test Run:	3
Stack or Duct No.:	Unit 2 North Inlet Duct
Start Time:	12:53
Stop Time:	15:10

Pb:	29.45	Inches Hg
Static	-15.50	Inches H2O
Ps:	28.31	Inches Hg Abs.
Vlc:	267	ml + grams
Mn:	0.0000	gm
Test Time:	120	minutes
% O2:	4.00	%
% CO2:	15.00	%
% N2:	81.00	%
Delta H:	1.32	Inches H20
Cp:	0.836	Dimensionless - pitot
Tm:	78.65	°F
Sqrt P:	1.233	Inches H20
Ts:	288.00	°F
Vm:	76.211	Cubic Feet
Dn:	0.195	Inches - nozzle
As:	204.00	Sq. Feet
Yd:	1.004	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	74.069	cubic feet (dry)
Vwstd:	12.590	cubic feet (wet)
Bwo:	0.145	
Md:	30.560	lb/lb-mole (dry)
Ms:	28.735	lb/lb-mole (wet)
Excess Air (%)	23.010	
Vs:	84.481	fps
ACFM:	1034045.	
DSCFM:	590305.	
WSCFM:	690642	
%I:	102.9	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G013706 **TEST RUN NO.:** 1 **TEST DATE:** 9/10/01

CUSTOMER:	Wisconsin Electric Power Company		**BAROMETRIC PRESSURE (Pb)**	29.35	**in. Hg.**	
PLANT:	Pleasant Prairie Power Plant		**STATIC PRESSURE**	-16	**in. H2O**	
TEST LOC.:	Unit 2 North Outlet Duct		**FLUE PRESSURE (Ps)**	28.17	**in. Hg. abs.**	
CLIENT:	ADA Environmental Solutions, L.L.C.		**PROBE LENGTH:**	9	**ft.**	
OPERATOR:	G. Rock		**PROBE LINER MATERIAL:**	Teflon		
CONTROL BOX:	E-43		**NOZZLE IDENTIFICATION NO.:**	N/A		
METER NO.:	E-43		**CALIBRATED NOZZLE DIAMETER:**	0.245	**in.**	
METER CALIBRATION FACTOR:		1.004	**LEAK CHECK** **PRE:**	0.002	**POST:**	0.012 @ 7 in. Hg.
PITOT ID NO.:	390A		**DUCT SHAPE:** Circular DIA.			Feet
			Rectangular	7.5 Feet		24 Feet
PITOT TUBE COEFFICIENT:	0.840		**DUCT AREA:**	180	**sq. ft.**	
PORT LENGTH:	24 in.		**TEST LENGTH:**	126	**min.**	
PORT SIZE:	6 in.		**MINUTES PER POINT:**	4.5		
PORT TYPE:	Flange		**TOTAL NUMBER OF TRAVERSE POINTS:**		28	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company **Date:** 9/10/01 **Test Run** 1

Location: Unit 2 North Outlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.37	0.608	14:35	91.53	0.78	290	77	76	3.5	2.295
1-2	0.48	0.693	14:39	93.82	1.00	298	79	76	4	2.450
1-3	0.59	0.768	14:44	96.27	1.25	300	80	77	5	2.820
1-4	0.38	0.616	14:48	99.09	1.00	297	81	77	5	2.520
			14:53	101.61						0.000
2-1	0.46	0.678	14:54	102.09	1.00	294	82	77	5	2.560
2-2	0.63	0.794	14:58	104.65	1.30	296	83	77	5	2.560
2-3	0.65	0.806	15:03	107.21	1.70	297	84	78	6	3.210
2-4	0.48	0.693	15:07	110.42	1.40	291	84	78	5	2.960
			15:12	113.38						0.000
3-1	0.60	0.775	15:13	113.63	1.40	290	84	78	5	2.932
3-2	0.67	0.819	15:17	116.57	1.50	293	84	78	5	3.035
3-3	0.56	0.748	15:22	119.60	1.20	292	85	79	5	2.900
3-4	0.57	0.755	15:26	122.50	1.20	290	86	79	5	2.724
			15:31	125.22						0.000
4-1	0.62	0.787	15:33	125.58	1.30	285	85	79	5	2.817
4-2	0.65	0.806	15:37	128.40	1.60	289	86	79	6	3.130
4-3	0.58	0.762	15:42	131.53	1.40	289	87	80	6	2.970
4-4	0.59	0.768	15:46	134.50	1.30	287	87	79	5	3.000
			15:51	137.50						0.000
5-1	0.59	0.768	15:53	138.36	1.40	282	86	80	6	2.871
5-2	0.49	0.700	15:57	141.23	1.10	284	86	80	5	2.720
5-3	0.57	0.755	16:02	143.95	1.20	282	86	80	5	2.850
5-4	0.54	0.735	16:06	146.80	1.20	270	87	80	5	2.720
			16:11	149.52						0.000
6-1	0.46	0.678	16:12	149.89	1.00	273	86	80	4	2.384
6-2	0.62	0.787	16:16	152.27	1.30	277	86	80	4	2.810
6-3	0.61	0.781	16:21	155.08	1.60	277	86	80	6	3.090
6-4	0.55	0.742	16:25	158.17	1.50	273	86	80	6	3.080
			16:30	161.25						0.000
7-1	0.50	0.707	16:31	161.47	1.10	275	85	80	4	2.441
7-2	0.60	0.775	16:35	163.91	1.40	278	85	80	6	3.039
7-3	0.54	0.735	16:40	166.95	1.20	277	85	80	5	2.880
7-4	0.44	0.663	16:44	169.83	1.00	274	85	80	5	2.560
			16:49	172.39						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		0.739		78.328	1.26	286	84	79		#####
							81.61			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Company **Date:** 9/10/01 **Test Run:** 1

Location: Unit 2 North Outlet Duct

SILICA GEL FINAL WT.: 742.60 **grams**
SILICA GEL INITIAL WT.: 723.30 **grams**
DIFFERENCE: 19.30

FINAL IMPINGER WATER: 4981.10 **mls.**
INITIAL IMPINGER WATER: 4747.50 **mls.**
DIFFERENCE: 233.60

TOTAL WATER GAIN: 252.90

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	0.0048		0.000000005
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000000005
KCl:	15.700		0.000015700
		Oxidized Total:	0.000015700
HNO_3/H_2O_2:	0.411		0.000000411
$KMNO_4$:	17.700		0.000017700
		Elemental Total:	0.000018111

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	13.60			13.60
Oxygen:	5.30			5.30

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	9/10/01
Test Run:	1
Stack or Duct No.:	Unit 2 North Outlet Duct
Start Time:	14:35
Stop Time:	16:49

Pb:	29.35	Inches Hg
Static	-16.00	Inches H2O
Ps:	28.17	Inches Hg Abs.
Vlc:	253	ml + grams
Mn:	0.0000	gm
Test Time:	126	minutes
% O2:	5.30	%
% CO2:	13.60	%
% N2:	81.10	%
Delta H:	1.26	Inches H20
Cp:	0.840	Dimensionless - pitot
Tm:	81.61	°F
Sqrt P:	0.739	Inches H20
Ts:	285.71	°F
Vm:	78.328	Cubic Feet
Dn:	0.245	Inches - nozzle
As:	180.00	Sq. Feet
Yd:	1.004	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	75.442	cubic feet (dry)
Vwstd:	11.912	cubic feet (wet)
Bwo:	0.136	
Md:	30.388	lb/lb-mole (dry)
Ms:	28.699	lb/lb-mole (wet)
Excess Air (%)	32.898	
Vs:	50.991	fps
ACFM:	550703.	
DSCFM:	317095.	
WSCFM:	367162	
%I:	103.9	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G013706 TEST RUN NO.: 2 TEST DATE: 9/11/01

CUSTOMER:	Wisconsin Electric Power Company		BAROMETRIC PRESSURE (Pb)		29.45	in. Hg.	
PLANT:	Pleasant Prairie Power Plant		STATIC PRESSURE		-16	in. H2O	
TEST LOC.:	Unit 2 North Outlet Duct		FLUE PRESSURE (Ps)		28.27	in. Hg. abs.	
CLIENT:	ADA Environmental Solutions, L.L.C.		PROBE LENGTH:		9	ft.	
OPERATOR:	G. Rock		PROBE LINER MATERIAL:		Teflon		
CONTROL BOX:	E-25		NOZZLE IDENTIFICATION NO.:		N/A		
METER NO.:	E-25		CALIBRATED NOZZLE DIAMETER:		0.245	in.	
METER CALIBRATION FACTOR:		0.99	LEAK CHECK	PRE:	0.002	POST:	0.002 @ 10 in. Hg.
PITOT ID NO.:	390A		DUCT SHAPE:	Circular	DIA.		Feet
				Rectangular	7.5 Feet		24 Feet
PITOT TUBE COEFFICIENT:		0.840	DUCT AREA:		180	sq. ft.	
PORT LENGTH:	24	in.	TEST LENGTH:		126	min.	
PORT SIZE:	6	in.	MINUTES PER POINT:		4.5		
PORT TYPE:	Flange		TOTAL NUMBER OF TRAVERSE POINTS:			28	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 9/11/01 Test Run 2

Location: Unit 2 North Outlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.46	0.678	9:30	527.73	1.00	275	72	69	5	2.570
1-2	0.56	0.748	9:34	530.30	1.30	276	72	70	5	2.717
1-3	0.54	0.735	9:39	533.01	1.20	275	74	70	5	2.716
1-4	0.43	0.656	9:43	535.73	0.95	270	75	71	5	2.535
			9:48	538.27						0.000
2-1	0.45	0.671	9:51	539.26	1.00	275	76	72	5	2.531
2-2	0.60	0.775	9:55	541.79	1.30	278	77	72	5	2.833
2-3	0.63	0.794	10:00	544.62	1.40	278	78	73	5	2.905
2-4	0.54	0.735	10:04	547.53	1.20	265	78	73	5	2.842
			10:09	550.37						0.000
3-1	0.53	0.728	10:11	550.86	1.30	282	78	74	5	2.793
3-2	0.53	0.728	10:15	553.65	1.20	286	79	74	5	2.730
3-3	0.60	0.775	10:20	556.38	1.30	286	80	75	5	2.763
3-4	0.66	0.812	10:24	559.14	1.40	283	80	75	5	2.857
			10:29	562.00						0.000
4-1	0.66	0.812	10:31	562.31	1.40	291	80	76	5	2.827
4-2	0.63	0.794	10:35	565.14	1.60	295	81	76	6	2.970
4-3	0.61	0.781	10:40	568.11	1.50	295	81	76	6	3.000
4-4	0.64	0.800	10:44	571.11	1.60	287	82	78	6	3.010
			10:49	574.12						0.000
5-1	0.67	0.819	10:50	574.46	1.50	288	82	77	6	3.040
5-2	0.74	0.860	10:54	577.50	1.60	299	83	78	6	3.000
5-3	0.63	0.794	10:59	580.50	1.40	300	83	78	6	2.940
5-4	0.57	0.755	11:03	583.44	1.30	291	83	78	6	2.850
			11:08	586.29						0.000
6-1	0.54	0.735	11:09	586.52	1.20	294	83	79	6	2.760
6-2	0.69	0.831	11:13	589.28	1.50	299	84	79	6	2.960
6-3	0.75	0.866	11:18	592.24	1.60	302	84	79	6	3.190
6-4	0.53	0.728	11:22	595.43	1.40	300	84	79	6	2.720
			11:27	598.15						0.000
7-1	0.38	0.616	11:28	598.52	0.85	294	84	80	5	2.360
7-2	0.52	0.721	11:32	600.88	1.20	301	84	80	5	2.708
7-3	0.63	0.794	11:37	603.59	1.30	304	84	79	5	2.822
7-4	0.44	0.663	11:41	606.41	0.90	297	84	80	5	2.490
			11:46	608.90						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		0.757		78.439	1.30	288	80	76		######
							77.95			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Company **Date:** 9/11/01 **Test Run:** 2

Location: Unit 2 North Outlet Duct

SILICA GEL FINAL WT.:	804.10	**grams**
SILICA GEL INITIAL WT.:	784.70	**grams**
DIFFERENCE:	19.40	
FINAL IMPINGER WATER:	5096.50	**mls.**
INITIAL IMPINGER WATER:	4851.50	**mls.**
DIFFERENCE:	245.00	
TOTAL WATER GAIN:	264.40	

ITEM	**MERCURY (UG)**		**= NET WT. (G)**
FILTER:	0.0922		0.000000092
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000000092
KCl:	10.300		0.000010300
		Oxidized Total:	0.000010300
HNO_3/H_2O_2:	0.654		0.000000654
$KMNO_4$:	20.300		0.000020300
		Elemental Total:	0.000020954

Orsat Analysis	**1**	**2**	**3**	**Average**
Carbon Dioxide:	13.70			13.70
Oxygen:	5.30			5.30

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	9/11/01
Test Run:	2
Stack or Duct No.:	Unit 2 North Outlet Duct
Start Time:	9:30
Stop Time:	11:46

Pb:	29.45	Inches Hg
Static	-16.00	Inches H2O
Ps:	28.27	Inches Hg Abs.
Vlc:	264	ml + grams
Mn:	0.0000	gm
Test Time:	126	minutes
% O2:	5.30	%
% CO2:	13.70	%
% N2:	81.00	%
Delta H:	1.30	Inches H20
Cp:	0.840	Dimensionless - pitot
Tm:	77.95	°F
Sqrt P:	0.757	Inches H20
Ts:	288.07	°F
Vm:	78.439	Cubic Feet
Dn:	0.245	Inches - nozzle
As:	180.00	Sq. Feet
Yd:	0.990	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	75.265	cubic feet (dry)
Vwstd:	12.453	cubic feet (wet)
Bwo:	0.142	
Md:	30.404	lb/lb-mole (dry)
Ms:	28.643	lb/lb-mole (wet)
Excess Air (%)	32.952	
Vs:	52.264	fps
ACFM:	564454.	
DSCFM:	323027.	
WSCFM:	376475	
%I:	101.7	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G013706 **TEST RUN NO.:** 3 **TEST DATE:** 9/11/01

CUSTOMER:	Wisconsin Electric Power Company		**BAROMETRIC PRESSURE (Pb)**		29.45	**in. Hg.**	
PLANT:	Pleasant Prairie Power Plant		**STATIC PRESSURE**		-16	**in. H2O**	
TEST LOC.:	Unit 2 North Outlet Duct		**FLUE PRESSURE (Ps)**		28.27	**in. Hg. abs.**	
CLIENT:	ADA Environmental Solutions, L.L.C.		**PROBE LENGTH:**		9	**ft.**	
OPERATOR:	G. Rock		**PROBE LINER MATERIAL:**		Teflon		
CONTROL BOX:	E-25		**NOZZLE IDENTIFICATION NO.:**		N/A		
METER NO.:	E-25		**CALIBRATED NOZZLE DIAMETER:**		0.245	**in.**	
METER CALIBRATION FACTOR:	0.99		**LEAK CHECK**	**PRE:**	0.006	**POST:**	0.009 @ 6 in. Hg.
PITOT ID NO.:	390A		**DUCT SHAPE:**	Circular	DIA.		Feet
				Rectangular	7.5 Feet		24 Feet
PITOT TUBE COEFFICIENT:	0.840		**DUCT AREA:**		180	**sq. ft.**	
PORT LENGTH:	24	in.	**TEST LENGTH:**		126	**min.**	
PORT SIZE:	6	in.	**MINUTES PER POINT:**		4.5		
PORT TYPE:	Flange		**TOTAL NUMBER OF TRAVERSE POINTS:**			28	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company   Date: 9/11/01   Test Run 3

Location: Unit 2 North Outlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.40	0.632	13:10	612.52	0.87	306	79	79	4	2.370
1-2	0.51	0.714	13:14	614.89	1.30	309	80	79	5	2.790
1-3	0.62	0.787	13:19	617.68	1.30	311	81	79	5	2.800
1-4	0.45	0.671	13:23	620.48	1.30	302	81	79	5	2.850
			13:28	623.33						0.000
2-1	0.50	0.707	13:29	623.53	1.00	304	81	79	4	2.500
2-2	0.71	0.843	13:33	626.03	1.60	308	81	78	5	2.950
2-3	0.75	0.866	13:38	628.98	2.00	310	82	78	5	3.370
2-4	0.45	0.671	13:42	632.35	1.60	295	82	78	5	3.033
			13:47	635.38						0.000
3-1	0.66	0.812	13:48	635.88	1.40	303	81	78	5	2.834
3-2	0.80	0.894	13:52	638.71	2.00	307	81	78	6	3.350
3-3	0.67	0.819	13:57	642.06	1.60	308	81	78	6	3.220
3-4	0.60	0.775	14:01	645.28	1.30	302	81	78	6	2.986
			14:06	648.27						0.000
4-1	0.70	0.837	14:29	649.39	1.60	296	77	77	5	3.044
4-2	0.72	0.849	14:33	652.43	1.60	302	78	77	5	3.140
4-3	0.65	0.806	14:38	655.57	1.60	303	79	77	5	3.080
4-4	0.67	0.819	14:42	658.65	1.80	297	79	77	6	3.280
			14:47	661.93						0.000
5-1	0.64	0.800	14:48	662.40	1.40	289	79	77	5	2.883
5-2	0.57	0.755	14:52	665.28	1.40	292	80	76	5	2.990
5-3	0.64	0.800	14:57	668.27	1.50	290	80	77	5	3.030
5-4	0.68	0.825	15:01	671.30	1.50	288	80	77	5	3.030
			15:06	674.33						0.000
6-1	0.51	0.714	15:07	674.57	1.10	276	79	77	5	2.711
6-2	0.67	0.819	15:11	677.28	1.50	284	80	77	5	2.730
6-3	0.70	0.837	15:16	680.01	1.60	283	80	77	5	3.150
6-4	0.65	0.806	15:20	683.16	1.70	279	80	77	5	2.990
			15:25	686.15						0.000
7-1	0.48	0.693	15:26	686.31	1.40	278	79	77	5	2.742
7-2	0.58	0.762	15:30	689.05	1.20	281	80	77	5	0.250
7-3	0.58	0.762	15:35	689.30	1.20	281	80	77	5	5.400
7-4	0.52	0.721	15:39	694.70	1.10	281	80	77	5	2.594
			15:44	697.29						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		0.778		82.097	1.45	295	80	78		#####
							78.80			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Company **Date:** 9/11/01 **Test Run:** 3

Location: Unit 2 North Outlet Duct

SILICA GEL FINAL WT.:	720.70	**grams**
SILICA GEL INITIAL WT.:	701.40	**grams**
DIFFERENCE:	19.30	
FINAL IMPINGER WATER:	4825.80	**mls.**
INITIAL IMPINGER WATER:	4567.50	**mls.**
DIFFERENCE:	258.30	
TOTAL WATER GAIN:	277.60	

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	0.0546		0.000000055
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000000055
KCl:	10.300		0.000010300
		Oxidized Total:	0.000010300
HNO_3/H_2O_2:	0.556		0.000000556
$KMNO_4$:	19.600		0.000019600
		Elemental Total:	0.000020156

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	13.90			13.90
Oxygen:	5.20			5.20

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	9/11/01
Test Run:	3
Stack or Duct No.:	Unit 2 North Outlet Duct
Start Time:	13:10
Stop Time:	15:44

Pb:	29.45	Inches Hg
Static	-16.00	Inches H2O
Ps:	28.27	Inches Hg Abs.
Vlc:	278	ml + grams
Mn:	0.0000	gm
Test Time:	126	minutes
% O2:	5.20	%
% CO2:	13.90	%
% N2:	80.90	%
Delta H:	1.45	Inches H20
Cp:	0.840	Dimensionless - pitot
Tm:	78.80	°F
Sqrt P:	0.778	Inches H20
Ts:	295.18	°F
Vm:	82.097	Cubic Feet
Dn:	0.245	Inches - nozzle
As:	180.00	Sq. Feet
Yd:	0.990	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	78.678	cubic feet (dry)
Vwstd:	13.075	cubic feet (wet)
Bwo:	0.143	
Md:	30.432	lb/lb-mole (dry)
Ms:	28.660	lb/lb-mole (wet)
Excess Air (%)	32.183	
Vs:	53.958	fps
ACFM:	582750.	
DSCFM:	330154.	
WSCFM:	385020	
%I:	104.1	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G014603 | TEST RUN NO.: 1 | TEST DATE: 11/12/01

CUSTOMER:	Wisconsin Electric Power Company		BAROMETRIC PRESSURE (Pb)		29.52	in. Hg.
PLANT:	Pleasant Prairie Power Plant		STATIC PRESSURE		-15.5	in. H2O
TEST LOC.:	Unit 2 North Inlet Duct		FLUE PRESSURE (Ps)		28.38	in. Hg. abs.
CLIENT:	ADA Environmental Solutions, L.L.C.		PROBE LENGTH:		9	ft.
OPERATOR:	M. Ebner		PROBE LINER MATERIAL:		Teflon	
CONTROL BOX:	E-14		NOZZLE IDENTIFICATION NO.:		N/A	
METER NO.:	E-14		CALIBRATED NOZZLE DIAMETER:		0.190	in.
METER CALIBRATION FACTOR:	1.002		LEAK CHECK	PRE:	0.008	POST: 0.002 @ 18 in. Hg.
PITOT ID NO.:	429A		DUCT SHAPE:	Circular Rectangular	DIA. 8.5 Feet	Feet 24 Feet
PITOT TUBE COEFFICIENT:	0.829		DUCT AREA:		204	sq. ft.
PORT LENGTH:	30	in.	TEST LENGTH:		120	min.
PORT SIZE:	6	in.	MINUTES PER POINT:		5	
PORT TYPE:	Flange		TOTAL NUMBER OF TRAVERSE POINTS:		24	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 11/12/01 Test Run 1

Location: Unit 2 North Inlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.73	0.854	13:30	29.25	0.55	270	59	61	4	1.980
1-2	1.90	1.378	13:35	31.23	1.43	273	59	61	5	3.260
1-3	1.30	1.140	13:40	34.49	0.98	272	60	62	5	2.700
1-4	1.70	1.304	13:45	37.19	1.28	275	60	64	5	2.830
			13:50	40.02						0.000
2-1	2.10	1.449	13:51	40.22	1.58	281	60	65	6	3.330
2-2	2.30	1.517	13:56	43.55	1.73	285	61	67	6	3.650
2-3	1.00	1.000	14:01	47.20	0.75	283	63	67	6	2.630
2-4	1.90	1.378	14:06	49.83	1.43	281	62	67	6	2.970
			14:11	52.80						0.000
3-1	2.00	1.414	14:12	53.07	1.50	280	62	67	6	3.220
3-2	2.00	1.414	14:17	56.29	1.50	285	63	68	6	3.290
3-3	1.10	1.049	14:22	59.58	0.83	288	63	68	6	2.720
3-4	0.95	0.975	14:27	62.30	0.71	287	64	68	6	2.100
			14:32	64.40						0.000
4-1	0.83	0.911	14:33	64.66	0.62	291	64	66	5	2.020
4-2	1.00	1.000	14:38	66.68	0.75	293	64	67	5	2.450
4-3	0.83	0.911	14:43	69.13	0.62	296	65	67	5	2.100
4-4	0.90	0.949	14:48	71.23	0.68	295	64	66	5	2.080
			14:53	73.31						0.000
6-1	2.20	1.483	14:58	73.50	1.65	294	64	66	6	3.370
6-2	2.00	1.414	15:03	76.87	1.50	295	64	66	6	3.460
6-3	1.20	1.095	15:08	80.33	0.90	299	65	68	6	2.470
6-4	1.70	1.304	15:13	82.80	1.28	305	65	69	6	2.810
			15:18	85.61						0.000
7-1	1.80	1.342	15:19	86.03	1.35	307	65	69	8	2.990
7-2	1.60	1.265	15:24	89.02	1.20	310	66	70	8	3.610
7-3	1.60	1.265	15:29	92.63	1.20	316	64	67	7	2.520
7-4	1.90	1.378	15:34	95.15	1.43	318	64	67	8	3.380
			15:39	98.53						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		1.216		67.940	1.14	291	63	66		#####
							64.65			

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MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Compa **Date:** 11/12/01 **Test Run:** 1

Location: Unit 2 North Inlet Duct

SILICA GEL FINAL WT.:	783.30 **grams**
SILICA GEL INITIAL WT.:	765.40 **grams**
DIFFERENCE:	17.90
FINAL IMPINGER WATER:	4936.00 **mls.**
INITIAL IMPINGER WATER:	4740.30 **mls.**
DIFFERENCE:	195.70
TOTAL WATER GAIN:	213.60

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	3.761		0.000003761
PROBE WASH:	0.034		0.000000034
		Particle-bound Total:	0.000003795
KCl:	3.990		0.000003990
		Oxidized Total:	0.000003990
HNO_3/H_2O_2:	0.110		0.000000110
$KMNO_4$:	18.900		0.000018900
		Elemental Total:	0.000019010

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	14.80			14.80
Oxygen:	5.30			5.30

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	11/12/01
Test Run:	1
Stack or Duct No.:	Unit 2 North Inlet Duct
Start Time:	13:30
Stop Time:	15:39

Pb:	29.52	Inches Hg
Static	-15.50	Inches H2O
Ps:	28.38	Inches Hg Abs.
Vlc:	214	ml + grams
Mn:	0.0000	gm
Test Time:	120	minutes
% O2:	5.30	%
% CO2:	14.80	%
% N2:	79.90	%
Delta H:	1.14	Inches H20
Cp:	0.829	Dimensionless - pitot
Tm:	64.65	°F
Sqrt P:	1.216	Inches H20
Ts:	290.79	°F
Vm:	67.940	Cubic Feet
Dn:	0.190	Inches - nozzle
As:	204.00	Sq. Feet
Yd:	1.002	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	67.788	cubic feet (dry)
Vwstd:	10.061	cubic feet (wet)
Bwo:	0.129	
Md:	30.580	lb/lb-mole (dry)
Ms:	28.954	lb/lb-mole (wet)
Excess Air (%)	33.558	
Vs:	82.393	fps
ACFM:	1008493.	
DSCFM:	585791.	
WSCFM:	672730	
%I:	100.0	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.:	G014603	**TEST RUN NO.:**	2	**TEST DATE:**	11/13/01

CUSTOMER:	Wisconsin Electric Power Company		**BAROMETRIC PRESSURE (Pb)**		29.33	**in. Hg.**	
PLANT:	Pleasant Prairie Power Plant		**STATIC PRESSURE**		-17	**in. H2O**	
TEST LOC.:	Unit 2 North Inlet Duct		**FLUE PRESSURE (Ps)**		28.08	**in. Hg. abs.**	
CLIENT:	ADA Environmental Solutions, L.L.C.		**PROBE LENGTH:**		9	**ft.**	
OPERATOR:	M. Ebner		**PROBE LINER MATERIAL:**		Teflon		
CONTROL BOX:	E-14		**NOZZLE IDENTIFICATION NO.:**		N/A		
METER NO.:	E-14		**CALIBRATED NOZZLE DIAMETER:**		0.190	**in.**	
METER CALIBRATION FACTOR:		1.002	**LEAK CHECK**	**PRE:**	0.003	**POST:**	0.005 @ 15 in. Hg.
PITOT ID NO.:	429A		**DUCT SHAPE:**	Circular Rectangular	DIA. 8.5 Feet		Feet 24 Feet
PITOT TUBE COEFFICIENT:	0.829		**DUCT AREA:**		204 **sq. ft.**		
PORT LENGTH:	30 in.		**TEST LENGTH:**		120	**min.**	
PORT SIZE:	6 in.		**MINUTES PER POINT:**		5		
PORT TYPE:	Flange		**TOTAL NUMBER OF TRAVERSE POINTS:**			24	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 11/13/01 Test Run 2

Location: Unit 2 North Inlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.90	0.949	8:35	0.73	0.68	263	53	54	5	2.350
1-2	1.80	1.342	8:40	3.08	1.35	265	54	55	5	2.950
1-3	1.30	1.140	8:45	6.03	0.98	266	55	58	5	2.920
1-4	2.00	1.414	8:50	8.95	1.50	266	55	60	5	3.180
			8:55	12.13						0.000
2-1	1.70	1.304	8:56	12.33	1.28	265	56	61	5	3.110
2-2	2.20	1.483	9:01	15.44	1.65	269	57	63	5	3.360
2-3	1.10	1.049	9:06	18.80	0.83	273	57	64	6	2.720
2-4	1.70	1.304	9:11	21.52	1.28	274	55	63	6	2.970
			9:16	24.49						0.000
3-1	1.90	1.378	9:17	24.57	1.43	276	56	63	6	3.130
3-2	2.00	1.414	9:22	27.70	1.50	280	58	65	6	3.490
3-3	1.00	1.000	9:27	31.19	0.75	283	58	66	6	2.390
3-4	1.00	1.000	9:32	33.58	0.75	283	60	65	6	2.420
			9:37	36.00						0.000
4-1	1.90	1.378	9:38	36.06	1.43	284	59	66	7	3.130
4-2	1.20	1.095	9:43	39.19	0.90	289	59	65	7	2.760
4-3	0.66	0.812	9:48	41.95	0.50	288	60	66	7	2.930
4-4	0.90	0.949	9:53	44.88	0.68	288	60	66	7	1.130
			9:58	46.01						0.000
6-1	2.00	1.414	9:59	46.13	1.50	286	60	67	7	3.320
6-2	2.00	1.414	10:04	49.45	1.50	285	59	65	7	3.450
6-3	1.30	1.140	10:09	52.90	0.98	303	60	66	8	2.530
6-4	1.50	1.225	10:14	55.43	1.13	303	62	66	8	2.790
			10:19	58.22						0.000
7-1	1.80	1.342	10:20	58.42	1.35	302	61	65	8	3.010
7-2	1.50	1.225	10:25	61.43	1.13	309	61	66	8	3.230
7-3	1.50	1.225	10:30	64.66	1.13	309	61	66	9	2.730
7-4	1.90	1.378	10:35	67.39	1.43	311	62	66	9	3.640
			10:40	71.03						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		1.224		69.640	1.15	284	58	64		#####
							60.94			

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MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Compa **Date:** 11/13/01 **Test Run:** 2

Location: Unit 2 North Inlet Duct

SILICA GEL FINAL WT.:	778.60	**grams**
SILICA GEL INITIAL WT.:	758.00	**grams**
DIFFERENCE:	20.60	
FINAL IMPINGER WATER:	5094.20	**mls.**
INITIAL IMPINGER WATER:	4898.60	**mls.**
DIFFERENCE:	195.60	
TOTAL WATER GAIN:	216.20	

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	0.390		0.000000390
PROBE WASH:	0.002		0.000000002
		Particle-bound Total:	0.000000392
KCl:	2.700		0.000002700
		Oxidized Total:	0.000002700
HNO_3/H_2O_2:	0.040		0.000000040
$KMNO_4$:	30.400		0.000030400
		Elemental Total:	0.000030440

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	14.90			14.90
Oxygen:	4.20			4.20

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company: Wisconsin Electric Power Company

Date: 11/13/01

Test Run: 2

Stack or Duct No.: Unit 2 North Inlet Duct

Start Time: 8:35

Stop Time: 10:40

Pb:	29.33	Inches Hg
Static	-17.00	Inches H2O
Ps:	28.08	Inches Hg Abs.
Vlc:	216	ml + grams
Mn:	0.0000	gm
Test Time:	120	minutes
% O2:	4.20	%
% CO2:	14.90	%
% N2:	80.90	%
Delta H:	1.15	Inches H20
Cp:	0.829	Dimensionless - pitot
Tm:	60.94	°F
Sqrt P:	1.224	Inches H20
Ts:	284.17	°F
Vm:	69.640	Cubic Feet
Dn:	0.190	Inches - nozzle
As:	204.00	Sq. Feet
Yd:	1.002	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	69.531	cubic feet (dry)
Vwstd:	10.183	cubic feet (wet)
Bwo:	0.128	
Md:	30.552	lb/lb-mole (dry)
Ms:	28.949	lb/lb-mole (wet)
Excess Air (%)	24.479	
Vs:	82.996	fps
ACFM:	1015873.	
DSCFM:	590039.	
WSCFM:	676452	
%I:	101.8	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.:	G014603	**TEST RUN NO.:**	3	**TEST DATE:**		11/13/01	
CUSTOMER:	Wisconsin Electric Power Company			**BAROMETRIC PRESSURE (Pb)**		29.33	**in. Hg.**
PLANT:	Pleasant Prairie Power Plant			**STATIC PRESSURE**		-17	**in. H2O**
TEST LOC.:	Unit 2 North Inlet Duct			**FLUE PRESSURE (Ps)**		28.08	**in. Hg. abs.**
CLIENT:	ADA Environmental Solutions, L.L.C.			**PROBE LENGTH:**		9	**ft.**
OPERATOR:	M. Ebner			**PROBE LINER MATERIAL:**		Teflon	
CONTROL BOX:	E-14			**NOZZLE IDENTIFICATION NO.:**		N/A	
METER NO.:	E-14			**CALIBRATED NOZZLE DIAMETER:**		0.190	**in.**
METER CALIBRATION FACTOR:		1.002		**LEAK CHECK**	**PRE:**	0.002	**POST:** 0.002 @ 12 in. Hg.
PITOT ID NO.:	429A			**DUCT SHAPE:**	Circular	DIA.	Feet
					Rectangular	8.5 Feet	24 Feet
PITOT TUBE COEFFICIENT:	0.829			**DUCT AREA:**		204 **sq. ft.**	
PORT LENGTH:	30	in.		**TEST LENGTH:**		120	**min.**
PORT SIZE:	6	in.		**MINUTES PER POINT:**		5	
PORT TYPE:	Flange			**TOTAL NUMBER OF TRAVERSE POINTS:**			24

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company   Date: 11/13/01   Test Run 3

Location: Unit 2 North Inlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
7-1	1.80	1.342	11:20	71.36	1.34	309	60	65	6	3.050
7-2	1.50	1.225	11:25	74.41	1.11	309	61	64	6	3.090
7-3	1.60	1.265	11:30	77.50	1.19	310	61	64	6	3.060
7-4	2.00	1.414	11:35	80.56	1.48	308	62	66	6	3.240
			11:40	83.80						0.000
6-1	2.20	1.483	11:41	83.92	1.63	307	62	66	6	3.350
6-2	2.10	1.449	11:46	87.27	1.56	308	63	67	7	3.350
6-3	1.30	1.140	11:51	90.62	0.97	305	62	67	7	2.910
6-4	1.70	1.304	11:56	93.53	1.26	306	63	66	7	2.860
			12:01	96.39						0.000
4-1	1.90	1.378	12:02	96.52	1.41	305	62	66	7	3.370
4-2	1.10	1.049	12:07	99.89	0.82	306	63	66	7	2.440
4-3	0.75	0.866	12:12	102.33	0.56	302	62	66	6	2.040
4-4	0.83	0.911	12:17	104.37	0.62	300	62	66	6	2.020
			12:22	106.39						0.000
3-1	2.00	1.414	12:23	106.43	1.48	300	61	65	6	3.540
3-2	2.00	1.414	12:28	109.97	1.48	295	62	65	6	3.230
3-3	1.30	1.140	12:33	113.20	0.97	295	62	66	6	2.720
3-4	0.91	0.954	12:38	115.92	0.68	289	62	67	7	2.150
			12:43	118.07						0.000
2-1	2.20	1.483	12:44	118.15	1.63	288	63	67	7	3.600
2-2	2.40	1.549	12:49	121.75	1.78	282	62	66	8	3.580
2-3	1.20	1.095	12:54	125.33	0.89	281	62	66	8	2.640
2-4	1.90	1.378	12:59	127.97	1.41	282	62	66	8	3.380
			13:04	131.35						0.000
1-1	0.93	0.964	13:05	131.43	0.69	279	62	66	8	2.120
1-2	2.00	1.414	13:10	133.55	1.48	274	62	66	8	3.070
1-3	1.00	1.000	13:15	136.62	0.74	273	63	66	8	2.530
1-4	1.30	1.140	13:20	139.15	0.97	273	63	66	8	2.810
			13:25	141.96						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		1.241		70.150	1.17	295	62	66		#####
							63.96			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Compa **Date:** 11/13/01 **Test Run:** 3

Location: Unit 2 North Inlet Duct

SILICA GEL FINAL WT.:	791.10	**grams**
SILICA GEL INITIAL WT.:	773.80	**grams**
DIFFERENCE:	17.30	
FINAL IMPINGER WATER:	5064.90	**mls.**
INITIAL IMPINGER WATER:	4858.30	**mls.**
DIFFERENCE:	206.60	
TOTAL WATER GAIN:	223.90	

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	1.076		0.000001076
PROBE WASH:	0.005		0.000000005
		Particle-bound Total:	0.000001081
KCl:	2.740		0.000002740
		Oxidized Total:	0.000002740
HNO_3/H_2O_2:	0.410		0.000000410
$KMNO_4$:	30.800		0.000030800
		Elemental Total:	0.000031210

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	14.90			14.90
Oxygen:	4.80			4.80

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	11/13/01
Test Run:	3
Stack or Duct No.:	Unit 2 North Inlet Duct
Start Time:	11:20
Stop Time:	13:25

Pb:	29.33	Inches Hg
Static	-17.00	Inches H2O
Ps:	28.08	Inches Hg Abs.
Vlc:	224	ml + grams
Mn:	0.0000	gm
Test Time:	120	minutes
% O2:	4.80	%
% CO2:	14.90	%
% N2:	80.30	%
Delta H:	1.17	Inches H20
Cp:	0.829	Dimensionless - pitot
Tm:	63.96	°F
Sqrt P:	1.241	Inches H20
Ts:	295.25	°F
Vm:	70.150	Cubic Feet
Dn:	0.190	Inches - nozzle
As:	204.00	Sq. Feet
Yd:	1.002	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	69.640	cubic feet (dry)
Vwstd:	10.546	cubic feet (wet)
Bwo:	0.132	
Md:	30.576	lb/lb-mole (dry)
Ms:	28.922	lb/lb-mole (wet)
Excess Air (%)	29.270	
Vs:	84.786	fps
ACFM:	1037782.	
DSCFM:	591350.	
WSCFM:	680900	
%I:	101.7	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G014603 **TEST RUN NO.:** 1 **TEST DATE:** 11/12/01

CUSTOMER:	Wisconsin Electric Power Company		**BAROMETRIC PRESSURE (Pb)**	29.52	**in. Hg.**	
PLANT:	Pleasant Prairie Power Plant		**STATIC PRESSURE**	-17.5	**in. H2O**	
TEST LOC.:	Unit 2 North Outlet Duct		**FLUE PRESSURE (Ps)**	28.23	**in. Hg. abs.**	
CLIENT:	ADA Environmental Solutions, L.L.C.		**PROBE LENGTH:**	8.5	**ft.**	
OPERATOR:	G. Rock		**PROBE LINER MATERIAL:**	Teflon		
CONTROL BOX:	E-51		**NOZZLE IDENTIFICATION NO.:**	N/A		
METER NO.:	E-51		**CALIBRATED NOZZLE DIAMETER:**	0.245	**in.**	
METER CALIBRATION FACTOR:	0.998		**LEAK CHECK** **PRE:**	0.015	**POST:**	0.010 @ 10 in. Hg.
PITOT ID NO.:	287B		**DUCT SHAPE:** Circular DIA. / Rectangular	7.5 Feet		Feet / 24 Feet
PITOT TUBE COEFFICIENT:	0.837		**DUCT AREA:**	180	**sq. ft.**	
PORT LENGTH:	24	in.	**TEST LENGTH:**	126	**min.**	
PORT SIZE:	6	in.	**MINUTES PER POINT:**	4.5		
PORT TYPE:	Flange		**TOTAL NUMBER OF TRAVERSE POINTS:**		28	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 11/12/01 Test Run 1

Location: Unit 2 North Outlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.55	0.742	13:30	710.43	1.10	280	64	61	7	2.752
1-2	0.64	0.800	13:34	713.18	1.20	280	66	61	7	2.620
1-3	0.57	0.755	13:39	715.80	1.10	278	68	62	7	2.590
1-4	0.50	0.707	13:43	718.39	1.00	277	69	62	7	2.340
			13:48	720.73						0.000
2-1	0.50	0.707	13:49	721.15	1.00	281	71	63	7	2.420
2-2	0.66	0.812	13:53	723.57	1.30	282	71	63	7	2.830
2-3	0.70	0.837	13:58	726.40	1.70	281	73	64	7	3.056
2-4	0.58	0.762	14:02	729.46	1.20	280	74	64	7	2.504
			14:07	731.96						0.000
3-1	0.67	0.819	14:09	732.46	1.30	292	74	65	7	2.686
3-2	0.56	0.748	14:13	735.15	1.40	291	72	65	7	2.780
3-3	0.65	0.806	14:18	737.93	1.50	289	74	66	7	2.820
3-4	0.66	0.812	14:22	740.75	1.30	287	74	66	8	2.850
			14:27	743.60						0.000
4-1	0.75	0.866	14:29	744.10	1.50	300	74	67	8	2.900
4-2	0.68	0.825	14:33	747.00	1.50	300	74	67	8	2.900
4-3	0.62	0.787	14:38	749.90	1.50	299	75	67	8	2.850
4-4	0.62	0.787	14:42	752.75	1.50	299	75	67	8	2.960
			14:47	755.71						0.000
5-1	0.74	0.860	14:49	755.97	1.50	303	73	68	8	2.878
5-2	0.79	0.889	14:53	758.85	1.70	304	74	68	8	3.150
5-3	0.64	0.800	14:58	762.00	1.50	304	75	68	8	3.150
5-4	0.58	0.762	15:02	765.15	1.20	304	75	68	8	2.745
			15:07	767.90						0.000
6-1	0.59	0.768	15:08	768.20	1.20	302	74	68	7	2.530
6-2	0.73	0.854	15:12	770.73	1.60	304	75	68	8	2.860
6-3	0.72	0.849	15:17	773.59	1.80	306	75	68	8	3.160
6-4	0.48	0.693	15:21	776.75	0.90	305	75	69	8	2.550
			15:26	779.30						0.000
7-1	0.45	0.671	15:27	779.52	0.90	303	73	68	7	2.327
7-2	0.54	0.735	15:31	781.85	1.10	305	74	69	7	2.450
7-3	0.65	0.806	15:36	784.30	1.60	307	74	69	8	3.000
7-4	0.45	0.671	15:40	787.30	0.90	307	75	69	8	2.390
			15:45	789.69						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		0.783		77.048	1.32	295	73	66		#####
							69.46			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Compa **Date:** 11/12/01 **Test Run:** 1

Location: Unit 2 North Outlet Duct

SILICA GEL FINAL WT.:	775.40	**grams**
SILICA GEL INITIAL WT.:	758.60	**grams**
DIFFERENCE:	16.80	
FINAL IMPINGER WATER:	5028.00	**mls.**
INITIAL IMPINGER WATER:	4846.20	**mls.**
DIFFERENCE:	181.80	
TOTAL WATER GAIN:	198.60	

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	0.000		0.000000000
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000000000
KCl:	0.090		0.000000090
		Oxidized Total:	0.000000090
HNO_3/H_2O_2:	0.000		0.000000000
$KMNO_4$:	7.910		0.000007910
		Elemental Total:	0.000007910

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	13.80	13.80	13.60	13.73
Oxygen:	5.20			5.20

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	Wisconsin Electric Power Company
Date:	11/12/01
Test Run:	1
Stack or Duct No.:	Unit 2 North Outlet Duct
Start Time:	13:30
Stop Time:	15:45

Pb:	29.52	Inches Hg
Static	-17.50	Inches H2O
Ps:	28.23	Inches Hg Abs.
Vlc:	199	ml + grams
Mn:	0.0000	gm
Test Time:	126	minutes
% O2:	5.20	%
% CO2:	13.73	%
% N2:	81.07	%
Delta H:	1.32	Inches H20
Cp:	0.837	Dimensionless - pitot
Tm:	69.46	°F
Sqrt P:	0.783	Inches H20
Ts:	294.64	°F
Vm:	77.048	Cubic Feet
Dn:	0.245	Inches - nozzle
As:	180.00	Sq. Feet
Yd:	0.998	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	75.905	cubic feet (dry)
Vwstd:	9.354	cubic feet (wet)
Bwo:	0.110	
Md:	30.405	lb/lb-mole (dry)
Ms:	29.044	lb/lb-mole (wet)
Excess Air (%)	32.096	
Vs:	53.762	fps
ACFM:	580627.	
DSCFM:	341285.	
WSCFM:	383343	
%I:	97.1	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G014603 **TEST RUN NO.:** 2 **TEST DATE:** 11/13/01

CUSTOMER:	Wisconsin Electric Power Company		**BAROMETRIC PRESSURE (Pb)**		29.33	**in. Hg.**
PLANT:	Pleasant Prairie Power Plant		**STATIC PRESSURE**		-17	**in. H2O**
TEST LOC.:	Unit 2 North Outlet Duct		**FLUE PRESSURE (Ps)**		28.08	**in. Hg. abs.**
CLIENT:	ADA Environmental Solutions, L.L.C.		**PROBE LENGTH:**		8.5	**ft.**
OPERATOR:	G. Rock		**PROBE LINER MATERIAL:**		Teflon	
CONTROL BOX:	E-51		**NOZZLE IDENTIFICATION NO.:**		N/A	
METER NO.:	E-51		**CALIBRATED NOZZLE DIAMETER:**		0.245	**in.**
METER CALIBRATION FACTOR:	0.998		**LEAK CHECK**	**PRE:**	0.015	**POST:** 0.020 @ 11 in. Hg.
PITOT ID NO.:	287B		**DUCT SHAPE:**	Circular	DIA.	Feet
				Rectangular	7.5 Feet	24 Feet
PITOT TUBE COEFFICIENT:	0.837		**DUCT AREA:**		180	**sq. ft.**
PORT LENGTH:	24	in.	**TEST LENGTH:**		126	**min.**
PORT SIZE:	6	in.	**MINUTES PER POINT:**		4.5	
PORT TYPE:	Flange		**TOTAL NUMBER OF TRAVERSE POINTS:**		28	

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company Date: 11/13/01 Test Run 2

Location: Unit 2 North Outlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.48	0.693	8:10	791.09	1.00	273	55	54	8	2.505
1-2	0.63	0.794	8:14	793.59	1.50	272	58	54	8	2.807
1-3	0.65	0.806	8:19	796.40	1.40	271	61	54	8	2.850
1-4	0.57	0.755	8:23	799.25	1.40	269	63	55	8	2.750
			8:28	802.00						0.000
2-1	0.58	0.762	8:31	802.97	1.20	271	61	56	8	2.683
2-2	0.62	0.787	8:35	805.65	1.40	271	64	56	8	2.842
2-3	0.56	0.748	8:40	808.49	1.20	269	65	57	8	2.590
2-4	0.48	0.693	8:44	811.08	1.30	269	66	58	8	2.328
			8:49	813.41						0.000
3-1	0.64	0.800	8:52	814.05	1.70	282	67	58	9	3.084
3-2	0.55	0.742	8:56	817.13	1.10	282	68	59	8	2.585
3-3	0.62	0.787	9:01	819.72	1.30	281	68	59	8	2.825
3-4	0.63	0.794	9:05	822.54	1.30	279	69	60	8	2.779
			9:10	825.32						0.000
4-1	0.69	0.831	9:12	825.98	1.40	291	68	60	8	2.851
4-2	0.67	0.819	9:16	828.83	1.60	292	69	61	8	3.230
4-3	0.60	0.775	9:21	832.06	1.20	291	70	61	8	2.550
4-4	0.62	0.787	9:25	834.61	1.30	290	70	61	8	2.790
			9:30	837.40						0.000
5-1	0.69	0.831	9:33	837.92	1.40	295	67	62	9	2.816
5-2	0.75	0.866	9:37	840.74	2.00	295	70	62	10	3.260
5-3	0.58	0.762	9:42	844.00	1.40	295	71	62	10	3.040
5-4	0.56	0.748	9:46	847.04	1.20	295	71	62	9	2.585
			9:51	849.63						0.000
6-1	0.54	0.735	9:53	850.26	1.10	293	70	63	8	2.520
6-2	0.68	0.825	9:57	852.78	1.40	295	71	63	9	2.820
6-3	0.68	0.825	10:02	855.60	1.70	297	72	64	9	3.000
6-4	0.52	0.721	10:06	858.60	1.50	298	73	64	9	2.955
			10:11	861.56						0.000
7-1	0.42	0.648	10:13	861.98	0.90	293	70	64	7	2.240
7-2	0.52	0.721	10:17	864.22	1.50	296	72	64	8	2.800
7-3	0.60	0.775	10:22	867.02	1.20	298	72	65	8	2.830
7-4	0.43	0.656	10:26	869.85	0.80	296	72	65	8	2.421
			10:31	872.27						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		0.767		77.336	1.34	286	68	60		#####
							63.86			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Compa **Date:** 11/13/01 **Test Run:** 2

Location: Unit 2 North Outlet Duct

SILICA GEL FINAL WT.:	790.70	**grams**
SILICA GEL INITIAL WT.:	774.90	**grams**
DIFFERENCE:	15.80	
FINAL IMPINGER WATER:	5001.50	**mls.**
INITIAL IMPINGER WATER:	4772.10	**mls.**
DIFFERENCE:	229.40	
TOTAL WATER GAIN:	245.20	

ITEM	**MERCURY (UG)**		**= NET WT. (G)**
FILTER:	0.000		0.000000000
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000000000
KCl:	1.220		0.000001220
		Oxidized Total:	0.000001220
HNO_3/H_2O_2:	0.000		0.000000000
$KMNO_4$:	8.810		0.000008810
		Elemental Total:	0.000008810

Orsat Analysis	**1**	**2**	**3**	**Average**
Carbon Dioxide:	13.70			13.70
Oxygen:	5.30			5.30

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	**Wisconsin Electric Power Company**
Date:	11/13/01
Test Run:	2
Stack or Duct No.:	Unit 2 North Outlet Duct
Start Time:	8:10
Stop Time:	10:31

Pb:	29.33	Inches Hg
Static	-17.00	Inches H2O
Ps:	28.08	Inches Hg Abs.
Vlc:	245	ml + grams
Mn:	0.0000	gm
Test Time:	126	minutes
% O2:	5.30	%
% CO2:	13.70	%
% N2:	81.00	%
Delta H:	1.34	Inches H20
Cp:	0.837	Dimensionless - pitot
Tm:	63.86	°F
Sqrt P:	0.767	Inches H20
Ts:	285.68	°F
Vm:	77.336	Cubic Feet
Dn:	0.245	Inches - nozzle
As:	180.00	Sq. Feet
Yd:	0.998	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	76.513	cubic feet (dry)
Vwstd:	11.549	cubic feet (wet)
Bwo:	0.131	
Md:	30.404	lb/lb-mole (dry)
Ms:	28.777	lb/lb-mole (wet)
Excess Air (%)	32.952	
Vs:	52.739	fps
ACFM:	569583.	
DSCFM:	328867.	
WSCFM:	378506	
%I:	101.6	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

ONTARIO HYDRO METHOD TEST SUPPORT DATA

PROJECT NO.: G014603 **TEST RUN NO.:** 3 **TEST DATE:** 11/13/01

CUSTOMER:	Wisconsin Electric Power Company	**BAROMETRIC PRESSURE (Pb)**	29.33	**in. Hg.**	
PLANT:	Pleasant Prairie Power Plant	**STATIC PRESSURE**	-17	**in. H2O**	
TEST LOC.:	Unit 2 North Outlet Duct	**FLUE PRESSURE (Ps)**	28.08	**in. Hg. abs.**	
CLIENT:	ADA Environmental Solutions, L.L.C.	**PROBE LENGTH:**	8.5	**ft.**	
OPERATOR:	G. Rock	**PROBE LINER MATERIAL:**	Teflon		
CONTROL BOX:	E-51	**NOZZLE IDENTIFICATION NO.:**	N/A		
METER NO.:	E-51	**CALIBRATED NOZZLE DIAMETER:**	0.245	**in.**	
METER CALIBRATION FACTOR:	0.998	**LEAK CHECK** **PRE:**	0.011	**POST:**	0.004 @ 12 in. Hg.
PITOT ID NO.:	287B	**DUCT SHAPE:** Circular / Rectangular	DIA. / 7.5 Feet		Feet / 24 Feet
PITOT TUBE COEFFICIENT:	0.837	**DUCT AREA:**	180	**sq. ft.**	
PORT LENGTH:	24 in.	**TEST LENGTH:**	126	**min.**	
PORT SIZE:	6 in.	**MINUTES PER POINT:**	4.5		
PORT TYPE:	Flange	**TOTAL NUMBER OF TRAVERSE POINTS:**	28		

ONTARIO HYDRO METHOD TRAVERSE DATA

Company Wisconsin Electric Power Company **Date:** 11/13/01 **Test Run** 3

Location: Unit 2 North Outlet Duct

Point	Δp	Sq. Root Δp	Time	Volume cubic feet	ΔH	Stack Temp °F	Meter Inlet °F	Meter Outlet °F	Vacuum in. Hg	
1-1	0.44	0.663	11:20	873.90	0.90	297	64	63	7	2.351
1-2	0.52	0.721	11:24	876.25	1.10	298	66	63	8	2.430
1-3	0.60	0.775	11:29	878.68	1.50	299	69	63	8	2.930
1-4	0.43	0.656	11:33	881.61	0.95	299	70	64	7	2.390
			11:38	884.00						0.000
2-1	0.53	0.728	11:41	884.98	1.10	296	70	64	8	2.658
2-2	0.71	0.843	11:45	887.64	1.60	299	72	64	9	3.050
2-3	0.72	0.849	11:50	890.69	1.60	300	73	65	9	3.000
2-4	0.55	0.742	11:54	893.69	1.30	300	73	65	9	2.860
			11:59	896.55						0.000
3-1	0.52	0.721	12:02	897.37	1.10	299	70	65	8	2.554
3-2	0.64	0.800	12:06	899.92	1.50	300	72	65	9	2.920
3-3	0.49	0.700	12:11	902.84	1.10	300	72	65	8	2.620
3-4	0.50	0.707	12:15	905.46	1.00	299	72	65	7	2.420
			12:20	907.88						0.000
4-1	0.70	0.837	12:28	909.81	1.50	298	70	66	8	2.797
4-2	0.70	0.837	12:32	912.61	1.60	299	72	66	9	3.040
4-3	0.60	0.775	12:37	915.65	1.60	297	73	66	9	3.060
4-4	0.63	0.794	12:41	918.71	1.50	297	74	66	9	2.960
			12:46	921.67						0.000
5-1	0.65	0.806	12:49	922.39	1.50	293	72	66	9	2.857
5-2	0.58	0.762	12:53	925.25	1.30	292	73	66	9	2.848
5-3	0.66	0.812	12:58	928.10	1.50	290	73	66	9	2.872
5-4	0.70	0.837	13:02	930.97	1.60	287	73	66	9	2.995
			13:07	933.97						0.000
6-1	0.60	0.775	13:09	934.61	1.30	282	72	66	8	2.815
6-2	0.65	0.806	13:13	937.42	1.50	281	72	66	9	2.930
6-3	0.58	0.762	13:18	940.35	1.30	280	72	66	9	2.800
6-4	0.49	0.700	13:22	943.15	1.00	278	71	66	8	2.550
			13:27	945.70						0.000
7-1	0.50	0.707	13:29	946.20	1.00	282	70	65	7	2.455
7-2	0.66	0.812	13:33	948.65	1.60	282	71	65	9	2.970
7-3	0.71	0.843	13:38	951.62	1.60	280	70	65	9	3.060
7-4	0.59	0.768	13:42	954.68	1.30	278	71	65	9	2.550
			13:47	957.23						0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
										0.000
		0.769		77.742	1.34	292	71	65		#####
							68.13			

MOISTURE, DILUENT AND MERCURY DATA

Company Wisconsin Electric Power Compa **Date:** 11/13/01 **Test Run:** 3

Location: Unit 2 North Outlet Duct

SILICA GEL FINAL WT.:	724.60	**grams**
SILICA GEL INITIAL WT.:	709.50	**grams**
DIFFERENCE:	15.10	
FINAL IMPINGER WATER:	4983.60	**mls.**
INITIAL IMPINGER WATER:	4748.90	**mls.**
DIFFERENCE:	234.70	
TOTAL WATER GAIN:	249.80	

ITEM	MERCURY (UG)		= NET WT. (G)
FILTER:	0.000		0.000000000
PROBE WASH:	0.000		0.000000000
		Particle-bound Total:	0.000000000
KCl:	1.340		0.000001340
		Oxidized Total:	0.000001340
HNO_3/H_2O_2:	0.000		0.000000000
$KMNO_4$:	9.030		0.000009030
		Elemental Total:	0.000009030

Orsat Analysis	1	2	3	Average
Carbon Dioxide:	13.70			13.70
Oxygen:	5.20			5.20

ONTARIO HYDRO METHOD DATA ENTRY FORM

Field Data/Calculated Data

Company:	Wisconsin Electric Power Company
Date:	11/13/01
Test Run:	3
Stack or Duct No.:	Unit 2 North Outlet Duct
Start Time:	11:20
Stop Time:	13:47

Pb:	29.33	Inches Hg
Static	-17.00	Inches H2O
Ps:	28.08	Inches Hg Abs.
Vlc:	250	ml + grams
Mn:	0.0000	gm
Test Time:	126	minutes
% O2:	5.20	%
% CO2:	13.70	%
% N2:	81.10	%
Delta H:	1.34	Inches H20
Cp:	0.837	Dimensionless - pitot
Tm:	68.13	°F
Sqrt P:	0.769	Inches H20
Ts:	292.21	°F
Vm:	77.742	Cubic Feet
Dn:	0.245	Inches - nozzle
As:	180.00	Sq. Feet
Yd:	0.998	Mcf
CF:	N/A	Process tons/hr
Heat Input:	N/A	MM BTU/hr
Fd:	N/A	dscf/10^6 Btu
Fc:	N/A	scf/10^6 Btu

Vmstd:	76.293	cubic feet (dry)
Vwstd:	11.766	cubic feet (wet)
Bwo:	0.134	
Md:	30.400	lb/lb-mole (dry)
Ms:	28.743	lb/lb-mole (wet)
Excess Air (%)	32.078	
Vs:	53.129	fps
ACFM:	573792.	
DSCFM:	327487.	
WSCFM:	377990	
%I:	101.7	isokinetic variance
GR/ACF:	---	
GR/DSCF:	---	
lbs/hr	---	
lbs/ton prod.:	N/A	
lbs/MM BTU:	N/A	Heat Input
lbs/MM BTU:	N/A	O2 Basis
lbs/MM BTU:	N/A	CO2 Basis

APPENDIX E
PART 2

ATTACHMENT E
SAMPLING LOG AND
CHAIN OF CUSTODY RECORDS

GE-Mostardi Platt

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: G013706		Date Results Required:	
Client: ADA		TAT Required:	
Plant/Location: Pleasant Prarie, WI	LAB Use Only	PO Number: 30088	
Project Supervisor: DSB		LIMS Entry:	

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
001	9/10/01	INLET, TEST 1, FILTER FH Rinse	2		MERCURY By Ontario Hydro Method	
002	9/11/01	↓ TEST 2 ↓	2		↓	
003	9/11/01	↓ TEST 3 ↓	2			
004	9/10/01	INLET, TEST 1, IMPS 1,2,3 (KCl)	2			
005	9/11/01	↓ TEST 2 ↓	2			
006	9/11/01	↓ TEST 3 ↓	2			
007	9/10/01	INLET, TEST 1, IMP 4 (HNO$_3$-H$_2$O$_2$)	1			
008	9/11/01	↓ TEST 2 ↓	1			
009	9/11/01	↓ TEST 2 ↓	1			
010	9/10/01	INLET, TEST 1, IMPS 5,6,7 (H$_2$SO$_4$-KMnO$_4$)	1			
011	9/11/01	↓ TEST 2 ↓	1			
012	9/11/01	↓ TEST 3 ↓	1			
013	9/10/01	OUTLET, TEST 1, FILTER FH Rinse	2			
014	9/11/01	↓ TEST 2 ↓	2			
015	9/11/01	↓ TEST 3 ↓	2			
016	9/10/01	OUTLET, TEST 1, IMPS 1,2,3 (KCl)	2		↓	

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
John Wandler	09/11/01	John Wandler	09/13/01 9-14-01 1130	[signature]

Special Instructions:

GE-Mostardi Platt

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: G013706		Date Results Required:	
Client:		TAT Required:	
Plant/Location:	LAB Use Only	PO Number:	
Project Supervisor:		LIMS Entry:	

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
017	9/11/01	OUTLET, TEST2, IMPS 1,2,3 (KCl)	2		MERCURY By Ontario Hydro Method	
018	9/11/01	↓ TEST3 ↓	2		↓	
019	9/10/01	OUTLET, TEST 1, IMP 4 (HNO_3-H_2O_2)	1			
020	9/11/01	↓ TEST2 ↓	1			
021	9/11/01	↓ TEST3 ↓	1			
022	9/10/01	OUTLET, TEST 1, IMPS 5,6,7 (H_2SO_4-$KMnO_4$)	1			
023	9/11/01	↓ TEST 2 ↓	1			
024	9/11/01	↓ TEST3 ↓	1			
025	9/10/01	INLET, FIELD BLANK, IMPS 1,2,3 (KCl)	1			
026	9/10/01	↓ ↓ IMP 4 (HNO_3-H_2O_2)	1			
027	9/10/01	↓ ↓ IMPS 5,6,7 (H_2SO_4-$KMnO_4$)	1			
028	9/10/01	OUTLET, FIELD BLANK, IMPS 1,2,3 (KCl)	1			
029	9/10/01	↓ ↓ IMP 4 (HNO_3-H_2O_2)	1			
030	9/10/01	↓ ↓ IMPS 5,6,7 (H_2SO_4-$KMnO_4$)	1			
031	9/11/01	BLANK: QUARTZ THIMBLE (#031)				
032	9/11/01	↓ ↓ (#032)			↓	

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
			9-14-01/1315	J. O'Neill

Special Instructions:

GE-Mostardi Platt

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: G013706	Date Results Required:
Client:	TAT Required:
Plant/Location:	LAB Use Only — PO Number:
Project Supervisor:	LIMS Entry:

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
033	9/11/01	BLANK: QUARTZ THIMBLE (#033)	1		MERCURY By Ontario Hydro Method	
034	9/10/01	BLANKS: 50mL 0.1N HNO_3	1		↓	
035	9/10/01	50mL 1N KCl	1		↓	
036	9/10/01	50mL HNO_3-H_2O_2	1		↓	
037	9/10/01	50mL H_2SO_4-$KMnO_4$	1		↓	
038	9/11/01	50mL H_2SO_4-$KMnO_4$	1		↓	
039	9/10/01	100mL 10% Hydroxylamine	1		↓	
040						
041						
042						
043						
044						
045						
046						
047						
048						

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
			9-14-01/1515	J O'Neill

Special Instructions:

GE-Mostardi Platt

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: G014603		Date Results Required:	
Client: ADA		TAT Required:	
Plant/Location: Pleasant Prarie, WI (WEPCO) UNIT 2	LAB Use Only	PO Number: 30274	
Project Supervisor: DSB		LIMS Entry:	

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
001	11/12/01	INLET, TEST 1, Filter + Nitric Rinse	2		MERCURY By Ontario Hydro Method	
002	11/13/01	↓ TEST 2 ↓	2		↓	
003	11/13/01	↓ TEST 3 ↓	2			
004	11/12/01	INLET, TEST 1, IMPS 1,2,3 KCl	2			
005	11/13/01	↓ TEST 2 ↓	2			
006	11/13/01	↓ TEST 3 ↓	2			
007	11/12/01	INLET, TEST 1, IMP 4 HNO_3/H_2O_2	1			
008	11/13/01	↓ TEST 2 ↓	1			
009	11/13/01	↓ TEST 3 ↓	1			
010	11/12/01	INLET, TEST 1, IMPS 5,6,7 H_2SO_4-$KMnO_4$	1			
011	11/13/01	↓ TEST 2 ↓	1			
012	11/13/01	↓ TEST 3 ↓	1			
013	11/12/01	OUTLET, TEST 1, Filter + Nitric Rinse	2			
014	11/13/01	↓ TEST 2 ↓	2			
015	11/13/01	↓ TEST 3 ↓	2			
016	11/12/01	OUTLET, TEST 1, IMPS 1,2,3 KCl	2		↓	

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:

Special Instructions:

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: G014603	Date Results Required:
Client: ADA	TAT Required:
Plant/Location: Pleasant Prarie, WI (WEPCO) UNIT 2	LAB Use Only — PO Number:
Project Supervisor: DSB	LIMS Entry:

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
017	11/13/01	OUTLET, TEST 2, IMPS 1,2,3 KCl	2		MERCURY By Ontario Hydro Method	
018	11/13/01	↓ TEST 3 ↓	2		↓	
019	11/12/01	OUTLET, TEST 1, IMP 4 HNO_3-H_2O_2	1			
020	11/13/01	↓ TEST 2 ↓	1			
021	11/13/01	↓ TEST 3 ↓	1			
022	11/12/01	OUTLET, TEST 1, IMPS 5,6,7 H_2SO_4-$KMnO_4$	1			
023	11/13/01	↓ TEST 2 ↓	1			
024	11/13/01	↓ TEST 3 ↓	1			
025	11/12/01	INLET, FIELD BLANK, IMPS 1,2,3 KCl	1			
026	↓	↓ ↓ IMP 4 HNO_3-H_2O_2	1			
027	↓	↓ ↓ IMPS 5,6,7 H_2SO_4-$KMnO_4$	1			
028	11/12/01	OUTLET, FIELD BLANK, IMPS 1,2,3 KCl	1			
029	↓	↓ ↓ IMP 4 HNO_3-H_2O_2	1			
030	↓	↓ ↓ IMPS 5,6,7 H_2SO_4-$KMnO_4$	1			
031	11/12/01	BLANK: Filters #'s: 179, 183, 184	3			
032	11/12/01	BLANK: 0.1N Nitric Acid	1		↓	

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:

Special Instructions:

GE-Mostardi Platt

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CHAIN-OF-CUSTODY RECORD

Project Number: G014603	Date Results Required:		
Client: ADA	TAT Required:		
Plant/Location: Pleasant Prarie, WI (WEPCO) UNIT 2	LAB Use Only	PO Number:	
Project Supervisor: DSB		LIMS Entry:	

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
033	11/12/01	BLANK: IN KCl	1		MERCURY By Ontario Hydro Method	
034	11/12/01	↓ HNO_3/H_2O_2	1		↓	
035	11/12/01	↓ H_2SO_4-$KMnO_4$	1		↓	
036	11/13/01	↓ H_2SO_4-$KMnO_4$	1		↓	
037	11/12/01	↓ Hydroxylamine	1		↓	
038	11/12/01	Outlet, Test 1, impactor	2		M5/cascade impactor	
039	11/13/01	Outlet, Test 2, impactor	2		↓	
040						
041						
042						
043						
044						
045						
046						
047						
048						

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
		J.W. 11.19.01		

Special Instructions:

APPENDIX E
PART 2

ATTACHMENT F
ANALYTICAL DATA SHEETS

LABORATORY REPORT

TEI Analytical, Inc.
7177 N. Austin
Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Frank Jarke
GE Mostardi Platt
945 Oaklawn Avenue
Elmhurst, IL 60126

Report #: 52543
Report Date: 10/5/01
Sample Received:
9/14/01 13:15

G013706

TEI Number	Sample	Mercury (Ontario Method) Total ug (except as noted)	Date Performed
52543	001 Filter (12.1269g)	0.276 mg/kg	9/27/01
52544	002 Filter (14.1179g)	0.429 mg/kg	9/27/01
52545	003 Filter (9.4973g)	0.254 mg/kg	9/27/01
52546	001 Rinse	<0.003	9/26/01
52547	002 Rinse	<0.003	9/26/01
52548	003 Rinse	<0.003	9/26/01
52549	004 KCl	4.80	9/26/01
52550	005 KCl	4.91	9/26/01
52551	006 KCl	5.15	9/26/01
52552	007 HNO3, H2O2	0.598	9/27/01
52553	008 HNO3, H2O2	0.484	9/27/01
52554	009 HNO3, H2O2	0.297	9/27/01
52555	010 H2SO4, KMnO4	23.5	10/5/01
52556	011 H2SO4, KMnO4	25.8	10/5/01
52557	012 H2SO4, KMnO4	21.8	10/5/01
52558	013 Filter (3.1847g)	<0.003 mg/kg	9/27/01
52559	014 Filter (3.0876g)	0.039 mg/kg	9/27/01
52560	015 Filter (3.1847g)	0.026 mg/kg	9/27/01
52561	013 Rinse	<0.003	9/26/01
52562	014 Rinse	<0.003	9/26/01

G. E. O'Neill

Gayle E. O'Neill, Ph.D.

LABORATORY REPORT

TEI Analytical, Inc.
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Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Frank Jarke
GE Mostardi Platt
945 Oaklawn Avenue
Elmhurst, IL 60126

Report #: 52543
Report Date: 10/5/01
Sample Received:
9/14/01 13:15

G013706

TEI Number	Sample	Mercury (Ontario Method) Total ug (except as noted)	Date Performed
52563	015 Rinse	<0.003	9/26/01
52564	016 KCl	15.7	9/26/01
52565	017 KCl	10.3	9/26/01
52566	018 KCl	10.3	9/26/01
52567	019 HNO3, H2O2	0.429	9/27/01
52568	020 HNO3, H2O2	0.672	9/27/01
52569	021 HNO3, H2O2	0.574	9/27/01
52570	022 H2SO4, KMnO4	17.7	10/5/01
52571	023 H2SO4, KMnO4	20.3	10/5/01
52572	024 H2SO4, KMnO4	19.6	10/5/01
52573	025 KCl	<0.03	9/26/01
52574	026 HNO3, H2O2	0.169	9/27/01
52575	027 H2SO4, KMnO4	<0.003	10/5/01
52576	028 KCl	<0.03	9/26/01
52577	029 HNO3, H2O2	0.183	9/27/01
52578	030 H2SO4, KMnO4	<0.003	10/5/01
52579	031 Thimble (3.1230g)	0.006 mg/kg	9/27/01
52580	032 Thimble (3.0969g)	0.010 mg/kg	9/27/01
52581	033 Thimble (3.1768g)	0.011 mg/kg	9/27/01
52582	034 HNO3	<0.003	9/27/01

Gayle E. O'Neill, Ph.D.

LABORATORY REPORT

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7177 N. Austin
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847-647-1345

PREPARED FOR:

Frank Jarke
GE Mostardi Platt
945 Oaklawn Avenue
Elmhurst, IL 60126

Report #: 52543
Report Date: 10/5/01
Sample Received:
9/14/01 13:15

G013706

TEI Number	Sample	Mercury (Ontario Method) Total ug (except as noted)	Date Performed
52583	035 KCl	<0.03	9/26/01
52584	036 HNO3, H2O2	0.018	9/27/01
52585	037 H2SO4, KMnO4	<0.003	10/5/01
52586	038 H2SO4, KMnO4	<0.003	10/5/01
52587	039 Hydroxylamine	<0.003	9/27/01

Gayle E. O'Neill, Ph.D.

LABORATORY REPORT

TE. Analytical, Inc.
7177 N. Austin
Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Frank Jarke
GE Mostardi Platt
888 Industrial Dr.
Elmhurst, IL 60126

Report #: 54195
Report Date: 12/10/2001
Sample Received:
11/15/01 15:35

G014603

TEI Number	Sample	Mercury (Ontario Method) Total ug except as noted	Date Performed
54195	001 Filter (0.1510 g)	0.411 mg/kg	12/8/2001
54196	002 Filter ([illegible])	0.042 mg/kg	12/8/2001
54197	003 Filter (9.7785 g)	0.110 mg/kg	12/8/2001
54198	004	3.99	12/2/2001
54199	005	2.70	12/2/2001
54200	006	2.74	12/2/2001
54201	007	0.11	12/2/2001
54202	008	0.04	12/2/2001
54203	009	0.41	12/2/2001
54204	010	18.9	12/8/2001
54205	011	30.4	12/8/2001
54206	012	30.8	12/8/2001
54207	013 Filter (3.3077 g)	<0.003 mg/kg	12/8/2001
54208	014 Filter (3.596 g)	<0.003 mg/kg	12/8/2001
54209	015 Filter ([illegible] g)	<0.003 mg/kg	12/8/2001
54210	016	0.09	12/2/2001
54211	017	1.22	12/2/2001
54212	018	1.34	12/2/2001
54213	019	<0.03	12/2/2001
54214	020	<0.03	12/2/2001

G. E. O'Neill

Gayle E. O'Neill, Ph.D.

LABORATORY REPORT

TEI Analytical, Inc.
7177 N. Austin
Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Frank Jarke
GE Mostardi Platt
888 Industrial Dr.
Elmhurst, IL 60126

Report #: 54195
Report Date: 12/10/2001
Sample Received:
11/15/01 15:35

G014603

TEI Number	Sample	Mercury (Ontario Method) Total ug except as noted	Date Performed
54215	021	<0.03	12/2/2001
54216	022	7.92	12/8/2001
54217	023	8.82	12/8/2001
54218	024	9.04	12/8/2001
54219	025	<0.03	12/2/2001
54220	026	<0.03	12/2/2001
54221	027	0.195	12/8/2001
54222	028	<0.03	12/2/2001
54223	029	<0.03	12/2/2001
54224	030	0.083	12/8/2001
54225	031	<0.003 mg/kg	12/8/2001
54226	032	<0.003	12/8/2001
54227	033	<0.02	12/2/2001
54228	034	0.17	12/2/2001
54229	035	0.007	12/10/2001
54230	036	<0.003	12/8/2001
54231	037	<0.003	12/8/2001
54232	001 Rinse	0.034	12/8/2001
54233	002 Rinse	<0.003	12/8/2001
54234	003 Rinse	0.005	12/8/2001

G. E. O'Neill

Gayle E. O'Neill, Ph.D.

LABORATORY REPORT

TEI Analytical, Inc.
7177 N. Austin
Niles, IL 60714-4617
847-647-1345

PREPARED FOR:

Frank Jarke
GE Mostardi Platt
888 Industrial Dr.
Elmhurst, IL 60126

Report #: 54195
Report Date: 12/10/2001
Sample Received:
11/15/01 15:35

G014603

TEI Number	Sample	Mercury (Ontario Method) Total ug except as noted	Date Performed
54235	013 Rinse	<0.003	12/8/2001
54236	014 Rinse	<0.003	12/8/2001
54237	015 Rinse	<0.003	12/8/2001

g. e. O'Neill

Gayle E. O'Neill, Ph.D.

PLEASANT PRAIRIE COAL SAMPLES

ADA-ES#: PP400004
MTI #: 01-225
Sampled: 9/10/2001
Description: Coal, Unit 2-4

Analyte	As-received	Dry basis
Hg	---	0.145 μg/g
Cl	---	10.62 μg/g
Proximate:		
Total moisture	31.73 wt%	---
Ash	5.00 wt%	7.32 wt%
Total sulfur	0.34 wt%	0.50 wt%
Heating value	8237 BTU/lb	12065 BTU/lb
Volatile matter	29.45 wt%	43.14 wt%
Fixed carbon	33.82 wt%	49.54 wt%
Ultimate:		
Total moisture	31.73 wt%	---
Ash	5.00 wt%	7.32 wt%
Total sulfur	0.34 wt%	0.50 wt%
Carbon	47.05 wt%	68.92 wt%
Hydrogen	6.98 wt%	5.02 wt%
Nitrogen	0.68 wt%	1.00 wt%
Oxygen (by difference)	39.95 wt%	17.24 wt%

ADA-ES#: PP400034
MTI #: 01-226
Sampled: 9/11/2001
Description: Coal, Unit 2-4

Analyte	As-received	Dry basis
Hg	---	0.145 μg/g
Cl	---	12.26 μg/g
Proximate:		
Total moisture	31.68 wt%	---
Ash	5.07 wt%	7.42 wt%
Total sulfur	0.31 wt%	0.45 wt%
Heating value	8248 BTU/lb	12072 BTU/lb
Volatile matter	29.46 wt%	43.12 wt%
Fixed carbon	33.79 wt%	49.46 wt%
Ultimate:		
Total moisture	31.68 wt%	---
Ash	5.07 wt%	7.42 wt%
Total sulfur	0.31 wt%	0.45 wt%
Carbon	46.97 wt%	68.75 wt%
Hydrogen	6.83 wt%	4.81 wt%
Nitrogen	0.67 wt%	0.98 wt%
Oxygen (by difference)	40.15 wt%	17.59 wt%

ADA.ES COAL SAMPLES

ADA-ES#: PP400179
MTI #: 02-051
Sampled: 11/12/01
Description: Unit 2 Coal, Mill 2-3

Analyte	As-received	Dry basis
Proximate:		
Total moisture	29.79 wt%	---
Ash	5.54 wt%	7.89 wt%
Total sulfur	0.34 wt%	0.48 wt%
Heating value	8285 BTU/lb	11801 BTU/lb
Volatile matter	29.37 wt%	41.83 wt%
Fixed carbon	35.30 wt%	50.28 wt%
Ultimate:		
Total moisture	29.79 wt%	---
Ash	5.54 wt%	7.89 wt%
Total sulfur	0.34 wt%	0.48 wt%
Carbon	48.79 wt%	69.49 wt%
Hydrogen	6.91 wt%	5.09 wt%
Nitrogen	0.76 wt%	1.08 wt%
Oxygen (by difference)	37.66 wt%	15.96 wt%

ADA-ES#: PP400210
MTI #: 02-052
Sampled: 11/13/01
Description: Unit 2 Coal, Mill 2-3

Analyte	As-received	Dry basis
Proximate:		
Total moisture	30.02 wt%	---
Ash	5.28 wt%	7.55 wt%
Total sulfur	0.34 wt%	0.49 wt%
Heating value	8370 BTU/lb	11961 BTU/lb
Volatile matter	29.86 wt%	42.67 wt%
Fixed carbon	34.84 wt%	49.78 wt%
Ultimate:		
Total moisture	30.02 wt%	---
Ash	5.28 wt%	7.55 wt%
Total sulfur	0.34 wt%	0.49 wt%
Carbon	48.84 wt%	69.79 wt%
Hydrogen	7.32 wt%	5.66 wt%
Nitrogen	0.74 wt%	1.06 wt%
Oxygen (by difference)	37.48 wt%	15.46 wt%

ADA Sample	PP400004	PP400034	PP400253	PP400254	PP400170	PP400210	PP400255	PP400147	PP400148	PP400148	PP400151
MTI Sample	01-225	01-226	01-231	01-232	02-051	02-052	01-233	01-227	01-228	01-229	01-230
Date/Time	09/10/01	09/11/01	11/02/01	11/08/01	11/12/01	11/13/01	11/14/01	11/08/01	11/08/01	11/08/01	11/08/01
ULTIMATE ANALYSIS (As Received):											
Carbon	47.1	47.0	48.0	48.7	48.8	48.8	48.5				
Hydrogen	3.4	3.3	3.0	3.3	3.6	4.0	3.3				
Oxygen	11.8	12.0	12.3	11.9	11.2	10.8	12.4				
Nitrogen	0.7	0.7	0.7	0.7	0.8	0.7	0.7				
Sulfur	0.3	0.3	0.4	0.3	0.3	0.3	0.3				
Ash	5.0	5.1	4.8	5.4	5.5	5.3	5.3				
Moisture	31.7	31.7	30.8	29.8	29.8	30.0	29.5				
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0				
Hg, ug/g	0.099	0.099	0.098	0.117	0.099	0.101	0.131				
Cl, ug/g	7.3	8.4	7.6	0.0			8.8				
HHV	8,237	8,248	8,428	8,469	8,285	8,370	8,543	8,489	8,428	8,525	8,404
SO2, lb/MBtu	0.83	0.75	0.84	0.66	0.81	0.82	0.79				
Ash, lb/MBtu	6.07	6.15	5.64	6.41	6.69	6.31	6.17				
Hg, lb/TBtu	12.02	12.01	11.65	13.77	11.95	12.12	15.28				
Hg, ug/dnm3 (3%O2)	16.70	16.99	16.72	18.37	16.00	15.99	21.72				
PROXIMATE ANALYSIS (As Received):											
Fixed Carbon	33.8	33.8	34.2	33.3	35.3	34.8	34.4	34.8	34.9	34.6	34.7
Volatile matter	29.5	29.5	30.2	31.6	29.4	29.9	30.9	30.8	29.9	30.7	30.0
Ash	5.0	5.1	4.8	5.4	5.5	5.3	5.3	4.9	5.5	5.0	5.3
Moisture	31.7	31.7	30.8	29.8	29.8	30.0	29.5	29.4	29.7	29.7	30.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

ADA Sample	PP400004	PP400034	PP400253	PP400254	PP400170	PP400210	PP400255	PP400147	PP400148	PP400148	PP400151
MTI Sample	01-225	01-226	01-231	01-232	02-051	02-052	01-233	01-227	01-228	01-229	01-230
Date/Time	9/10/01	9/11/01	11/2/01	11/8/01	11/12/01	37208	37209	37203	37203	37203	37203
ULTIMATE ANALYSIS (Dry):											
Carbon	68.92	68.75	69.4	69.32	69.49	69.79	68.76				
Hydrogen	5.02	4.81	4.32	4.64	5.09	5.66	4.64				
Oxygen	17.24	17.59	17.84	16.91	15.96	15.46	17.64				
Nitrogen	1	0.98	1.06	1	1.08	1.06	1.01				
Sulfur	0.5	0.45	0.51	0.4	0.48	0.49	0.48				
Ash	7.32	7.42	6.87	7.73	7.89	7.55	7.47				
Moisture											
Total	100	100	100	100	99.99	100.01	100				
Hg, ug/g	0.145	0.145	0.142	0.166	0.141	0.145	0.185				
Cl, ug/g	10.62	12.26	11.04	12.03			12.46				
HHV	12065	12072	12186	12057	11801	11961	12109	12029	11988	12119	12009
PROXIMATE ANALYSIS (Dry):											
Fixed Carbon	49.54	49.46	49.41	47.36	50.28	49.78	48.76	49.37	49.62	49.25	49.6
Volatile matter	43.14	43.12	43.72	44.92	41.83	42.67	43.77	43.63	42.55	43.6	42.84
Ash	7.32	7.42	6.87	7.73	7.89	7.55	7.47	7	7.84	7.15	7.56
Moisture											
Total	100	100	100	100.01	100	100	100	100	100.01	100	100

APPENDIX F

WASTE CHARACTERIZATION AND COAL ANALYSES

The second test was conducted at Wisconsin Electric's Pleasant Prairie Power Plant, Unit 2 during fall of 2001. This site was of key interest because it was the only plant included in the DOE/NETL program that burned western sub-bituminous coal. The particulate control device (PCD) was an ESP, which represents the PCD of choice at over 90% of the nation's coal-fired utility boilers. Other features of this test site include:

- The ability to isolate one ESP treating one-quarter of the unit or about 150 MW.
- The challenge of implementing mercury control at a site where baseline mercury measurements in 1999 showed no significant mercury removal across the PCD and the mercury in the gas-phase is dominated by elemental mercury.
- A duct configuration with long, unobstructed runs that allows adequate space for the installation of water injection lances upstream of the sorbent injection lances so that the effects of spray cooling (to achieve lower flue gas temperatures) on mercury control could be evaluated.
- A high quality, Class C fly ash product that is sold for use in concrete.

Following baseline testing in September, the long-term tests at Pleasant Prairie were run in November, divided into three five-day periods of continuous injection at a rates of approximately1 lb/MMacf, 3 lb/MMacf , and 10 lb/MMacf . The average mercury removal efficiencies for the three injection rates were 40-50%, 50-60%, and 60-70%, respectively. Increasing injection concentration above 10 lb/Mmacf did not increase mercury removal. PAC-injection effectively removed both elemental and oxidized mercury from the gas phase. PAC did not have any significant impact on ESP performance. Some measures of fly ash quality were affected by the sorbent injection.

Table 1 summarizes the analysis carried out on the solid samples collected during this campaign. Ontario Hydro results have been reported separately and will only be referenced in passing here. All measurements were carried out under the direction of Microbeam Technologies except the leaching analyses, which were supervised by Dave Hassett at the University of North Dakota EERC.

Table 1. Analyses carried out on Pleasant Prairie long-term testing samples

Sample ID	Date	Sample Type	Location	Analyses	Test Condition
PP400004	9/10/2001	Coal	2-4	Ult, Prox, Hg, Cl	Baseline
PP400008	9/10/2001	Front Ash	7-3	Hg, LOI	Baseline
PP400011	9/10/2001	Back Ash	8-2	Hg, LOI	Baseline
PP400023	9/11/2001	Front Ash	7-3	Hg, LOI	Baseline
PP400026	9/11/2001	Back Ash	8-2	Hg, LOI	Baseline
PP400034	9/11/2001	Coal	2-4	Ult, Prox, Hg, Cl	Baseline
PP400147	11/8/2001	Coal	2-2	Prox	3 lbs/Mmacf
PP400148	11/8/2001	Coal	2-1	Prox	3 lbs/Mmacf
PP400149	11/8/2001	Coal	2-3	Prox	3 lbs/Mmacf
PP400151	11/8/2001	Coal	2-4	Prox	3 lbs/Mmacf
PP400247	11/14/2001	Front Ash	Composite	Hg, LOI, leaching	10 lbs/Mmacf
PP400248	11/8/2001	Front Ash	7-3	Hg, LOI	3 lbs/Mmacf
PP400249	11/14/2001	Back Ash	Composite	Hg, LOI, leaching	10 lbs/Mmacf
PP400250	11/2/2001	Front Ash	7-4	Hg, LOI	1 lbs/Mmacf
PP400251	11/3/2001	Back Ash	Composite	Hg, LOI	1 lbs/Mmacf
PP400252	11/8/2001	Back Ash	Composite	Hg, LOI	3 lbs/Mmacf
PP400253	11/2/2001	Coal	Composite	Ult, Prox, Hg, Cl	1 lbs/Mmacf
PP400254	11/8/2001	Coal	Composite	Ult, Prox, Hg, Cl	3 lbs/Mmacf
PP400255	11/14/2001	Coal	Composite	Ult, Prox, Hg, Cl	10 lbs/Mmacf

Coal Analyses

Table 2 gives the coal analyses for the baseline testing. The plant burns a western sub-bituminous coal with low chlorine and fairly high mercury content. The Ontario Hydro measurements of total mercury at the inlet to the ESP on 9/11 and 11/13 were from 15.5 to 17.5 μg/dscm. These compared favorably with the mercury analysis of the coal, as shown in Table 3.

Table 2. Coal Analyses from Pleasant Prairie testing.

ADA Sample	PP400004	PP400034	PP400253	PP400254	PP400170	PP400210	PP400255
MTI Sample	01-225	01-226	01-231	01-232	02-051	02-052	01-233
Date/Time	9/10/2001 0:00	9/11/2001 0:00	11/2/2001 0:00	11/8/2001 0:00	11/12/2001 0:00	11/13/2001 0:00	11/14/2001 0:00
ULTIMATE ANALYSIS (As Received):							
Carbon	47.05	46.97	48.00	48.69	48.79	48.84	48.51
Hydrogen	3.43	3.29	2.99	3.26	3.57	3.96	3.27
Oxygen	11.77	12.02	12.34	11.88	11.21	10.82	12.45
Nitrogen	0.68	0.67	0.73	0.70	0.76	0.74	0.71
Sulfur	0.34	0.31	0.35	0.28	0.34	0.34	0.34
Ash	5.00	5.07	4.75	5.43	5.54	5.28	5.27
Moisture	31.73	31.68	30.84	29.76	29.79	30.02	29.45
Hg, μg/g	0.099	0.099	0.098	0.117	0.099	0.101	0.131
Cl, μg/g	7.25	8.38	7.64	8.45			8.79
HHV, Btu/lb	8,237	8,248	8,428	8,469	8,285	8,370	8,543
SO_2, lb/MMBtu	0.83	0.75	0.84	0.66	0.81	0.82	0.79
Ash, lb/MMBtu	6.07	6.15	5.64	6.41	6.69	6.31	6.17
Hg, lb/TBtu	12.02	12.01	11.65	13.77	11.95	12.12	15.28
PROXIMATE ANALYSIS (As Received):							
Fixed Carbon	33.82	33.79	34.17	33.26	35.3	34.84	34.4
Volatile matter	29.45	29.46	30.24	31.55	29.37	29.86	30.88
Ash	5.00	5.07	4.75	5.43	5.54	5.28	5.27
Moisture	31.73	31.68	30.84	29.76	29.79	30.02	29.45

Table 3. Total mercury in flue gas at ESP inlet: comparison of Ontario Hydro measurement and calculation from coal composition

ADA Coal Sample	PP400004	PP400034	PP400253	PP400254	PP400170	PP400210	PP400255
MTI Coal Sample	01-225	01-226	01-231	01-232	02-051	02-052	01-233
Date	10-Sep-01	11-Sep-01	2-Nov-01	8-Nov-01	12-Nov-01	13-Nov-01	14-Nov-01
Coal Analysis	16.69	16.92	16.83	18.25	15.94	15.88	21.76
OH (ESP In)		15.55				17.44	

Ash Composition

The sorbent was injected upstream of the ESP. The injection rates ranged from 1 to 10 lb/MMacf. However, leaching tests were performed only on the ash collected from the highest injection rate.

Figure 1 shows the gas-phase mercury measured at Pleasant Prairie using the S-CEM. This technique does not measure particulate-bound mercury, but baseline Ontario Hydro measurements showed that only 10-15% of the mercury was particulate-bound at the ESP inlet.

LOI and mercury measurements were made for ash samples from the front and back hoppers at Pleasant Prairie. Table 4 gives those values as measured by MTI and Table 5 gives measured values on other ash samples taken during the testing and analyzed by Wisconsin Electric.

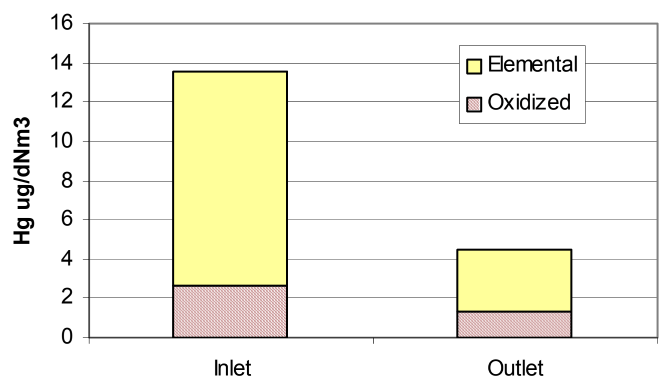


Figure 1. Mercury in flue gas (gas-phase only) at Pleasant Prairie during long-term PAC testing at 10 lb/MMacf injection rate as measured by S-CEM.

Table 4. Mercury and LOI contents of ash samples (MTI).

Sample ID	MTI ID	Date	Sample Type	Location	Hg, ug/g (AR)	LOI, wt%	Inj.Rate lb/Macf	Hg removal
PP400008	01-221	9/10/2001	Front Ash	7-3	0.159	0.58%	0	
PP400011	01-222	9/10/2001	Back Ash	8-2	0.197	0.47%	0	
PP400023	01-223	9/11/2001	Front Ash	7-3	0.0951	0.32%	0	
PP400026	01-224	9/11/2001	Back Ash	8-2	0.131	0.50%	0	
PP400250	01-218	11/2/2001	Front Ash	7-4	1.12	1.40%	1.8	48
PP400251	01-219	11/3/2001	Back Ash	Composite	0.598	0.66%	1.8	48
PP400248	01-216	11/8/2001	Front Ash	7-3	1.15	1.28%	3.9	54
PP400252	01-220	11/8/2001	Back Ash	Composite	3.23	1.50%	3.9	54
PP400247	01-215	11/14/2001	Front Ash	Composite	5.5	2.51%	10.3	65
PP400249	01-217	11/14/2001	Back Ash	Composite	4.73	3.50%	10.3	65

Table 5. Mercury and LOI contents of ash samples (WEPCo)

Sample ID	Pail	Date	Sample Type	Location	Hg, ug/g (AR)	LOI, wt%	Inj.Rate lb/Macf
ACO7418	400222	11/14/2001	Front Ash	7-2	0.84	2.50%	10.3
ACO7417	400204	11/13/2001	Front Ash	7-3	1.00	3.40%	10.3
ACO7416	400184	11/12/2001	Front Ash	7-1	1.00	5.00%	10.3
ACO7415	400164	11/8/2001	Front Ash	7-4	0.80	1.50%	3.9
ACO7414	400162	11/8/2001	Front Ash	7-2	0.91	1.60%	3.9
ACO7413	400161	11/8/2001	Front Ash	7-1	0.85	1.80%	3.9
ACO7412	400125	11/2/2001	Front Ash	7-3	0.48	0.80%	1.8
ACO7410	400123	11/2/2001	Front Ash	7-1	0.80	1.30%	1.8
ACO7411	400124	11/2/2001	Front Ash	7-2	0.93	1.20%	1.8

There does not appear to be any systematic variation between the mercury and LOI in the front and the back baseline ash samples. The variability of the mercury content in the baseline samples is rather high, though. Given the large variability in mercury content for the baseline samples, the difference between mercury in the front and back samples taken during long term testing does not seem significant.

The baseline (no sorbent) ash had an LOI of 0.5% and <0.5 μg/g of mercury. Addition of sorbent increased the LOI to a maximum of 2.5 –3.5% (Figure 2). There was a linear increase in mercury content with PAC injection rate (Figure 3) and little difference between ash from the front and back hoppers. The trend in mercury concentration is more pronounced for the MTI-measured samples than for the samples measured by WEPCo, even though the LOI values of the two sets of data are close for a given injection rate.

Notice that the maximum mercury content for Pleasant Prairie ash (at 10 lb/MMacf injection rate) was ten times lower than the maximum mercury content for Gaston ash (at 1.5 lb/MMacf). This illustrates a fundamental difference between PAC-injection upstream of a baghouse as compared to an ESP. The mercury content of sorbent-ash mixtures from baghouses will be significantly higher than that from ESPs.

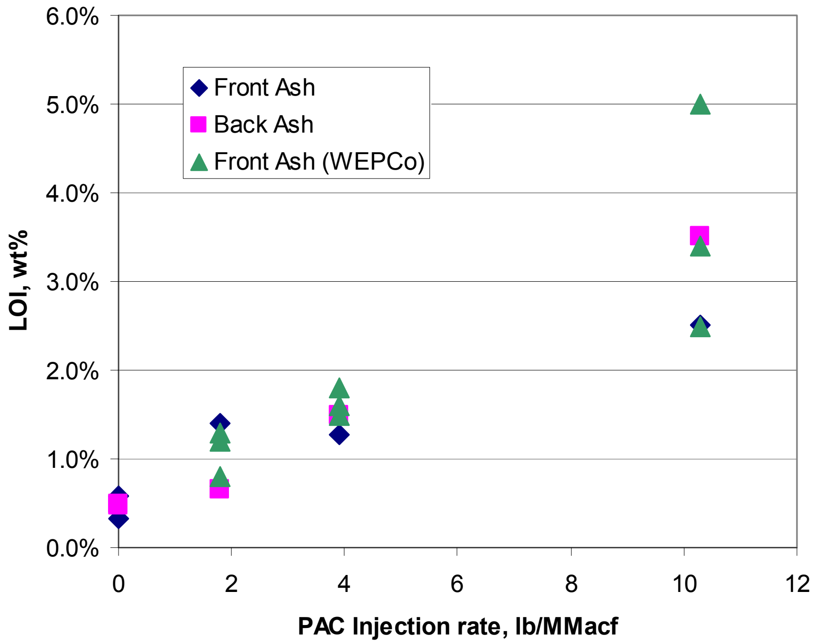


Figure 2: LOI as a function of injection rate at Pleasant Prairie

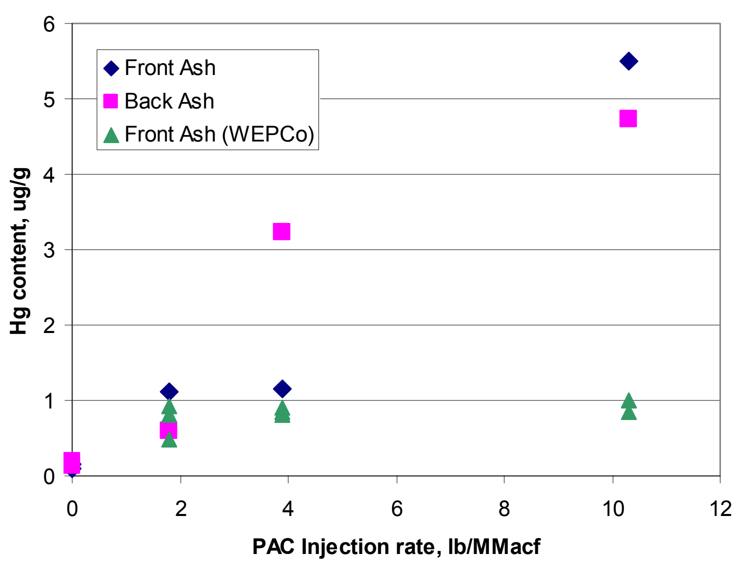


Figure 3. Mercury content as a function of injection rate at Pleasant Prairie

Leaching Protocol

Many standard leaching procedures exist. The procedure used most often is the toxicity characteristic leaching procedure (TCLP). The method was designed to simulate leaching in an unlined, sanitary landfill, based on a co-disposal scenario of 95% municipal waste and 5% industrial waste. The method is an agitated extraction test using leaching fluid that is a function of the alkalinity of the phase of the waste. Typically an acetic acid solution having a pH of 2.88 is used. Details of the procedure can be found in Reference 1.

The synthetic ground water leaching procedure (SGLP) was developed at the University of North Dakota Energy and Environmental Research Center (EERC) and was designed to simulate the leaching of CUBs under important environmental conditions. It was initially used to characterize highly alkaline CUBs, primarily fly ash produced from the combustion of low rank coals. The procedure was modeled after the TCLP, but allowing for disposal conditions other than those of a sanitary landfill. Deionized water is used as the leaching solution instead of the acidic solutions used in the TCLP. The SGLP was designed primarily for use with materials such as low-rank coal ash that undergo hydration reactions upon contact with water. Test conditions are end-over-end agitation, a 20:1 liquid to solid ratio and a thirteen-hour equilibration time. Details of the procedure can be found in Reference 2.

Long-term leaching is a subset of SGLP has been used previously to identify mineralogical changes that might occur in the wastes as a result of long-term contact with water. The samples were prepared as in the SGLP, but analysis of the leachate was made at 30 and 60 days.

Leaching Results

Samples Pleasant Prairie were leached at EERC using the standard TCLP procedure and also the synthetic groundwater leaching procedure (SGLP). Separate samples of Pleasant Prairie ash collected during the long-term PAC-injection were analyzed using the ASTM water leaching protocol. The Pleasant Prairie samples were leached for longer times (30 and 60 days) using SGLP. The concern here is the slow reactions that can take place in some high calcium ashes that are exposed to water. One duplicate measurement was made for the TCLP procedure and one for the SGLP procedure. Table 6 gives the leaching results from EERC. With one exception, all of the results (in terms of Hg in leachate) were below the detection limit of 0.01 mg/L.

Ash samples from Pleasant Prairie collected separately by Wisconsin Electric were analyzed by the utility using the ASTM water leaching procedure (ASTM D-3987). Mercury concentrations in the leachate are shown in Table 7. Measurements were made of other trace metals, but these are not shown. The baseline sample was taken after the conclusion of the long-term testing. Three samples were taken during the long term sorbent injection tests at the three different sorbent injection rates. These samples were composites of three different pails; the LOI and mercury content were not measured on the composites, so these have been estimated from a simple average.

Table 6. Leaching results (EERC).

Plant	Sample Type	Location	Inj.Rate lb/MMacf	Hg in TCLP	Leachate SGLP	(mg/L or SGLP-30	SGLP-60	ppbw) SAL
Gaston	COHPAC Ash	B-Side	1.5	0.01	<0.01			<0.01
Gaston	COHPAC Ash	B-Side	1.5		<0.01			
Gaston	COHPAC Ash	B-Side	1.5	<0.01	<0.01			<0.01
Prairie	Front Ash	Composite	10	<0.01	<0.01	<0.01	0.01	
Prairie	Back Ash	Composite	10	<0.01	<0.01	<0.01	0.01	
Prairie	Back Ash	Composite	10	<0.01				

Table 7. Leaching results, Pleasant Prairie ash only (Wisconsin Electric).

Sample Type	Location	Hg, µg/g (AR) (est.)	LOI, wt% (est.)	Inj.Rate lb/MMacf	Hg in Leachate (ppbw)
Front Ash				0	<0.028
Front Ash	Composite	0.7	1.1	1	<0.028
Front Ash	Composite	0.7	1.1	1	0.033
Front Ash	Composite	0.9	1.6	3	<0.028
Front Ash	Composite	0.9	3.6	10	<0.028

With one exception, all of the results (in terms of Hg in leachate) were below the detection limit of 0.028 ppbw. The results for water leaching are consistent with the SGLP leaching carried out by EERC on the Pleasant Prairie samples. All tests show the amount of mercury leached from the sorbent/ash mixtures is low and generally below the detection limit of the method.

Other Ash Impacts

Leaching is not the only measure of the impact of PAC on fly ash. When fly ash is sold as a product, it is important to determine whether the fly ash is still saleable after the addition of PAC. In the case of Pleasant Prairie, the ash is sold as a "Class C" fly ash, which is added to cement during manufacture of concrete. To this end, Wisconsin Electric conducted several tests that fall under the protocol for the ASTM C-618. Table 8 shows the results of those tests, along with the limits of what can be considered Class C fly ash.

Fly ash from the long-term tests conformed to the ASTM C-618 tests. However, ash samples with carbon of any concentration failed another important test called the Foam Index Test. This is a rapid field test used to determine the amount of surfactant (air entrainment agent) needed to meet the freeze/thaw requirements for using concrete at temperatures below freezing in the winter. Results from the Foam Index Test (Table 9) were the most important because failing this test prohibited the plant from selling this ash. In fact, the ash failed the Foam Index test for five weeks after the PAC-injection was halted.

Table 8. Results of ASTM C-618 tests performed on Pleasant Prairie Fly Ash.

Sample Type	Inj.Rate lb/MMacf	LOI, wt%	7-day strength activity index	water required %of control	Autoclave, % exp.
Front Ash	0	0.58%	91.3	94.2	-0.06
Front Ash	1	1.04%	84.3	95	0.01
Front Ash	3	1.58%	86.8	94.6	0.01
Front Ash	10	3.57%	84.1	96.2	-0.02
Class C limit		*<6%*	*>75*	*<105*	*<0.8*

Table 9. Results of Foam Index Test on Pleasant Prairie ESP ash.
Salable Contract Limit is 25 Drops

Injection Concentration (lbs/Mmacf)	Unburned Carbon in Ash (%)	Foam Index (Drops)	Comment
0	**0.55**	**15**	**Normal**
1	**1.1**	**>72**	**Maxed out**
3	**1.6**	**>72**	**Maxed out**
10	**3.6**	**>72**	**Maxed out**

Conclusions

The Pleasant Prairie sample (the product of a sub-bituminous coal) had a low LOI and mercury content. Sorbent was injected upstream of an ESP and was combined with the full ash stream. The LOI and mercury content were much lower than the Gaston sample.

Little or no detectable Hg leached by ASTM water leach, TCLP, SGLP (including 30- and 60-day leaching), sulfuric acid leach (bituminous ash). The Pleasant Prairie (PRB) ash conformed to the ASTM C-618 standard for Class C fly ash, but did not pass the Foam Index test that is also required for sale of this ash for use in concrete formulation.

References

1. U.S. EPA, 1990, “Toxicity Characteristic Leaching Procedure,” Federal Register, Vol.55, No., 61, March 1990, pp. 11798-11877.

2. Hassett, D.J., 1987, “A Generic Test of Leachability: The Synthetic Groundwater Leaching Method,” North Dakota Mining and Mineral Resources Research Institute, Grand Forks, North Dakota.

APPENDIX G

ECONOMICS

NORIT COST QUOTES AND EQUIPMENT LISTS

DESIGN DRAWINGS

COST FACTORS

Norit-Americas

ADA.ES
PLEASANT PRAIRIE
PAC INJECTION SYSTEM – EQUIPMENT LIST & BUDGET PRICING
ESP CASE – 1440 lbs/hr

Two Powdered Activated Carbon Storage Silos, 14 ft. diameter, 77 ft. eave including:

- 260,000 pound PAC Storage Capacity each
- Caged Ladder Access and Rest Platforms to Roof Mounted Equipment
- Roof Perimeter Handrails
- Two Windowed Access Doors into Skirted Area
- Galvanized Anchor Bolts
- 4" Schedule 40 Fill Line Pipe and Supports
- Combination Vacuum/Pressure Relief Valve and Manway
- Freight for Delivery

Silo Vent Filters for Truck Unloading of PAC – 2 each
Six Silo Point Level Switches: High, Low and Low-Low
Silo Level Transmitters – 2 each
BLH Load Cells to measure Silo Storage Weight – 8 each
13' X 28' X 9' high Precast Concrete Power, Control and Blower Building including:

- 3'-0" X 6'-8" Windowed Access Door
- 3'-0" X 6'-8" Windowed Double Door for Equipment Access
- 480 VAC Motor Control Center with HOA Control Switches, Indicating Lights, 120VAC Transformer and Distribution Panel
- Feeder Control Panels – 2 each, one for each Silo System
- Positive Displacement Blower Packages, 10 HP – 4 each
- Pressure Switches to Verify Blower Operation – 4 each
- HVAC
- Lighting
- All Equipment Mounted and Wired
- Freight for Delivery

Each Feeder Control Panel includes:

- 2 each Feeder Speed Controllers
- PanelView 1000 Color Operator Interface
- Allen Bradley SLC 504 PLC
- Load Cell Indicator/Transmitter
- Emergency Stop Pushbutton
- 2 each Feeder HOA Switches

Skid Mounted Feeder equipment, 4 each including:

- Painted Tube Steel Support Frame
- Stainless Steel Feeder and Storage Hopper
- 2 each Hopper Level Switches: High and Low
- Pressure Switch to Verify Eductor Operation
- 3" Solids Conveying Eductor

- Freight for Delivery

Silo Discharge Knife Gate Valves – 4 each
Rotary Valves for Filling Feeder Hoppers – 4 each
Expansion Joints to connect Rotary Valves to Feeder Hoppers – 4 each
Truck Unloading Control Panels – 2 each
Air Fluidizing Headers, Nozzles, Valves, Tubing and Gauges
Silo Interior Lights (8 each) and Switch (2 each)
Silo Deck Light and Switch – 2 each
Operations and Maintenance Manuals – 5 sets

SPARE PARTS INCLUDED:

- Eductor
- Point Level Switch
- Silo Fluidizing Air Solenoid Valve
- Set of Vent Filter Bags
- Feeder Speed Controller
- Feeder Drive Motor Speed Pick-up
- Feeder Drive Motor
- Volumetric Feeder Auger and Gasket
- Three Blower Replacement Inlet Air Filters

PRICING:
Engineering, Material and Equipment, Delivered: $694,600

Norit-Americas

ADA.ES
PLEASANT PRAIRIE
PAC INJECTION SYSTEM – EQUIPMENT LIST & BUDGET PRICING
TOXECON CASE – 450 lbs/hr

Powdered Activated Carbon Storage Silo, 14 ft. diameter, 59 ft. eave including:

- 162,000 pound PAC Storage Capacity
- Caged Ladder Access and Rest Platform to Roof Mounted Equipment
- Roof Perimeter Handrail
- Two Windowed Access Doors into Skirted Area
- Galvanized Anchor Bolts
- 4" Schedule 40 Fill Line Pipe and Supports
- Combination Vacuum/Pressure Relief Valve and Manway
- Freight for Delivery

Silo Vent Filter for Truck Unloading of PAC
Three Silo Point Level Switches: High, Low and Low-Low
Silo Level Transmitter
BLH Load Cells to measure Silo Storage Weight – 4 each
8' X 10' X 9' high Precast Concrete Power and Control Building including the following:

- 3'-0" X 6'-8" Windowed Access Door – 2 each
- 480 VAC Motor Control Center with HOA Control Switches, Indicating Lights, 120VAC Transformer and Distribution Panel
- Feeder Control Panel
- HVAC
- Lighting
- All Equipment Mounted and Wired
- Freight for Delivery

Feeder Control Panel includes:

- 3 each Feeder Speed Controllers
- PanelView 1000 Color Operator Interface
- Allen Bradley SLC 504 PLC
- Load Cell Indicator/Transmitter
- Emergency Stop Pushbutton
- 3 each Feeder HOA Switches

Skid Mounted Feeder equipment, 3 each including:

- Painted Tube Steel Support Frame
- Stainless Steel Feeder and Storage Hopper
- 2 each Hopper Level Switches: High and Low
- Pressure Switch to Verify Eductor Operation
- 2" Solids Conveying Eductor
- Freight for Delivery

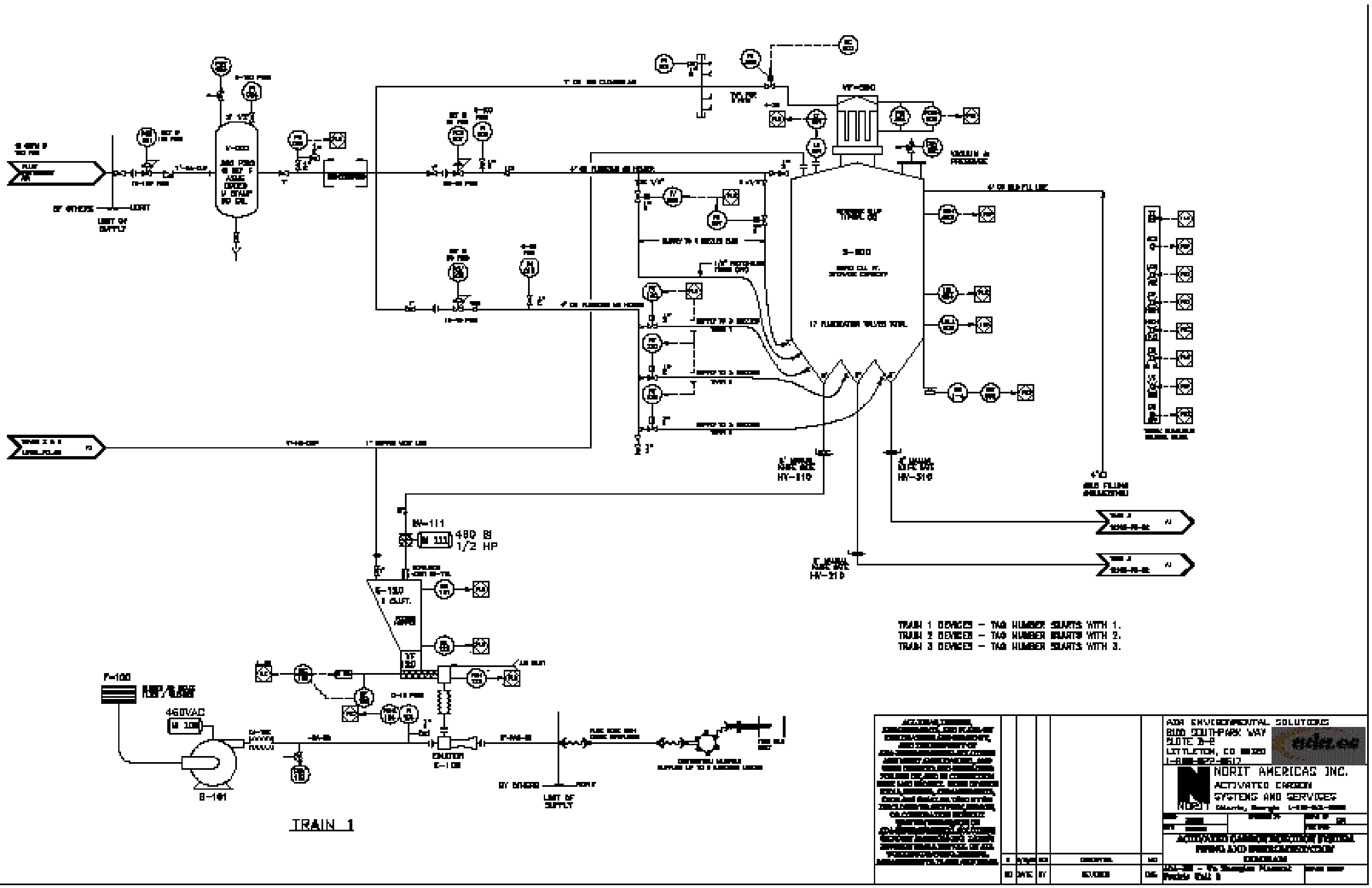
Silo Discharge Knife Gate Valves – 3 each

Rotary Valves for Filling Feeder Hoppers – 3 each
Expansion Joints to connect Rotary Valves to Feeder Hoppers – 3 each
Truck Unloading Control Panel
Air Fluidizing Headers, Nozzles, Valves, Tubing and Gauges
Silo Interior Lights (4 each) and Switch
Silo Deck Light and Switch
Operations and Maintenance Manuals – 5 sets

SPARE PARTS INCLUDED:

- Eductor
- Point Level Switch
- Silo Fluidizing Air Solenoid Valve
- Set of Vent Filter Bags
- Feeder Speed Controller
- Feeder Drive Motor Speed Pick-up
- Feeder Drive Motor
- Volumetric Feeder Auger and Gasket
- Three Blower Replacement Inlet Air Filters

PRICING:
Engineering, Material and Equipment, Delivered: $412,800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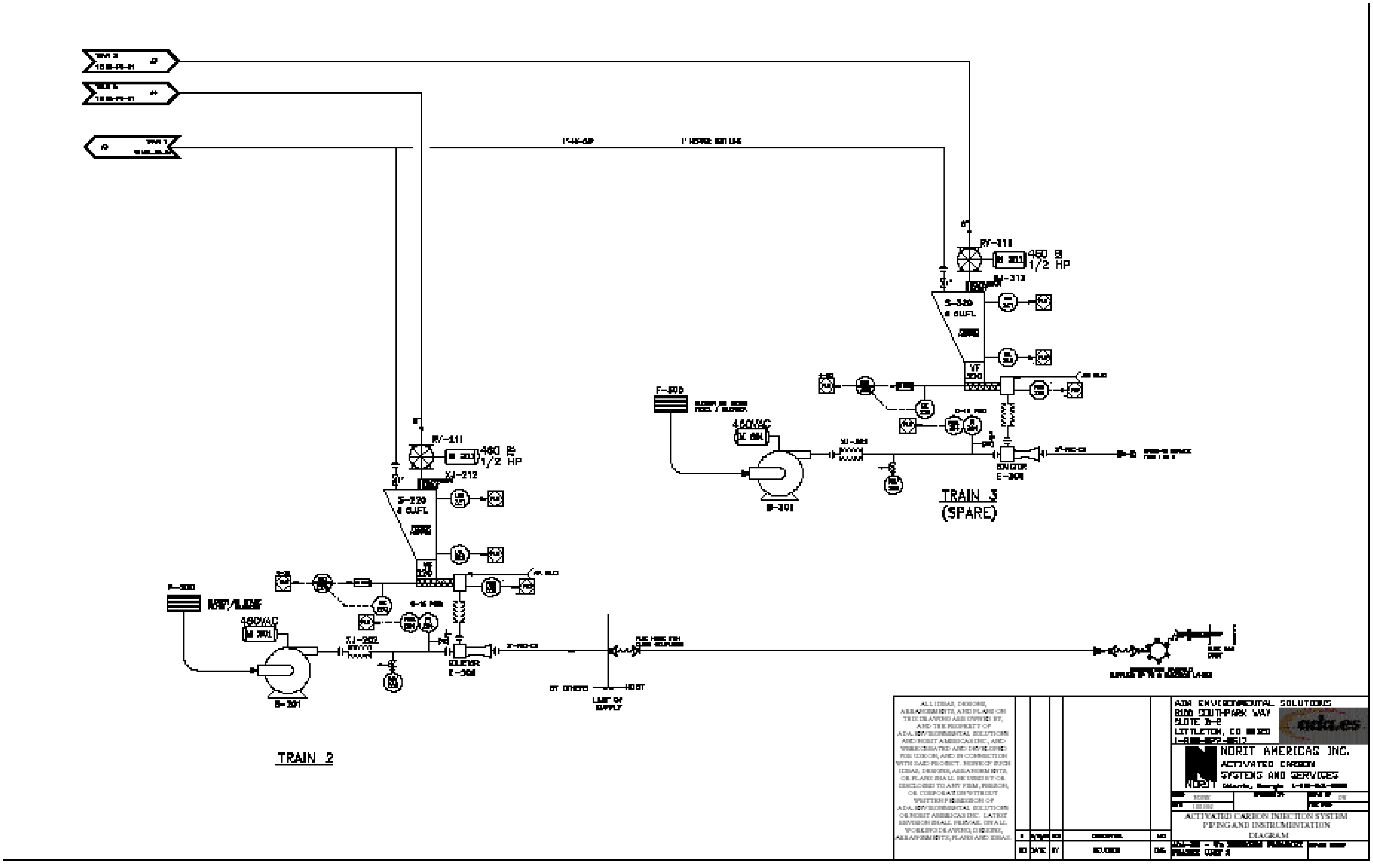
MV-111
1/2 HP
460VAC
B-101
E-108
TRAIN 1
ADA ENVIRONMENTAL SOLUTIONS
8100 SOUTHPARK WAY
SUITE B-2
LITTLETON, CO 80120
NORIT AMERICAS INC.
ACTIVATED CARBON
SYSTEMS AND SERVICES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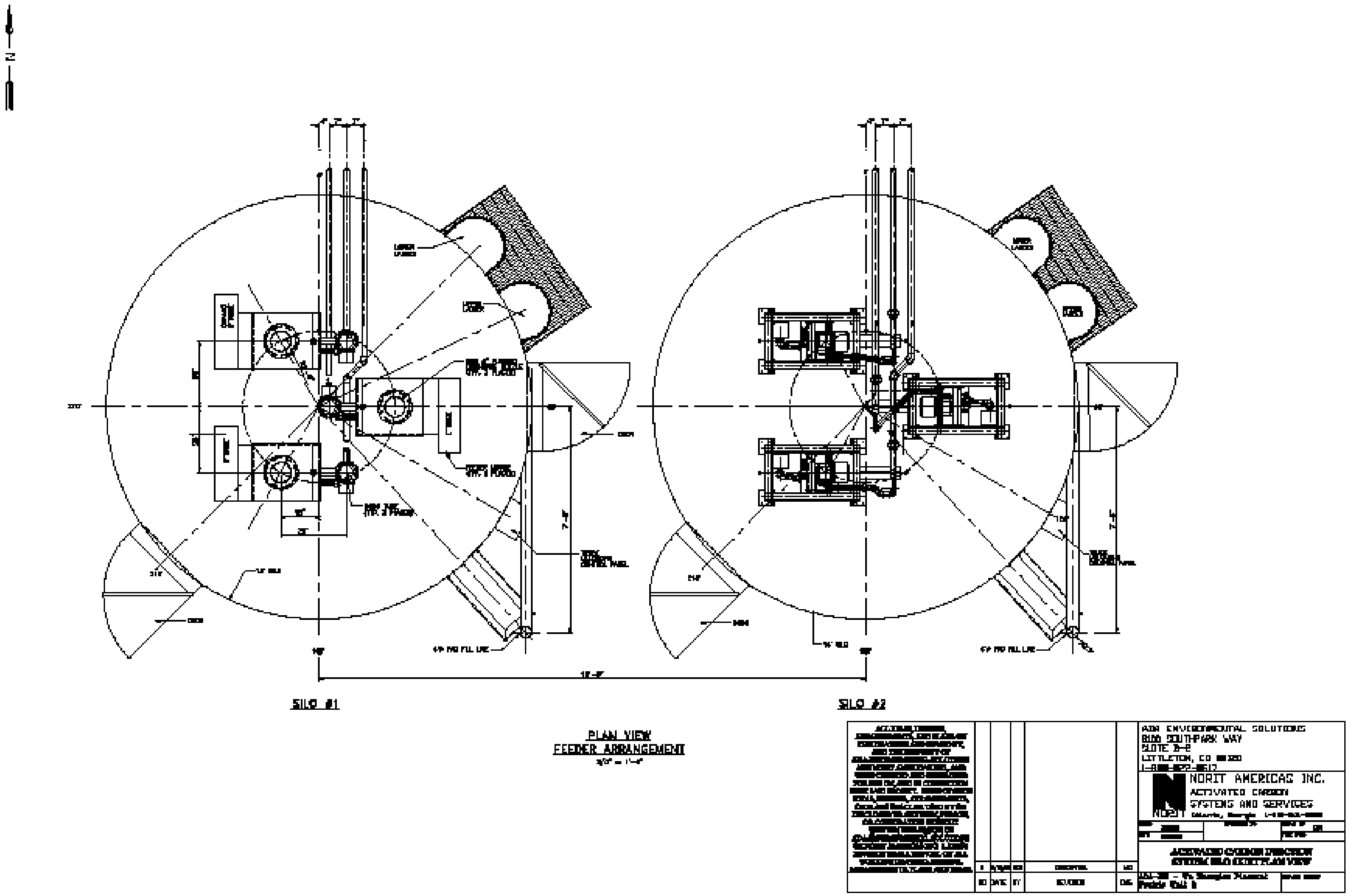
ACTIVATED CARBON
SYSTEMS AND SERVICES
ACTIVATED CARBON INJECTION SYSTEM
PIPING AND INSTRUMENTATION
DIAGRAM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FEEDER ARRANGEMENT
ADA ENVIRONMENTAL SOLUTIONS
SOUTHPARK WAY
LITTLETON, CO
NORIT AMERICAS INC.
ACTIVATED CARBON
SYSTEMS AND SERVICES

Summary of Pleasant Prairie Economics

		ESP Case 60-70% control	ESP Case 40-50% control	TOXECON Case unknown control
Capital Costs				
ACI Storage and Injection System	$	$694,600	$412,800	$412,800
Piping, Manifolds & Lances	$	$40,000	$30,000	$30,000
Foundations and Steel (installed)	$	$90,000	$65,000	$65,000
Electrical Supply Upgrades	$	$40,000	$35,000	$35,000
Misc Utilities, Lighting		$25,000	$20,000	$20,000
Controls Integration	$	$20,000	$20,000	$20,000
Subtotal		$909,600	$582,800	$582,800
Taxes	$	$54,576	$34,968	$34,968
Freight	$	*incl*	*incl*	*incl*
Purchased Equipment Cost Subtotal	$	$964,176	$617,768	$617,768
Installation of Process Equipment	$	$120,000	$85,000	$85,000
Total Direct Cost	$	$1,084,176	$702,768	$702,768
Indirects				
General Facilities	10%	$108,418	$70,277	$70,277
Engineering Fees	10%	$108,418	$70,277	$70,277
Project Contingency	15%	$162,626	$105,415	$105,415
Process Contingency	5%	$54,209	$35,138	$35,138
Total Plant Cost (TPC)	**$**	**$1,517,846**	**$983,875**	**$983,875**
Allow. for Funds During Constr. (AFDC)	$	$0	Construction period < 1yr.	0
Total Plant Investment (TPI)	$	$1,517,846	$983,875	$983,875
Preproduction Costs	$	$0	$0	$0
Inventory Capital	$	$0	$0	$0
Total Capital Requirement (TCR)	**$**	**$1,517,846**	**$983,875**	**$983,875**
	$/kW	**$2.50**	**$1.62**	**$1.62**
Variable O&M and Costs				
Cost Basis (Year)		2003	2003	2003
'Sorbent Injection Rate (lbs/hr)		1440	150	450
Sorbent Costs		$5,045,760	$525,600	$1,576,800
Waste Disposal Costs		$6,200,000	$6,200,000	$63,072
Power Consumption	kW	60	35	35
Power Cost ($0.05/kW)		$21,024	$12,264	$12,264
Operating Labor (6 hours/day, $45/hr))		$98,550	$65,700	$65,700
Maintenance Costs		$36,730	$22,140	$22,140
Periodic Replacement Items		$10,000	$10,000	$10,000
TOTAL	$	$11,412,124	$6,835,739	$1,750,011

Economic Factors				
Net Generating Capacity	MW	608	608	608
Annual Capacity Factor	%	80%	80%	80%
Power costs	$/kw	$0.05	$0.05	$0.05
Operating Labor Rate	$/hr	$45	$45	$45
Cost Basis - Year Dollars	Year	2003	2003	2003
Capital Esc During Construction	%	1.5%	1.5%	1.5%
Construction Years		0.5	0.5	0.5
Annual Inflation	%	2.5%	2.5%	2.5%
Discount Rate, % (MAR) =	%	9.2%	9.2%	9.2%
AFUDC Rate	%	10.8%	10.8%	10.8%
First Year Fixed Charge Rate, Current$	%	22.3%	22.3%	22.3%
First Year Fixed Charge Rate, Const$	%	15.7%	15.7%	15.7%
Lev Fixed Charge Rate, Current$ (FCR) =	%	16.9%	16.9%	16.9%
Lev Fixed Charge Rate, Const$ (FCR) =	%	11.7%	11.7%	11.7%
Service Life (years) =	Years	20	20	20
Escalation Rates :				
Consumables (O & M) =	%	3.0%	3.0%	3.0%
Fuel =	%	5.0%	5.0%	5.0%
Power =	%	3.0%	3.0%	3.0%