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

Quarterly Technical Progress Report

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ABSTRACT

With the Nation's coal-burning utilities facing tighter controls on mercury pollutants, the U.S. Department of Energy is supporting projects that could offer power plant operators better ways to reduce these emissions at much lower costs. Sorbent injection technology represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers. It involves injecting a solid material such as powdered activated carbon into the flue gas. The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with the mercury attached is then collected by a particulate control device along with the other solid material, primarily fly ash.

We Energies has over 3,200 MW of coal-fired generating capacity and supports an integrated multi-emission control strategy for SO_2, NO_x, and mercury emissions while maintaining a varied fuel mix for electric supply. The primary goal of this project is to reduce mercury emissions from three 90-MW units that burn Powder River Basin coal at the We Energies Presque Isle Power Plant. Additional goals are to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) emissions, allow for reuse and sale of fly ash, demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment, and demonstrate a process to recover mercury captured in the sorbent. To achieve these goals, We Energies (the Participant) will design, install, and operate a TOXECON™ system designed to clean the combined flue gases of Units 7, 8, and 9 at the Presque Isle Power Plant.

TOXECON™ is a patented process in which a fabric filter system (baghouse) installed downstream of an existing particulate control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. For this project, the flue gas emissions will be controlled from the three units using a single baghouse. Mercury will be controlled by injection of activated carbon or other novel sorbents, while NO_x and SO_2 will be controlled by injection of sodium-based or other novel sorbents. Addition of the TOXECON™ baghouse will provide enhanced particulate control. Sorbents will be injected downstream of the existing particulate control device to allow for continued sale and reuse of captured fly ash from the existing particulate control device, uncontaminated by activated carbon or sodium sorbents.

Methods for sorbent regeneration, i.e., mercury recovery from the sorbent, will be explored and evaluated. For mercury concentration monitoring in the flue gas streams, components available for use will be evaluated and the best available will be integrated into a mercury CEM suitable for use in the power plant environment. This project will provide for the use of a control system to reduce emissions of mercury while minimizing waste from a coal-fired power generation system.

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EXECUTIVE SUMMARY

Wisconsin Electric Power Company (We Energies) signed a Cooperative Agreement with the U.S. Department of Energy (DOE) in March 2004 to fully demonstrate TOXECON™ for mercury control at the We Energies Presque Isle Power Plant. The primary goal of this project is to reduce mercury emissions from three 90-MW units (Units 7, 8, and 9) that burn Powder River Basin (PRB) coal. Additional goals are to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) emissions, allow for reuse and sale of fly ash, demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment, and demonstrate a process to recover mercury captured in the sorbent.

We Energies teamed with ADA-ES, Inc., (ADA-ES) and Cummins & Barnard, Inc., (C&B) to execute this project. ADA-ES is providing engineering and management on the mercury measurement and control systems. Cummins & Barnard is the engineer of record and was responsible for construction, management, and startup of the TOXECON™ equipment.

This project was selected for negotiating an award in January 2003. Preliminary activities covered under the "Pre-Award" provision in the Cooperative Agreement began in March 2003. This Quarterly Technical Progress Report summarizes progress made on the project from January 1, 2008, through March 31, 2008. During this reporting period, work was conducted on the following tasks:

- Task 15. Operate, Test, Data Analysis, and Optimize TOXECON™ for Mercury Control
- Task 16. Operate, Test, Data Analysis, and Optimize TOXECON™ for SO_2/NO_x Control
- Task 17. Carbon-Ash Management System
- Task 18. Revise Design Specifications/O&M Manuals
- Task 19. Reporting, Management, Subcontracts, Technology Transfer

INTRODUCTION

DOE awarded Cooperative Agreement Number DE-FC26-04NT41766 to We Energies to demonstrate TOXECON™ for mercury and multi-pollutant control, a reliable mercury continuous emission monitor (CEM), and a process to recover mercury captured in the sorbent. Under this agreement, We Energies is working in partnership with the DOE.

Quarterly Technical Progress Reports will provide project progress, results from technology demonstrations, and technology transfer information.

Project Objectives

The specific objectives of this project are to demonstrate the operation of the TOXECON™ multi-pollutant control system and accessories, and

- Achieve 90% mercury removal from flue gas through activated carbon injection
- Evaluate the potential for 70% SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection
- Reduce PM emission through collection by the TOXECON™ baghouse
- Recover 90% of the mercury captured in the sorbent
- Utilize 100% of fly ash collected in the existing electrostatic precipitator
- Demonstrate a reliable, accurate mercury CEM suitable for use in the power plant environment
- Successfully integrate and optimize TOXECON™ system operation for mercury and multi-pollutant control

Scope of Project

The "TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers" project will be completed in two Budget Periods. These two Budget Periods are:

Budget Period 1: Project Definition, Design and Engineering, Prototype Testing, Major Equipment Procurement, and Foundation Installation. Budget Period 1 initiated the project with project definition activities including NEPA, followed by design, which included specification and procurement of long lead-time major equipment, and installation of foundations. In addition, testing of prototype mercury CEMs was conducted. Activities under Budget Period 1 were completed during 1Q05.

Budget Period 2: CEM Demonstration, TOXECON™ Erection, TOXECON™ Operation, and Carbon Ash Management Demonstration. In Budget Period 2, the TOXECON™ system was constructed and will be operated. Operation will include optimization for mercury control, parametric testing for SO_2 and NO_x control, and long-term testing for mercury

control. The mercury CEM and sorbent regeneration processes will be demonstrated in conjunction with the TOXECON™ system operation.

The project continues to move through Budget Period 2 as of the current reporting period. Each task is described in the Statement of Project Objectives (SOPO) that is part of the Cooperative Agreement.

EXPERIMENTAL

None to report.

RESULTS AND DISCUSSION

Following are descriptions of the work performed on project tasks during this reporting period.

Task 1 – Design Review Meeting

Work associated with this task was previously completed.

Task 2 – Project Management Plan

Work associated with this task was previously completed.

Task 3 – Provide NEPA Documentation, Environmental Approvals Documentation, and Regulatory Approval Documentation

Work associated with this task was previously completed.

Task 4 – Balance-of-Plant (BOP) Engineering

Work associated with this task was completed during 1Q05 in Budget Period 1.

Task 5 – Process Equipment Design and Major Equipment Procurement

Work associated with this task was completed during 1Q05 in Budget Period 1.

Task 6 – Prepare Construction Plan

Work associated with this task was completed during 1Q05 in Budget Period 1. The Construction Plan was issued on January 26, 2005.

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

The overall goal of this task was to have a compliance-grade, reliable, certified mercury CEM installed and operational for use in the TOXECON™ evaluation. Installation and checkout of two CEMs at the inlet and at the outlet of the baghouse was completed in 1Q06. The long-term evaluation of the mercury CEMs is described in Task 15 for the remainder of the project.

Task 8 – Mobilize Contractors

Primary work associated with this task was completed in 1Q06.

Task 9 – Foundation Erection

All major foundation work was completed during 1Q05.

Task 10 – Erect Structural Steel, Baghouse, and Ductwork

Primary work associated with this task was completed in 4Q05.

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

Primary work associated with this task was completed in 4Q05.

Task 12 – Balance-of-Plant Electrical Installations

Primary work associated with this task was completed in 4Q05.

Task 13 – Equipment Pre-Operational Testing

Pre-operational testing was completed in 4Q05.

Task 14 – Startup and Operator Training

Startup of all major equipment was completed in 4Q05. Final O&M manuals were received for most major equipment in 2005. Startup of the PAC system occurred in 1Q06.

The operator-training program was completed during 4Q05 to train the plant operations personnel.

The baghouse was initially brought into operation on December 17, 2005, with flue gas from Unit 7. Initial operation with Unit 8 occurred on January 5, 2006, and Unit 9 on January 27, 2006.

Task 15 – Operate, Test, Data Analysis, and Optimize TOXECON™ for Mercury Control

CEM Update

During 1Q08, the mercury Continuous Emissions Monitors (CEMs) located at the inlet and outlet of the baghouse were monitored for long-term operation. A summary of the operation of each system including any maintenance is presented below:

Inlet

Critical calibration failures for total mercury occurred 4 of the 31 days in January, 3 of 30 days in February, and 1 of the 31 days in March. Failing calibrations often occurred after periods of maintenance and activity. Availability of the system was 92.2% in January, 92.8% in February, and 79.3% in March. The poor reliability in March was attributed to a loss in communications with the mercury systems and prevented daily data collection from the systems and the ability to make corrections. This computer used for remote communication had stopped functioning and was replaced. Communication was restored in early April but data from March 24 to March 30 was lost. A loss in data indicates reduced availability of the instrument. Note that these systems were operated remotely and it was often several hours before a critical calibration failure was noticed and corrected. If a failure occurred on a Saturday, the system was out of "compliance" from the most recent successful calibration (typically Friday morning) until Monday. Also note that the availability calculations assume that the unit is online for 100% of the quarter and can skew the availability percentage low.

Maintenance:

- January:
  - Switched sampling from probe #1 (Unit 8) to #2 (Unit 9) due to Unit 8 going offline on January 7th.
  - Calibration span concentration incorrectly adjusted to 5.0 µg/m3 on January 8th. Corrected back to 11.0 µg/m3 on January 11th.
  - Inlet bypass pump removed on January 24th.
- February:
  - Switched sampling from probe #2 (Unit 9) to #3 (Unit 7) on February 18th due to Unit 9 going offline. When this switch was made the plumbing connections of the probe #3 going into the Hydra were backwards (Hg Total line was plumbed into the Hg Elemental port and the Hg Elemental line was plumbed into the Hg Total port). The connections were switched back to normal on February 26th.
  - Calibrated flow on analyzer on February 22nd.
- March:
  - Changed umbilical setpoint temperature from 160C to 120C, which is the Thermo recommended value, on March 12th.
  - Updated alarm min/max settings on March 12th.
  - Switched sampling from probe #3 (Unit 7) to probe #2 (Unit 9) on March 24th due to the Unit 7 outage

- Probe #2's Hg Elemental line was plumbed into the analyzer on March 25th in order to collect speciation data.

Outlet

Daily zero and span checks on the outlet system from January through March showed very good performance with no critical calibration failures during this time. The availability of the system was 100% in January, 100% in February, and 89.9% in March. The poor reliability in March was attributed to a loss in communications to the mercury systems and prohibited daily data collection from the systems in order to make corrections. Had there been communication the March availability probably would have been 100%. Communication was restored in early April but data from March 24 to March 28 was lost. A loss in data indicates reduced availability of the instrument. Note that the response to the calibration check on March 28 was very good despite 75 hours of missing data.

Maintenance:

- January:
  - Completed installation of oxidized mercury generator, more work needs to be done before it is fully functional.
- February:
  - Calibrated flow on analyzer on February 22nd.
- March:
  - Replaced sample pump on March 11th.
  - Updated alarm min/max settings on March 12th.
  - Changed umbilical set point temperature from 160C to 120C, which is the Thermo recommended value, on March 12th.

Ash Silo

During 1Q08, there continued to be problems with excessive dusting during unloading of the ash silo using the wet unloader, primarily during startup of the pin mixer. United Conveyer Corporation (UCC) and We Energies continued to work on modifications to the mixer and optimizing its operation to reduce dusting.

The excessive dusting is due to the short material retention time in the mixer that occurs until the material bed height is established. In December three atomizing nozzles were installed near the exit of the pin mixer. This reduced dust emissions during start up of ash unloading throughout 1Q08. In February a second set of atomizing nozzles were installed in the center section of the pin mixer. There did not appear to be any further reduction in dust emissions during start up after this was done. UCC and We Energies plan to do further investigation of ways to solve this problem during the next quarter.

The filter separator in the ash silo performed well during 1Q08. New bags were installed in December using a double clamp above the cage groove. The system has performed well since that time. A set of pleated PPS cartridge filters were ordered and installed during this quarter. Their performance and longevity will be compared with the standard polyester filter bags.

Other Operational Issues

A continuing problem has been maintaining proper temperatures in the fan building. This has been a problem in the winter when there are freezing temperatures in the lower level and excessive hot temperatures at the top of the fan room. Based upon the design recommendations from 3Q07, new louvers and control dampers were ordered in October 2007. These were shipped and installation began in December 2007. Installation was complete in January 2008.

During February snow and ice breaks were installed on the penthouse louver hoods. This will prevent ice from falling to the ground below and creating a safety hazard.

The plant EDS system was down for several days during the quarter. Data on baghouse and boiler performance was not available for downloading or archiving during those periods.

Carbon Monoxide Detectors

We Energies has been working with Forney Corporation to install a carbon monoxide detector on Compartment #4 hopper. Carbon monoxide is produced during overheating and auto-ignition of activated carbon so detection of an increase in this gas may be an early indicator of overheating in a hopper.

During 1Q08 there continued to be problems with the system due to condensation and contamination of the system. Forney will continue to troubleshoot the system next quarter.

ESP Detuning Tests

Background

The goals of this series of tests were to determine how the ash loading to the baghouse could be increased above base levels to:

- Improve collection efficiency of mercury
- Improve collection efficiency of particulate matter
- Protect the fabric of the filter bags and ensure normal life
- Eliminate dusting problems with the ash unloader operation.
- Reduce potential for auto-ignition in the baghouse hoppers.

ESP Detuning Test Results

Figure 1 shows the LOI data for the test period. The LOI did not significantly drop until one of the front chambers (7A1) was taken out of service in December, then the LOI dropped from 40-50% to around 30%. The lowest LOI was around 20%, and this was achieved with fields 7D, 7E, and 7F out of service. Unit 8 was out of service during this time, so the overall loading was much less than previous with all three units online.

These tests were discontinued at the end of January in preparation for the ash co-injection and alternative PAC testing.

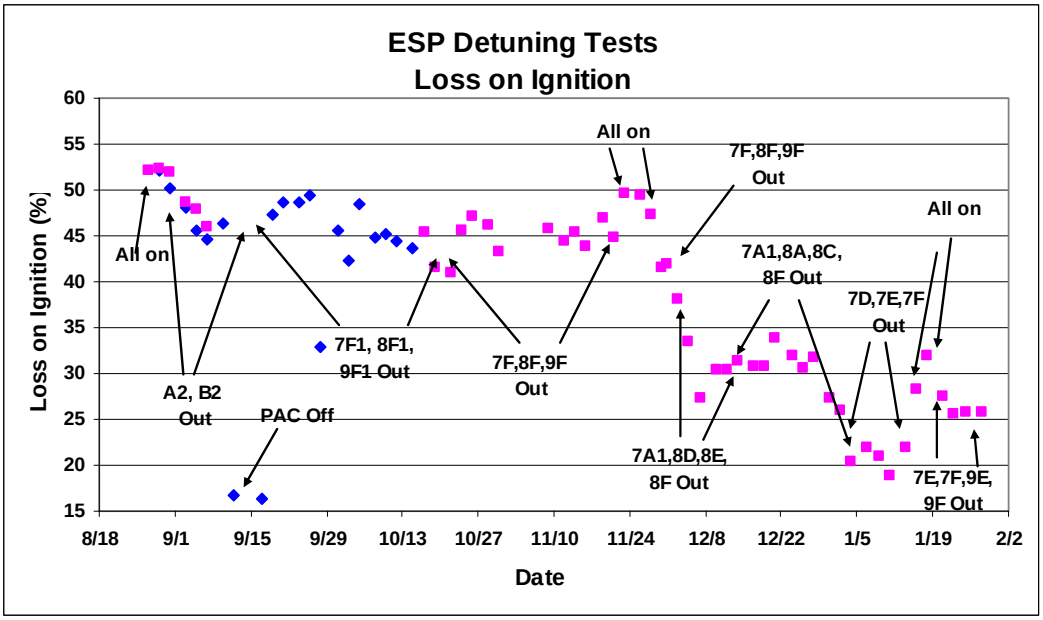

Figure 1. LOI During ESP Detuning Tests.

Alternative Sorbent Testing

During 1Q08 several test series were performed using a temporary silo and injection system. Specifically, the following test program objectives were pursued:

- Quantify the mercury removal curve for unprocessed high-LOI ash at full scale.
- Evaluate the effect of the ADA-ES sorbent enhancement treatment on high-LOI ash and DARCO® PAC.
- Quantify the mercury removal curve for ADA-ES imported carbon and Norit imported carbon.
- Record baghouse performance over all of the test periods, showing how pressure drop, cleaning frequency and mercury removal change.
- Evaluate the technical and economic performances of tested sorbents and processing.

The first objective involved co-injection of high Loss-On-Ignition (LOI) ash from the PIPP Units 5 & 6 ESP and baghouse. Units 5 &6 burn bituminous coal. Sorbent screening tests performed in December 2007 showed low (12-17%) mercury removal using this ash when tested upstream of the TOXECON™ baghouse. Full-scale re-injection of this ash upstream of the TOXECON™ baghouse was tested as a possible supplement to PAC injection. The effect of sorbent enhancement treatment of the ash was also tested at the highest ash injection rate to see if this would improve performance.

The ADA-ES sorbent enhancement process was also performed on the DARCO® Hg-LH PAC. This process has been used on other test sites and has shown favorable results.

The third objective involved injection of two alternative sources of activated carbon. The first source of PAC originated from Asia and was then treated, prepared, and shipped from a U.S. facility. This material was provided by ADA-ES. The second source was provided by Norit Americas.

Baghouse performance and mercury removal was monitored and assessed for all test phases.

Alternative Sorbent Test Equipment

Placement of the injection equipment for this test program was placed near the Units 7-9 stack. This is the same staging area that was used in August 2007 for the trona injection testing.

The sorbent injection equipment consisted of a hopper bulk trailer holding approximately 20 tons of high-LOI ash and a silo for sorbent injection (Figure 2). The silo had a storage capacity of 650 ft^3 and a monorail system with a hoist on top to allow loading smaller quantities of test sorbents from super sacks. Load cells at the base continuously recorded the weight of the silo over time to accurately measure sorbent injection rate. A maximum injection rate of 1000 lb/hr of the ash was planned.

Figure 2. Temporary Silo Installation.

High LOI Ash Co-Injection Testing

Parametric testing with high LOI ash from Units 5 & 6 silo was performed in early February. PAC injection had been turned off the previous week to allow the baghouse to stabilize. Figure 3 shows the removal curve for the ash up to 13.3 lb/MMacf (919 lb/hr).

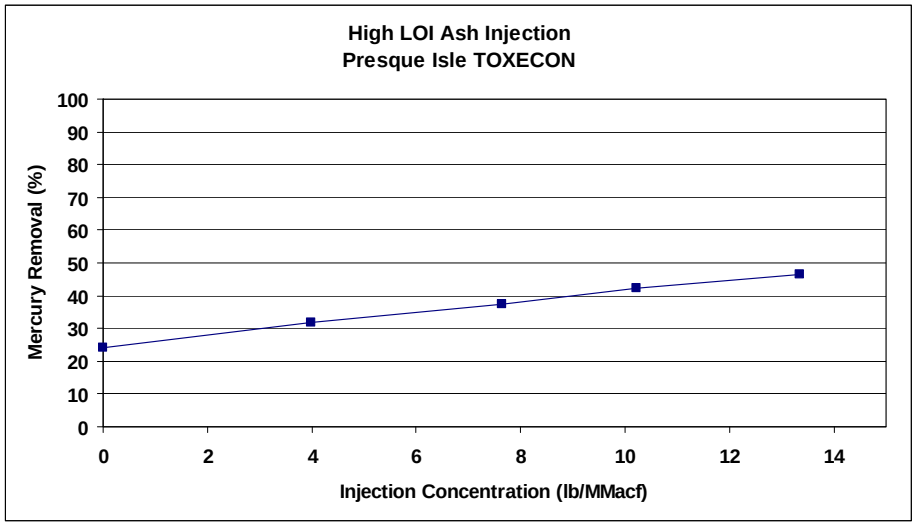

Figure 3. Mercury Removal Using High LOI Ash.

A second series of parametric tests was then performed by keeping the ash injection constant at the highest injection rate (920 lb/hr) while PAC injection was varied. The four targeted PAC injection rates were 0.25, 0.5, 0.75 and 1.0 lb/MMacf. The goal was to determine if ash could supplement PAC injection to achieve 90% mercury removal. Figure 4 shows the results of this series of tests and indicates that the ash did not contribute significantly at a removal rate >90%.

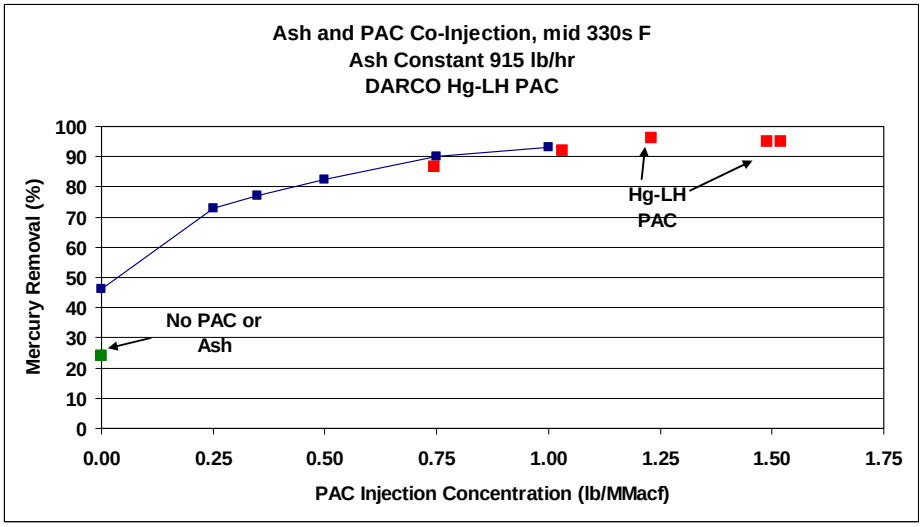

Figure 4. High LOI Ash and PAC Co-Injection Parametric Test Results.

In an effort to enhance the LOI carbon availability, the Unit 5 & 6 ash was treated with the ADA-ES sorbent enhancement process and injected upstream of the baghouse.

The injection rate was close to the highest rate injected in earlier parametric tests. Figure 5 shows that the sorbent enhancement treatment didn't increase mercury removal when injected upstream of a TOXECON™ baghouse.

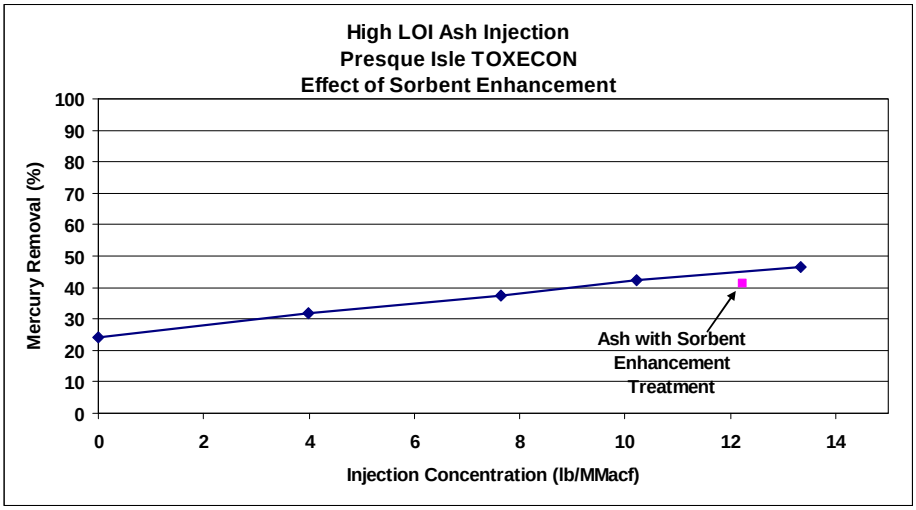

Figure 5. Effect of Sorbent Enhancement on High LOI Ash.

Alternative Carbon Testing

A series of tests were performed using various carbons. ADA-ES provided a brominated carbon that was treated and prepared domestically. This material will provide the utility industry with an additional source for future carbon needs. Norit Americas also provided a brominated carbon from a different manufacturing source than their DARCO® Hg-LH. Both of these carbons were compared with the DARCO® Hg-LH. The LH carbon was loaded into the mini-silo and injected into the baghouse using the same injection equipment as the ash and the two alternative carbons. This setup also allowed for sorbent enhancement treatment of the LH to determine if this would have an impact on mercury removal and PAC usage.

Figure 6 summarizes the results from this series of tests with all data normalized to removal at 330F. There were equipment issues due to cold weather and icing of the air lines during the Norit and ADA-ES PAC injection. Due to this the data at the lower injection rates should be considered a minimum for these carbons. This series of tests also showed that enhancement treatment had no major benefit in a TOXECON™ configuration.

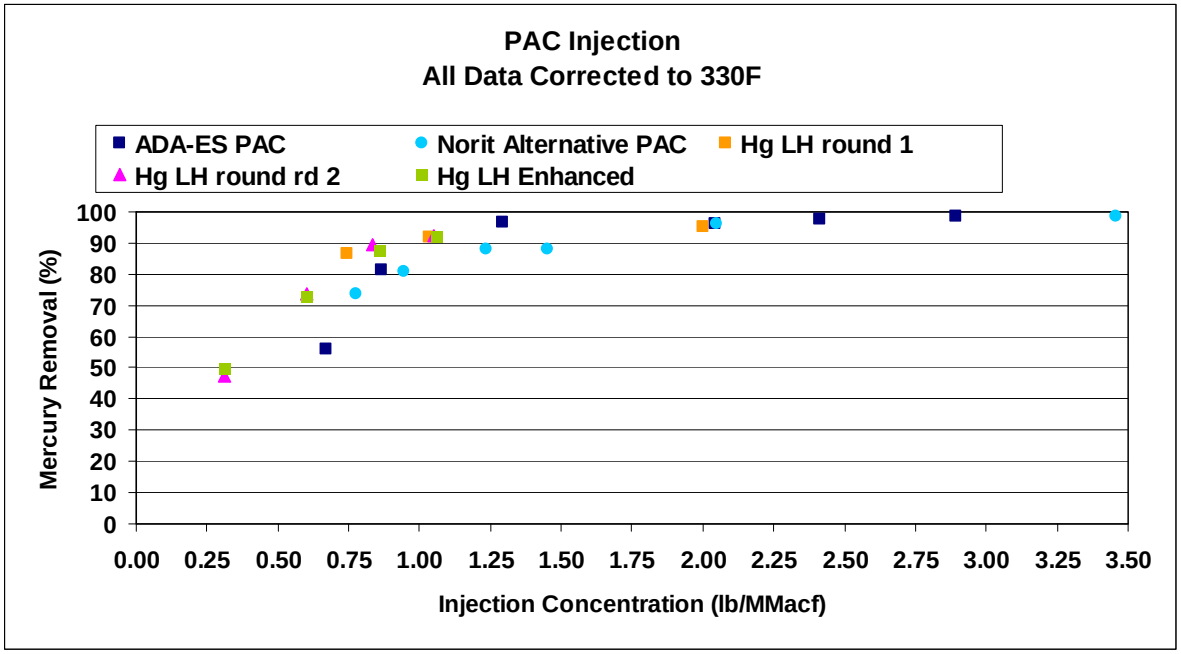

Figure 6. Alternative Carbon Test Results.

Baghouse Operations

DARCO® Hg-LH, a brominated carbon, was injected starting in January and continued throughout the quarter when alternative injection testing was not being performed. Figure 7 shows TOXECON™ data for January 2008. Mercury removal was over 90% for the majority of the month using 1.0 lb/MMacf PAC. The baghouse cleaning frequency was steady at 0.18 p/b/hr. The tube sheet pressure drop was around 2.0 inches of water when all units were at full load.

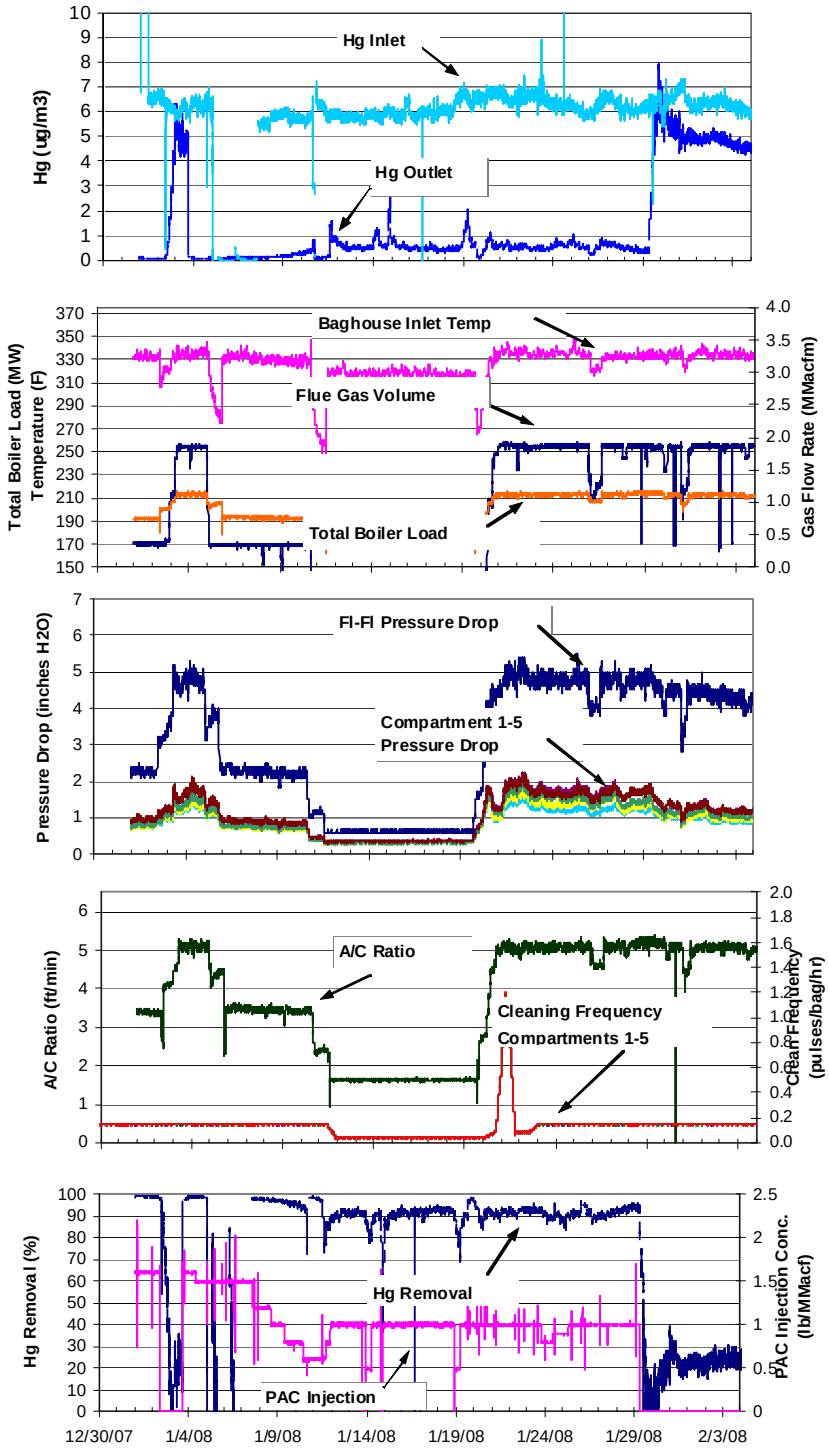

Figure 7. TOXECON™ Performance Data for January 2008.

Figure 8 shows TOXECON™ data for February 2008. Mercury removal varied dramatically depending upon the test being performed. The baghouse cleaning frequency was steady at 0.18 p/b/hr. The tube sheet pressure drop varied with particle loading entering the baghouse.

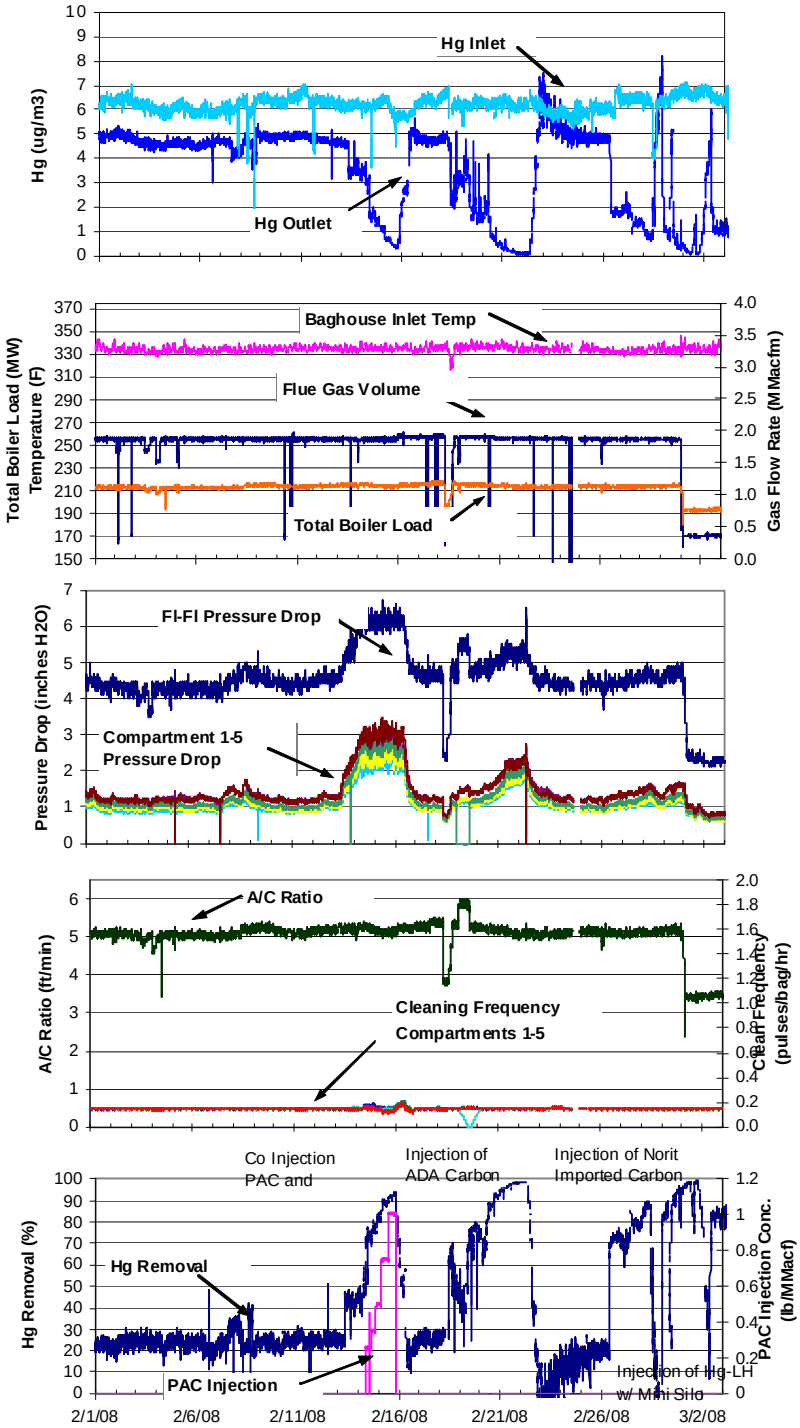

Figure 8. TOXECON™ Performance Data for February 2008.

Figure 9 shows TOXECON™ data for March 2008. Mercury removal varied dramatically depending upon the test being performed. Alternative carbon and ash testing ended the third week of the month. PAC injection from the permanent silo began on March 25 at 1 lb/MMACF. The baghouse cleaning frequency was steady at 0.18 p/b/hr. The tube sheet pressure drop varied with particle loading entering the baghouse.

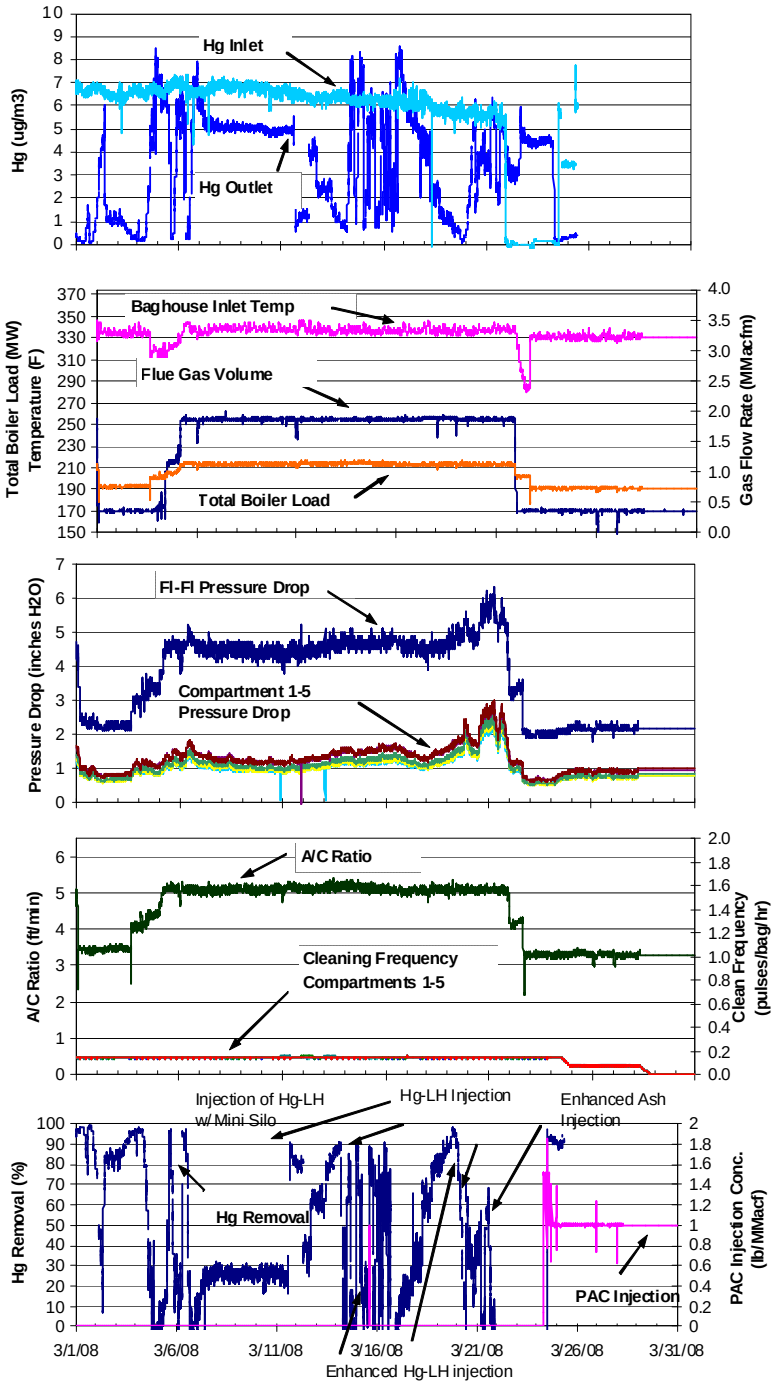

Figure 9. TOXECON™ Performance Data for March 2008.

Overheating of PAC/Ash

Investigations continued this quarter into the development of a model describing the factors that contribute to auto-ignition and resulting overheating of the ash mixture in the baghouse hoppers. Tests were conducted in the laboratory to determine the effect of bed size, PAC fraction, and ambient temperature on overheating.

During this quarter, laboratory oven tests continued using square containers filled with DARCO® Hg PAC/ash mixtures. Thermocouples were placed in the oven and inserted into the center of the bed of material at different levels to track temperature profiles over time.

The Frank-Kamenetskii model predicts that larger bed sizes require lower temperatures and longer times to ignite when compared to smaller bed sizes. Laboratory results confirm this behavior. Figure 10 shows results to date for DARCO® Hg PAC and PAC/ash mixtures. Larger beds auto-ignite at lower temperatures for all mixtures. Also the effect of LOI or PAC fraction in the bed has an effect on auto-ignition temperatures. These data indicate that lower LOI requires higher temperatures to auto-ignite. There is no data point for the 4-inch bed of either 21% or 26% LOI mixture. The auto-ignition temperature of these beds is above the maximum temperature of the oven used for the tests.

Using an 8-inch bed at the maximum oven temperature of 527 F, PAC/ash mixtures auto-ignited until the LOI level went below 9%. This is much lower than previously expected and this value may be lower using larger bed sizes. This quarter, a 12-inch bed was tested with PAC only. Low LOI PAC/ash mixtures became too heavy to safely place in the oven. The data from the 12-inch bed follows the previous curve as shown in Figure 10. It is expected that lower LOI mixtures will follow a similar curve but at a higher overall temperature.

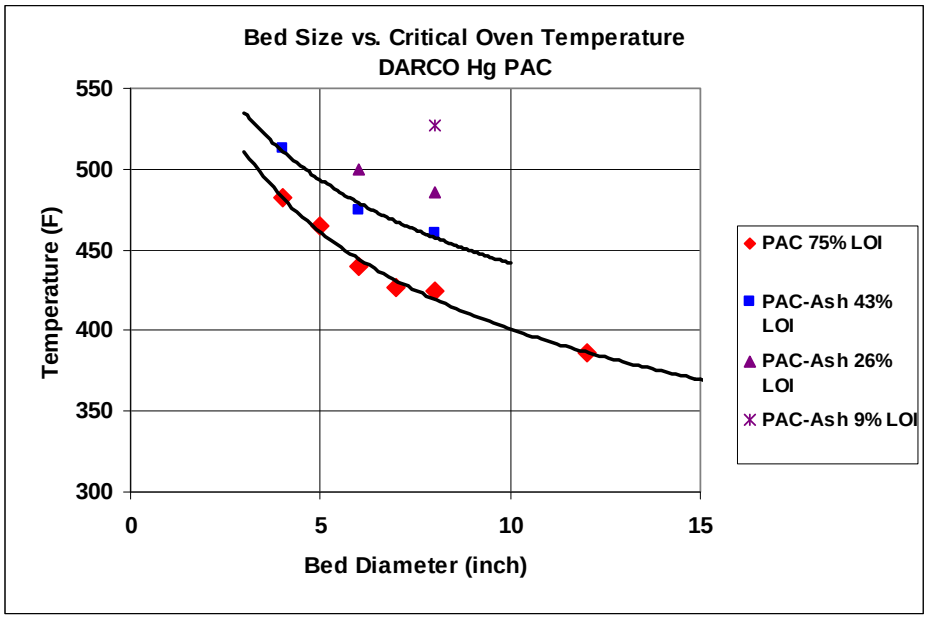

Figure 10. Correlation Between Bed Size and Critical Oven Temperature Required for Auto-Ignition.

When the critical temperature and bed dimensions are used in the model calculations, the result should be a linear correlation. Figure 11 shows the results of this correlation.

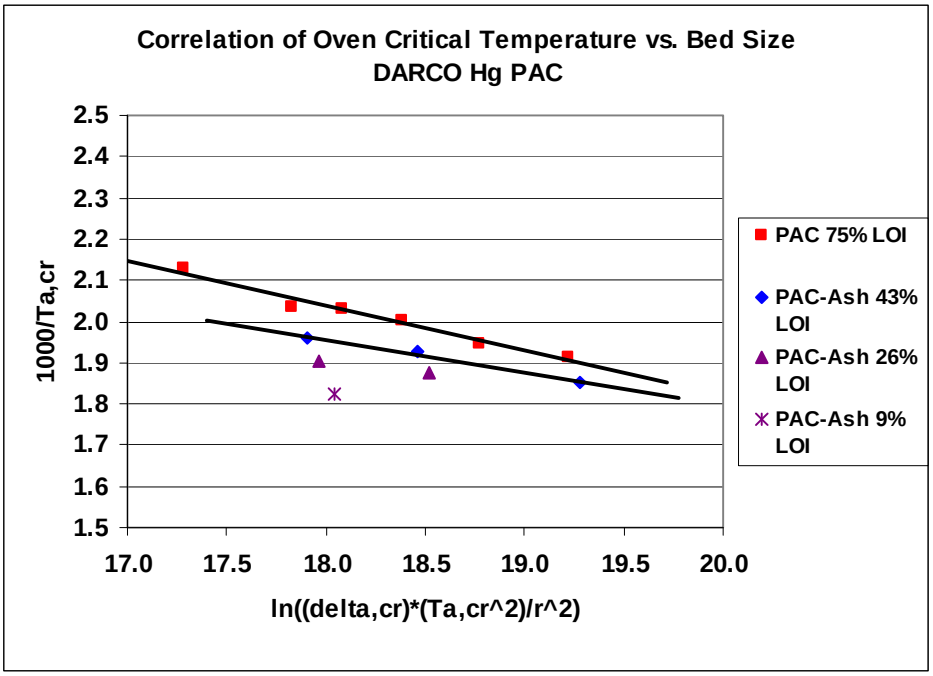

Figure 11. Auto-Ignition Correlation using DARCO® Hg PAC and PAC/Ash Mixtures.

Where:

Ta,cr = critical ambient temperature for ignition (K)
r = dimension parameter of sample (m)
delta,cr = critical parameter dictated by geometry of sample

Task 16 – Operate, Test, Data Analysis, and Optimize TOXECON™ for NO_x and SO_2 Control

This test effort was designed to support the overall objectives of the TOXECON™ retrofit at Presque Isle as well as to further the technical understanding of the TOXECON™ technology for both We Energies and the greater industry. Parametric tests were performed in August, 2007 to assess the capability of trona (sodium sesquicarbonate) injection upstream of the TOXECON™ baghouse to control SO_2 and NO_x. Injection equipment and measurement instrumentation were installed specifically for these tests. The following were the objectives of the testing program:

- Quantify the trona injection rate versus SO_2/NO_x removal.
- Record baghouse performance over the test period, showing how pressure drop, cleaning frequency and mercury removal change.
- Determine if there is any negative effect of trona injection on emissions (NO_2).

- Evaluate the technical and economic performance of trona.

Data and results from the testing in August were presented in the 3Q07 quarterly report. A topical report including technical results and economic assessment was submitted in late 1Q08. The following are the conclusions from the report.

The goal of 70% SO_2 removal was achieved during this two week test period when using 5926 lb/hr of trona. This corresponds to an average NSR of 1.02. The inlet concentration of SO_2 varied from 0.48-0.64 lb/MBtu. The highest removal was 74.1% with PAC injection at 3.8 lb/MMacf.

There was very little reduction in NO_x during the test period, although the presence of the side reaction with NO producing NO_2 was seen on one test day when PAC injection was turned off. This indicates that there is some reaction with NO_x, but not enough to measure on the stack CEMs and considerably below the target of 30% reduction. The NO_2 level was high enough to be visible and cause an increase in opacity of almost 3%. On days when PAC injection was occurring, the opacity increased by as much as 0.75% but there was no visible plume.

Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. This effect was seen every day that trona was injected. The mercury removal slowly recovered overnight to the pre-test level of >90%.

Baghouse and tube sheet pressure drop increased during trona injection, causing an increase in cleaning frequency from 0.18 p/b/hr to 0.22 p/b/hr.

Plant operators kept the three units at full, steady load during testing. The boiler soot blowers were used every hour on a staggered schedule to keep the flue gas temperature from fluctuating during testing. Trona was injected near the port where PAC injection occurs so there should have been excellent mixing with the flue gas before reaching the baghouse. The trona injection had no effect on boiler operations.

The reacted trona with PAC and ash that was collected in the baghouse was unloaded using a wet unloading system. Because trona and sodium carbonate will react with water to form solid hydrates, an anti-setup chemical was initially used with the water during unloading. No setup of the baghouse mixture was seen either in the mixer or in the transport truck. During the first week, an unloading during the morning occurred without the chemical, also resulting in no setup in the mixer or truck. The material may have been forming hydrates during mixing, preventing a hard setup. The use of the anti-setup chemical should be considered in future tests unless it can be shown that the mixing system prevents a solid setup in the mixer or truck.

An economic assessment of a full-scale trona injection system included equipment and other capital costs along with sorbent cost (trona and increased amount of PAC to maintain 90% removal) and O&M costs. The cost to remove SO_2 varied from $1,440/ton at 45% removal and one silo to $2,226/ton SO_2 at 70% removal with 3 silos.

Task 17 – Carbon/Ash Management System

During 4Q07 a review on current technologies concerning mercury removal from high carbon ash was completed. Several thermal treatment technologies were identified as having potential for a pilot scale test in 2008.

During 1Q08 two thermal technologies were identified as having the potential to treat the TOXECON® baghouse ash. One process uses microwave energy while the other uses natural gas as the heating source. Planning continues to do testing with both technologies.

An alternative use for the PAC/ash mixture from the TOXECON™ baghouse was identified in 4Q07. High carbon fly ash has been used successfully as an additive to create electrically conductive concrete. This could potentially create a demand for the untreated PAC/ash mixture. During 1Q08 a patent search identified We Energies as holding two patents regarding this technology. A task outline and detailed test plan were developed regarding this effort.

Laboratory testing, analysis, and preparation for a field demonstration of this technology are scheduled for 2Q08.

Task 18 – Revise Design Specifications, Prepare O&M Manuals

Work continued this quarter to develop a detailed training program and supplement to the Thermo Manual for the CEMs. This work was performed by ADA-ES and involved detailing background, startup, and operation of the CEMs. In 2Q08 further work will be done on developing a troubleshooting and maintenance guide and this will be presented to the plant.

Task 19 – Reporting, Management, Subcontracts, Technology Transfer

Reports as required in the Financial Assistance Reporting Requirements Checklist and the Statement of Project Objectives are prepared and submitted under this task. Subcontract management, communications, outreach, and technology transfer functions are also performed under this task.

Activity during this Reporting Quarter:

- Quarterly Technical Progress Report delivered
- Quarterly Financial Status Report delivered
- Quarterly Federal Assistance Program/Project Status Report delivered
- Gave a tour of the facility to representatives from the following:
    - Dominion Energy, Inc.
    - Norit Americas
    - Electric Energy

- Submitted an abstract for the book Air Quality VI Fuel Processing Technology
- Presented at the EUEC in January
- Technical papers and presentations for future meetings include:
    - AWMA (June 2008)
    - MEGA Symposium (August 2008)

CONCLUSION

This is the sixteenth Quarterly Technical Progress Report under Cooperative Agreement Number DE-FC26-04NT41766. All major construction efforts were completed during 4Q05, and only punch list items remained during the current quarter. Operational issues that were addressed included installation of new louvers and control dampers in the fan building, and modifying and repairing the ash silo wet unloading system to prevent dusting. The carbon monoxide detector was still not operational during this quarter but should be ready in 1Q08.

ESP Detuning tests were completed in January 2008. Increased ash loading did not seem to have a significant effect on mercury removal.

Alternative sorbent testing occurred for the majority of the quarter. A temporary "mini" silo injection system was set up by ADA-ES. High LOI ash injection was tested as a supplement to the PAC injection system. When ash and PAC were co-injected, the ash did not show significant benefit to reach 90% mercury removal. Two brominated sorbents supplied by ADA-ES and Norit Americas were also tested and showed removal comparable to the DARCO® Hg-LH. A sorbent enhancement process was tested and shown to have little benefit in a TOXECON® configuration. This process had shown significant benefit at a previous test site.

Several software and operational maintenance efforts were performed this quarter. In January the oxidized mercury generator on the outlet CEM was completed. The sample pump was replaced in March. CEM availability was impacted in March by a computer failure. This computer allows ADA-ES to communicate remotely with the CEMs on site. It was replaced in March.

Laboratory tests on PAC auto-ignition continued this quarter, and a good correlation between bed size and ignition temperature using the Frank-Kamenetskii Model was completed. An effect on the level of LOI in the PAC/ash mixture was measured for all bed sizes tested. Lower LOI mixtures required higher temperatures for auto-ignition. Twelve-inch test beds with an LOI of 75% were tested and fitted to the existing model data.

The project team is actively involved in a number of reporting and technology transfer activities, including tours of the facility at Presque Isle.