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

Quarterly Technical Progress Report

Reporting Period: January 1, 2009–March 31, 2009

Report No. 41766R20

Prepared by

Steven T. Derenne
Wisconsin Electric Power Company
333 West Everett Street
Milwaukee, WI 53203

April 30, 2009

DOE Cooperative Agreement No. DE-FC26-04NT41766

Michael McMillian
USDOE Contracting Officer's Representative

DISCLAIMER

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

ABSTRACT

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.

TABLE OF CONTENTS

EXECUTIVE SUMMARY 5

INTRODUCTION 6

- **Project Objectives** 6
- **Scope of Project** 6

EXPERIMENTAL 7

RESULTS AND DISCUSSION 7

- **Task 1 – Design Review Meeting** 7
- **Task 2 – Project Management Plan** 7
- **Task 3 – Provide NEPA Documentation, Environmental Approvals Documentation, and Regulatory Approval Documentation** 7
- **Task 4 – Balance-of-Plant (BOP) Engineering** 7
- **Task 5 – Process Equipment Design and Major Equipment Procurement** 7
- **Task 6 – Prepare Construction Plan** 7
- **Task 7 – Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment** 7
- **Task 8 – Mobilize Contractors** 8
- **Task 9 – Foundation Erection** 8
- **Task 10 – Erect Structural Steel, Baghouse, and Ductwork** 8
- **Task 11 – Balance-of-Plant Mechanical and Civil/Structural Installations** 8
- **Task 12 – Balance-of-Plant Electrical Installations** 8
- **Task 13 – Equipment Pre-Operational Testing** 8
- **Task 14 – Startup and Operator Training** 8
- **Task 15 – Operate, Test, Data Analysis, and Optimize TOXECON™ for Mercury Control** 9
  - **CEM Update** 9
  - **Ash Silo** 11
  - **Duct Temperature Monitoring** 11
  - **Baghouse Operations** 13
  - **Alternative PAC Injection** 16
- **Task 16 – Operate, Test, Data Analysis, and Optimize TOXECON™ for NO_x and SO_2 Control** 18
- **Task 17 – Carbon/Ash Management System** 19
  - **ADA-ES Update** 19
- **Task 18 – Revise Design Specifications, Prepare O&M Manuals** 22
- **Task 19 – Reporting, Management, Subcontracts, Technology Transfer** 22

CONCLUSION 23

LIST OF FIGURES

Figure 1. Duct Wall Temperature During Unit Outages. 11
Figure 2. Duct Flue Gas Temperatures During Unit Outages..... 12
Figure 3. TOXECON™ Performance Data for January 2009. 13
Figure 4. TOXECON™ Performance Data for February 2009. 14
Figure 5. TOXECON™ Performance Data for March 2009. 15
Figure 6. Sorbent Performance Curves, Normalized to 330°F. 17
Figure 7. Sorbent Performance Curves, Normalized to 340°F. 18
Figure 8. ADA-ES Variable Speed Concrete Mixer 19
Figure 9. Concrete Compressive Strength Results 20
Figure 10. TOXECON™ Ash Added to Concrete. 21
Figure 11. Compressive Strength Data - Field Test at Sky Ute S&G. 21

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. In January, 2009 a 6-month no-cost extension was requested by We Energies and this was approved by DOE in February, extending the completion date of this project until September 30, 2009.

This Quarterly Technical Progress Report summarizes progress made on the project from January 1, 2009, through March 31, 2009. During this reporting period, work was conducted on the following tasks:

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

Task 17. Carbon-Ash Management System

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 1Q09, 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

The inlet CEM system availability for 1Q09 is estimated since there were many interference periods with the amount of valid data collected. Some of the unavailability was accurate due to system component failure and maintenance while others are not, such as sampling from offline units.

The inlet CEM system availability for January was estimated at 90%. The system began the month sampling Unit 8's total mercury only. The system failed the calibration checks on January 2 and 3 while Unit 8 was at low load levels. No adjustments were made to the analyzer and the system passed the calibration check on January 4 when the Unit was back to the higher load. The sampling configuration was switched on January 30 to sample total mercury from Units 7 and 8 simultaneously.

Availability for February was 95%. The system began the month sampling total mercury from Unit 7 and Unit 8 simultaneously. The Unit 7 probe sample would deteriorate throughout the day since it was not performing blow backs regularly and ash would build up on the inertial filter in the probe. The sampling configuration was switched back to speciation mode from the Unit 8 probe only on February 11. Unit 8 went offline from February 14 to the 16 and the system failed calibration checks those mornings, but passed the calibration check on the 16 when the Unit came back online.

Availability for March was 92%. On March 21, power to the inlet CEM shelter was interrupted and caused the next morning's calibration check to fail. The next day's calibration check passed.

Maintenance:

- January:
  - On January 30, switched sampling configuration to sample total mercury from Units 7 and 8 simultaneously.
  - Replaced converter cores in probe # 1 (Unit 8) and probe #3 (Unit 7) on January 30.
  - Cleaned probe #2 (Unit 9) internal components, however the stinger was still plugged and was unable to be cleaned in January.

- February:
  - Switched from sampling total mercury from Units 7 and 8 simultaneously to speciation mode on Unit 8 only on February 11.
  - Unit 9 probe cleaned on February 23.

- Switched sampling from probe #1 (Unit 8) to probe # 3 (Unit 7) on February 27.

- March:
  - Switched sampling from probe #3 (Unit 7) to probe #2 (Unit 9) on March 1.
  - Switched to sampling total mercury from Units 7 and 9 simultaneously on March 2.
  - Switched to sample from probe #3 (Unit 7) only on March 21. The tubing in the back of the analyzer was set backwards, so the elemental channel was sampling total mercury and the total channel was sampling elemental mercury.
  - Switched to sampling total mercury from Units 7 and 9 simultaneously on March 24. Blow backs initiated every hour.

Outlet

The availability for January is estimated at 93%. There was one failed calibration on January 7 which was caused by the converter core in the probe being replaced the day before.

The availability for February is estimated at 94%. There were failed calibrations on February 11 and 12. The two failed calibration checks were most likely due to the eductor air being accidentally turned off on February 10 which may have allowed ash to build up in the probe.

The availability for March is estimated at 88%. The system failed calibration checks on March 2 and 3. The lamp was replaced on the March 2 which explains the failed checks. The system also failed calibration checks on the 10 and 11 due to a loss in communication with the calibrator.

Maintenance:

- January:
  - Replaced converter core on January 6.

- February:
  - Eductor air was accidentally turned off on February 10.

- March:
  - Mercury lamp replaced on March 2.
  - Communication cables from the CEMS to the trailer computer were repaired on March 12.
  - The chlorine in nitrogen cylinder used for the converter integrity checks was replaced on March 25.

Ash Silo

During 4Q08 a new pin mixer was ordered from UCC with delivery expected in 1Q09. The mixer shipment was delayed until April 2009. Installation of the mixer will occur in 2Q09.

In 4Q08 the plant began to build a partial enclosure around the base of the ash silo to eliminate the wind tunnel effect and prevent airborne dusting. Work continued on this enclosure during the current quarter although there were significant weather delays. This work is scheduled to be complete in early April 2009.

Duct Temperature Monitoring

During 4Q08 thermocouples were installed inside the return duct between Unit 7 and 8 near the wall where corrosion was evident during the inspection. A thermocouple was installed on the outside of the duct wall. A thermocouple was also added to monitor ambient conditions. Figure 1 shows duct temperatures with Units 7 and 9 online until March 30 when Unit 7 came off line. The duct wall temperature dropped to 118°F which corresponds to the Unit 7 duct becoming dead-ended. This is low enough to result in condensation on the walls of the duct.

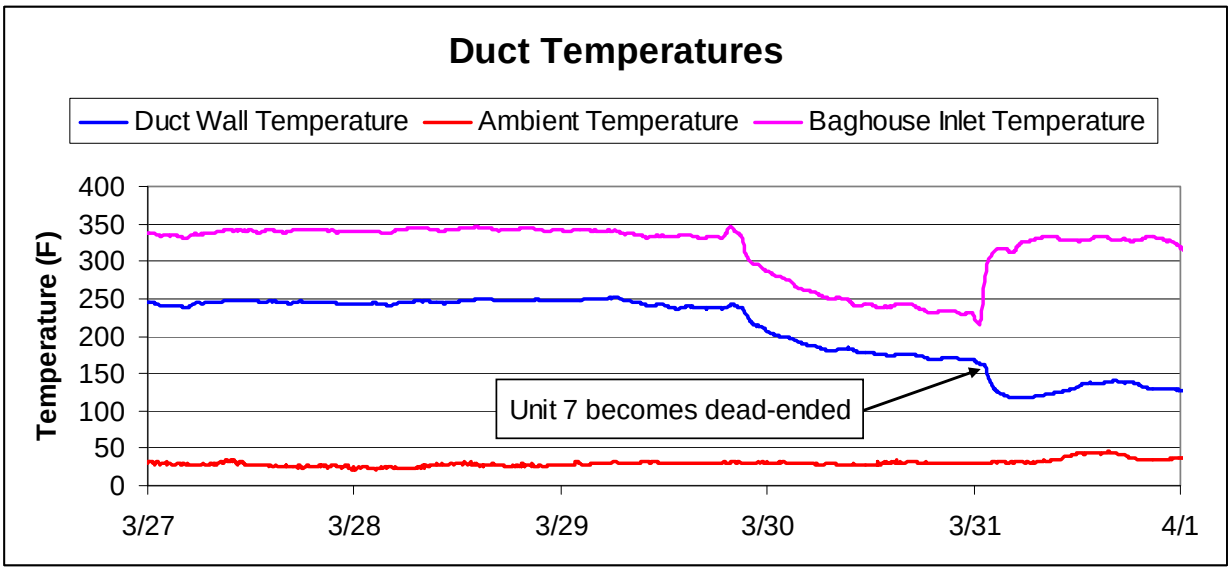

Figure 1. Duct Wall Temperature During Unit Outages.

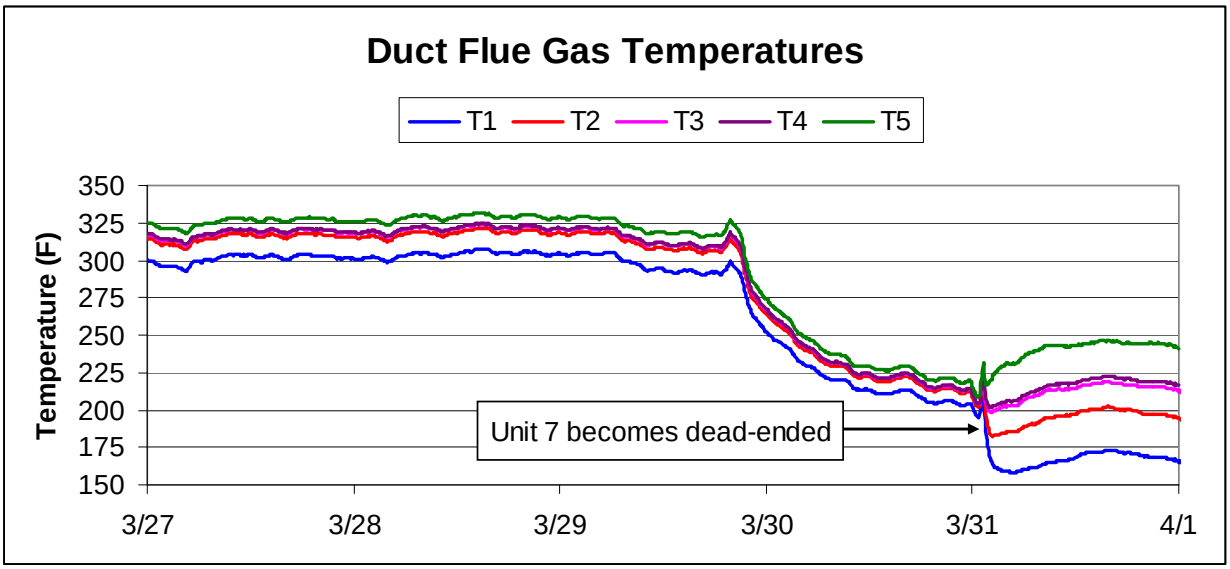

Figure 2. Duct Flue Gas Temperatures During Unit Outages

Figure 2 shows the flue gas temperatures during the same period as in Figure 1. This shows there is significant stratification between the flue gas at the bottom of the duct (T1) compared to that at the top of the duct (T5) during the time of stagnant flow in the Unit 7 return duct. This corresponds to the visual inspection which found the severe corrosion was only located at the lower duct walls and duct floor.

Baghouse Operations

DARCO® Hg-LH, a brominated carbon, has been used throughout 2008 and 2009. Figure 3 shows TOXECON™ data for January 2009. Mercury removal was over 90% for the majority of the month using 1.0 - 1.2 lb/MMacf PAC. The baghouse cleaning frequency was steady at 0.18 p/b/hr when all three units were online. The tube sheet pressure drop was around 2.0 inches of water with three units at full load.

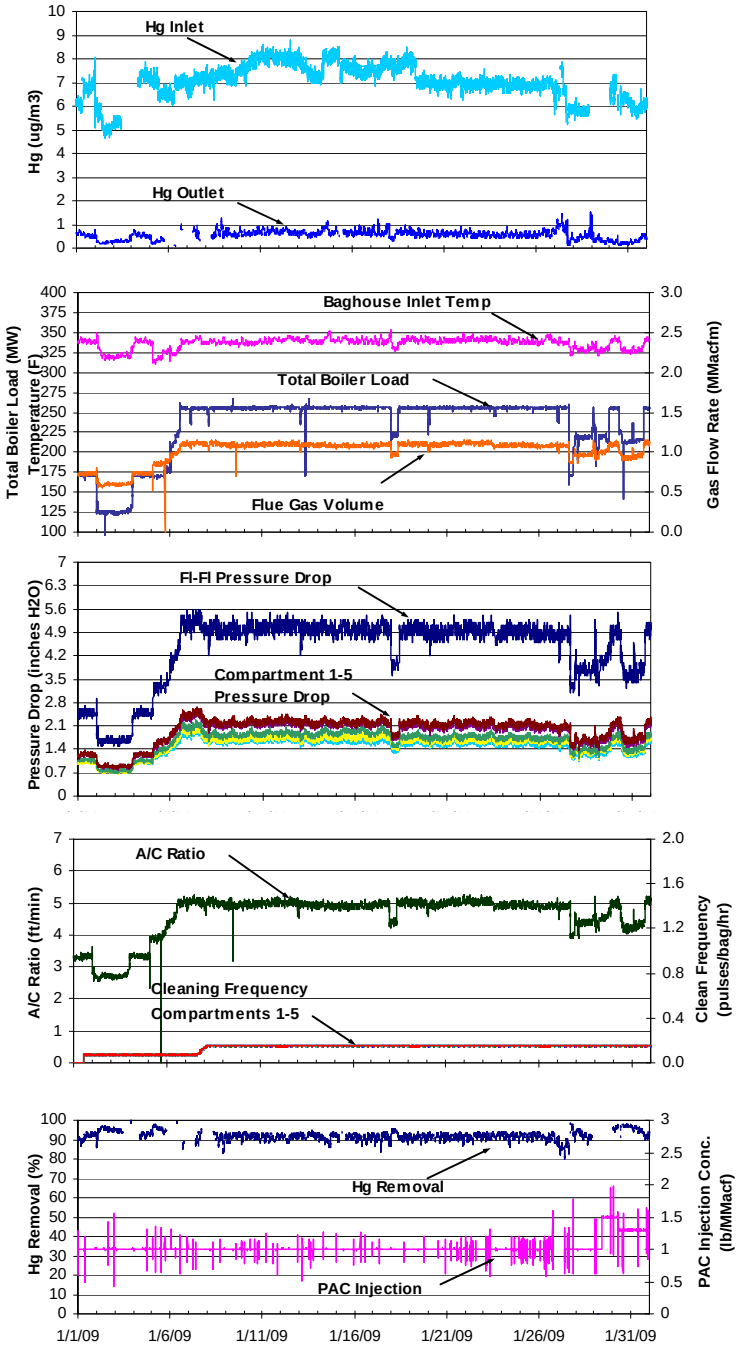

Figure 3. TOXECON™ Performance Data for January 2009.

Figure 4 shows TOXECON™ data for February 2009. Mercury removal was over 90% at a PAC injection rate of 1.0 - 1.2 lb/MMacf. 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. PAC injection was turned off on February 10 to establish a baseline for the alternative PAC tests which continued until the end of the month. These tests did not have an adverse effect on baghouse operations or pressure drop.

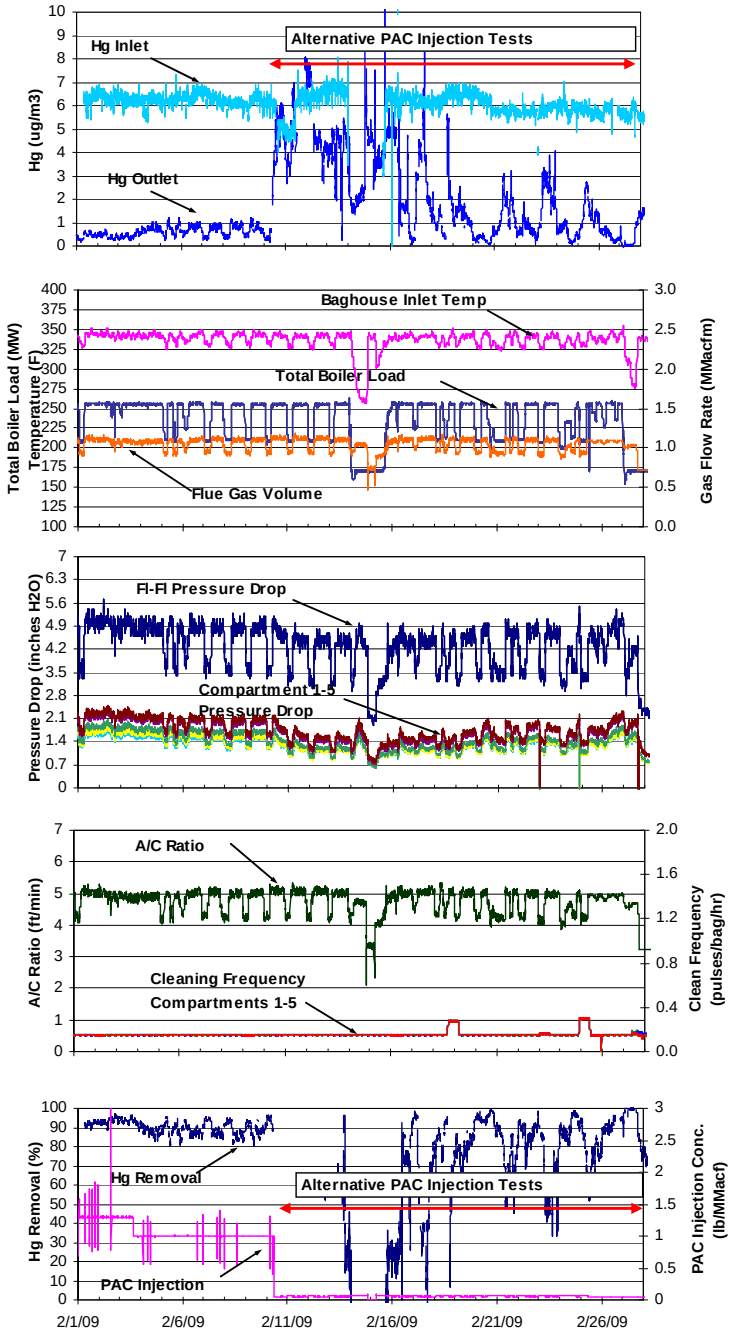

Figure 4. TOXECON™ Performance Data for February 2009.

Figure 5 shows TOXECON™ data for March 2009. This figure shows the effect of the ash re-burn test on the inlet mercury concentration towards the end of the month. PAC injection rate was 1.0 lb/MMacf for most of the month, then increased to 1.2 lb/MMacf during the re-burn test. The tube sheet pressure drop was around 1.0 inch of water with two units on at full load.

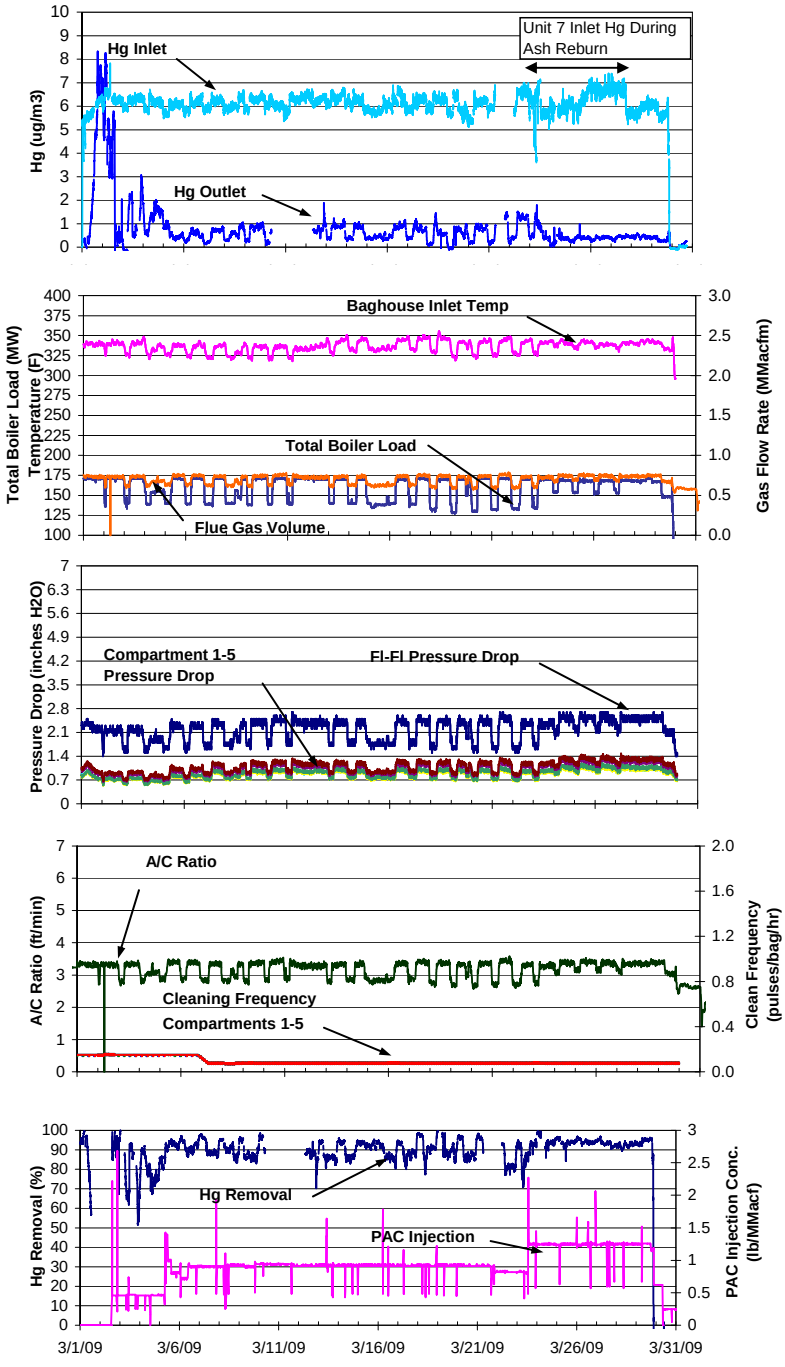

Figure 5. TOXECON™ Performance Data for March 2009.

Alternative PAC Injection

In February 2009 a series of tests using alternative sorbents for mercury control was performed. Temporary injection equipment was installed specifically for these tests. The existing mercury CEMs were used to measure the inlet and outlet mercury concentrations.

Specifically, the test objectives were:

1. Quantify the mercury removal versus sorbent injection rate while injecting alternative sorbents using temporary injection equipment.
2. Using data from previous testing periods to compare the mercury removal obtained by a commercially available sorbent against removals obtained by the alternative sorbents.
3. Record baghouse performance over the test period, showing how pressure drop, cleaning frequency and mercury removal change.
4. Evaluate the technical performances of tested sorbents.

Test Description

Parametric tests were performed with six alternative PACs over a two week period from February 16 through 28. Each PAC was injected using the temporary injection equipment at nominal concentrations ranging from 0.5 lb/MMacf to 1.5 lb/MMacf. Each parametric test was run for 6 to 12 hours depending on the amount of PAC available and operating conditions with the intent to capture enough stable mercury and baghouse data to produce an average mercury control point. The series of parametric tests were used to develop sorbent performance curves relating the injection concentration to mercury removal efficiency for each alternative PAC.

The alternative PAC injection tests were performed 24 hours a day throughout the entire test period. This made it possible to get the six PACs tested; however, there was not enough time to inject the DARCO® Hg-LH as planned. It was requested that the plant hold full, steady load for the duration of the test, but this was not possible due to power demand and the Unit 8's planned outage starting earlier than expected. Each night between about midnight and 6:00am the load on all three units was lowered to mid-load levels due to power demand. The last alternative PAC, PAC #4, was tested with only 2 Units online because of Unit 8's early outage. Since load and flue gas flow varied during testing the injection rates (lb/hr) were manually adjusted to maintain consistent injection concentrations (lb/MMacf).

All baghouse operational setpoints were unchanged during the two week period of testing except when a full clean of the baghouse was initiated when switching to a different carbon to remove residual PAC from the bags. This was performed by manually pulsing all the bags twice.

Test Results

Mercury removal data was obtained at each injection rate (apx. 0.5, 0.75, 1.0, and 1.5 lb/MMacf) and correlated with flue gas temperature. Previous data analysis has shown a strong correlation between flue gas temperature and mercury removal at a constant injection concentration. The

flue gas temperature varied throughout the two week test so that the correlation is required to compare the PACs at the same conditions.

The mercury removal at baghouse temperatures of 330°F and 340°F are shown in Figure 6 and 7 respectively. Each removal point was calculated using linear regression equations produced by the mercury removal versus baghouse temperature correlations. The data in these figures also shows removal data from DARCO Hg-LH® injection tests performed in 1Q08. The removals were determined by the same linear regression method as the alternative PACs.

Taking into account the variability of determining mercury removals at specific temperatures, the alternative PACs performed as well or perhaps better than the DARCO Hg-LH® did in the previous tests. PACs #1 and #2 seemed to perform slightly better than the others, while PACs #3, #6 were on the lower end of the removals.

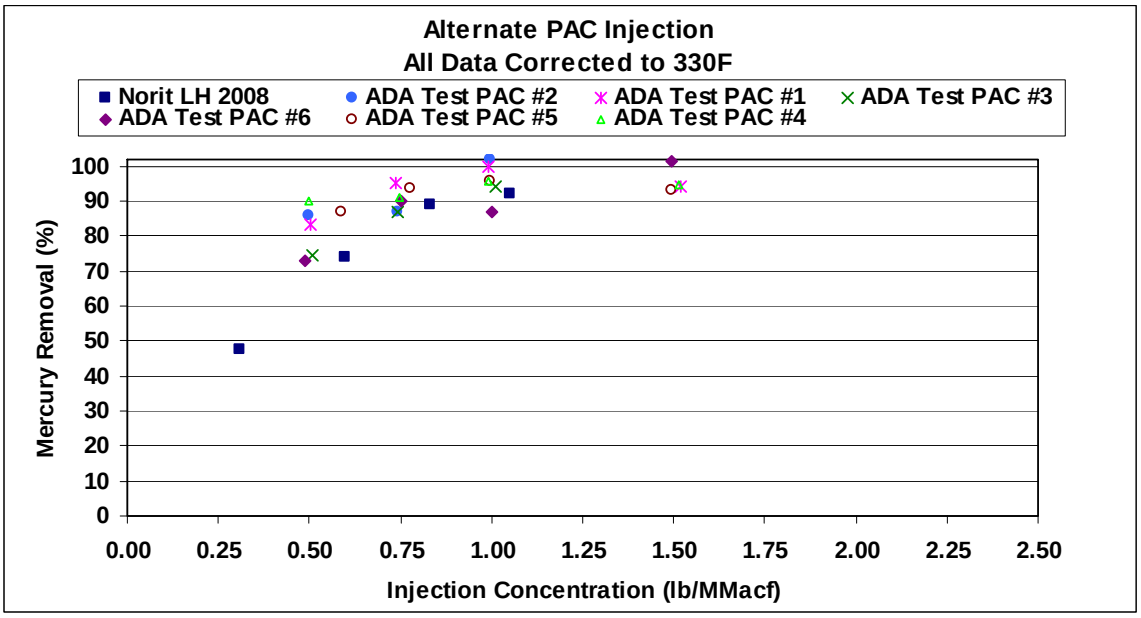

Figure 6. Sorbent Performance Curves, Normalized to 330°F.

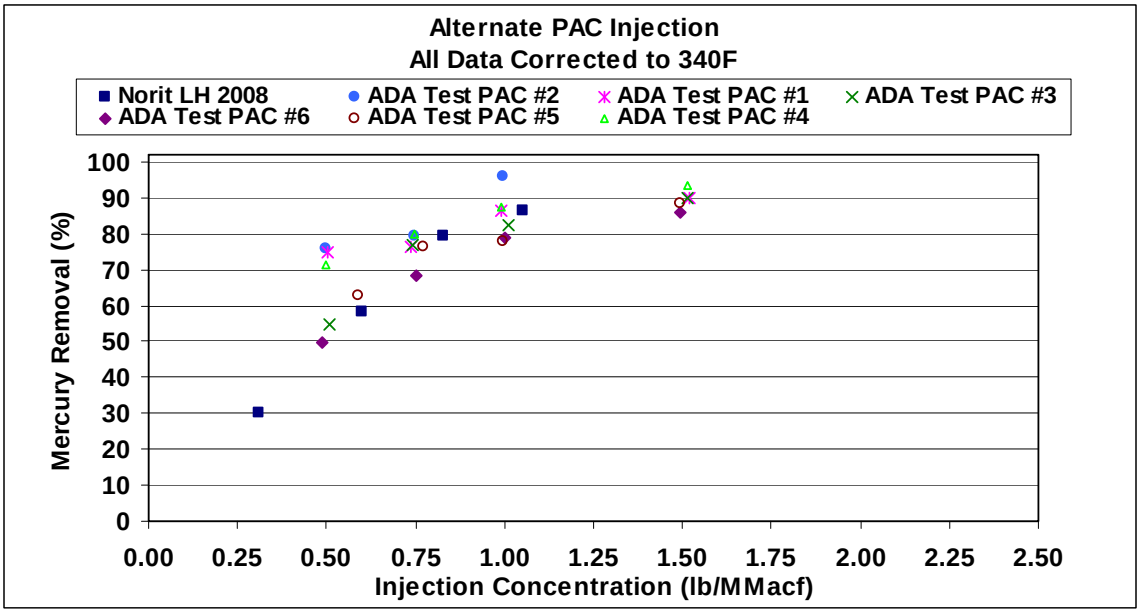

Figure 7. Sorbent Performance Curves, Normalized to 340°F.

Alternative PAC Test Conclusions

- All six ADA-ES alternative sorbents performed as well as the commercially available sorbent DARCO Hg-LH® in the TOXECON™ baghouse at Presque Isle.
- Mercury removal varied linearly with baghouse temperature. As temperature increased mercury removal decreased. This is a well-documented correlation in the TOXECON™ baghouse.
- PAC injection using these six alternative carbons showed minimal effect on baghouse pressure drop or other performance parameters. Cleaning frequency was unchanged during these tests.

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

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.

Data and results from the testing in August were presented in the 3Q07 quarterly report. A draft topical report including technical results and economic assessment was submitted in late 1Q08. The final topical report was sent out for review and was submitted in 3Q08.

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. Several 55-gallon drums of baghouse ash were shipped out to be tested using both technologies.

Results of the work performed by United Environment & Energy (UEE) and UP Steel were reported in 4Q08 Technical Report.

ADA-ES Update

During most of 2008 the concrete development effort focused on the largest application for fly ash, and that is structural concrete. Both low- and high-carbon ash mixtures were tested during this time.

In order to create structural concrete suitable for exterior applications, the concrete must be able to withstand multiple freeze-thaw cycles. This freeze-thaw durability is obtained by the introduction of numerous small air bubbles in the concrete. The carbon content of fly ash has a negative effect on most air entrainment additives (AEA), resulting in increased cost for additional chemical and unreliable batching operations. During 1Q09, a foam air entrainment system developed by Miracon™ Technologies in combination with a specific admixture blend was further refined and tested on PAC-containing ash.

During 1Q09, ADA-ES prepared concrete batches according to formulations that vary the amount of cement, fly ash, LOI, and commercial admixtures using a small batch mixer (Figure 8). Cylinders from successful batches were tested at an independent laboratory for compressive strength. CTL Thompson, Inc. is a Denver-based laboratory that has worked with ADA-ES in the past and is known for their expertise in analyzing concrete. Hardened Air Void (HAV) tests were performed on select batches to determine freeze/thaw durability.

Figure 8. ADA-ES Variable Speed Concrete Mixer

Figure 9 shows a comparison of compressive strength results using MicroAir, a liquid AEA, and Miracon (foam) AEA. The ash LOI varied from 0.7% (control), 5% and 30% using 20% cement replacement. The amount of AEA is normalized to the amount used in control batches. The 5% LOI ash tests show very good strength for both MicroAir and Miracon, but the AEA usage varied significantly. Miracon required no increase in dosage, while the MicroAir required 6x the amount needed for the control batch. The 30% LOI tests with Miracon required 7-12x more Miracon than the control, compared to a test with MicroAir that required up to 250x (not shown). The air content was stable for 90 minutes, which is sufficient for most applications. The water/cement ratio (w/c) varied in the tests in Figure 9, and was the major factor in strength variability between the batches. The legend also shows the measured air content in the concrete, which can have an effect on strength values. Higher air content generally results in lower strength concrete.

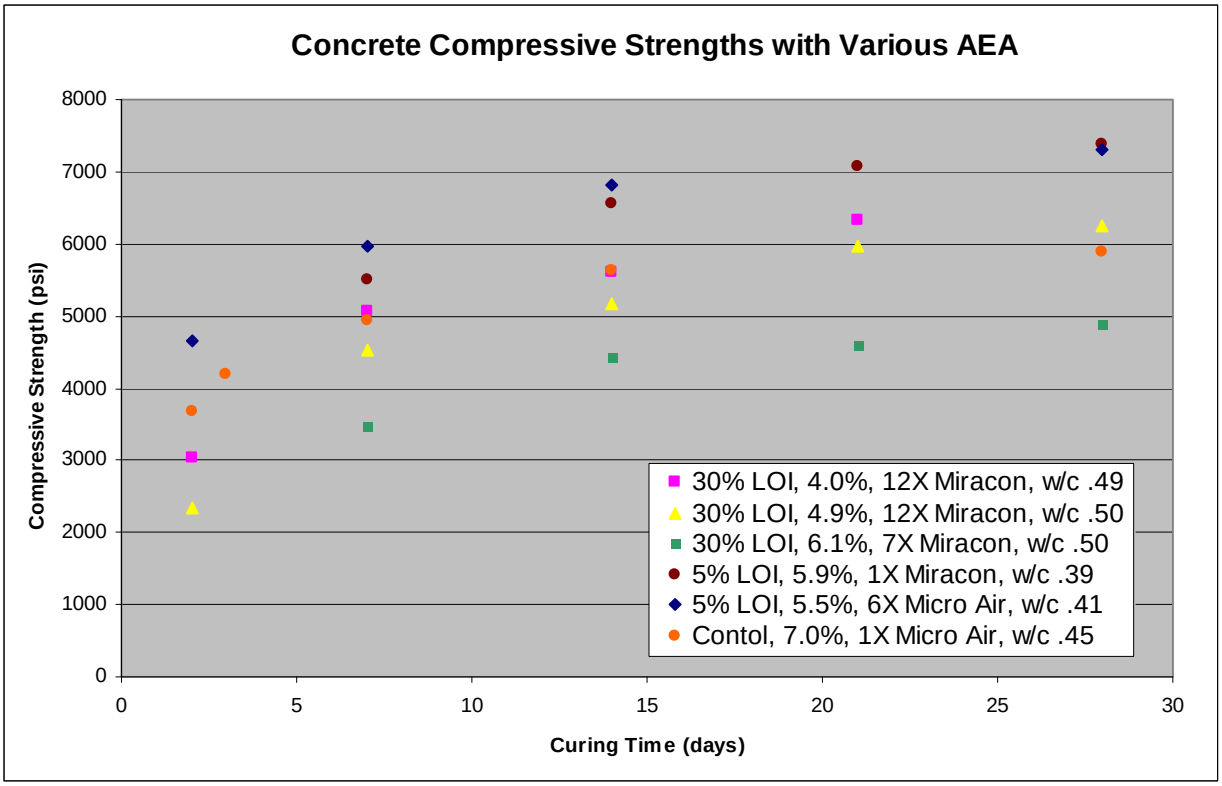

Figure 9. Concrete Compressive Strength Results

Hardened Air Void (HAV) tests on select test batches at 5% and 30% LOI showed good air void size and spacing, which is a predictor of freeze/thaw durability.

The first field test of the new foam and batch design was performed in the first week of January at Sky Ute Sand & Gravel in Farmington, New Mexico. Two drums of TOXECON™ ash were shipped to the site for testing. The ash was blended with water in order to minimize dusting and to allow exact additions of the ash to the truck (Figure 10). The batch size for these field tests was 4 cubic yards each. This is considered the minimum amount that can be used in a truck and still have representative mixing.

Figure 10. TOXECON™ Ash Added to Concrete.

There were water dosage issues with the first two batches so they were discarded for being either too wet or too dry. Either condition results in poor air retention. A 2% LOI blend on the second day had sufficient air content (5.6%) and slump (6”) so cylinders were made for compressive strength testing. Figure 11 shows the strength data through 28 days. The strength at 28 days is very good and at the targeted level. The HAV data showed a lower air content at 3.8% indicating that the air was not stable during curing. This issue has since been corrected with the new admixture formulation.

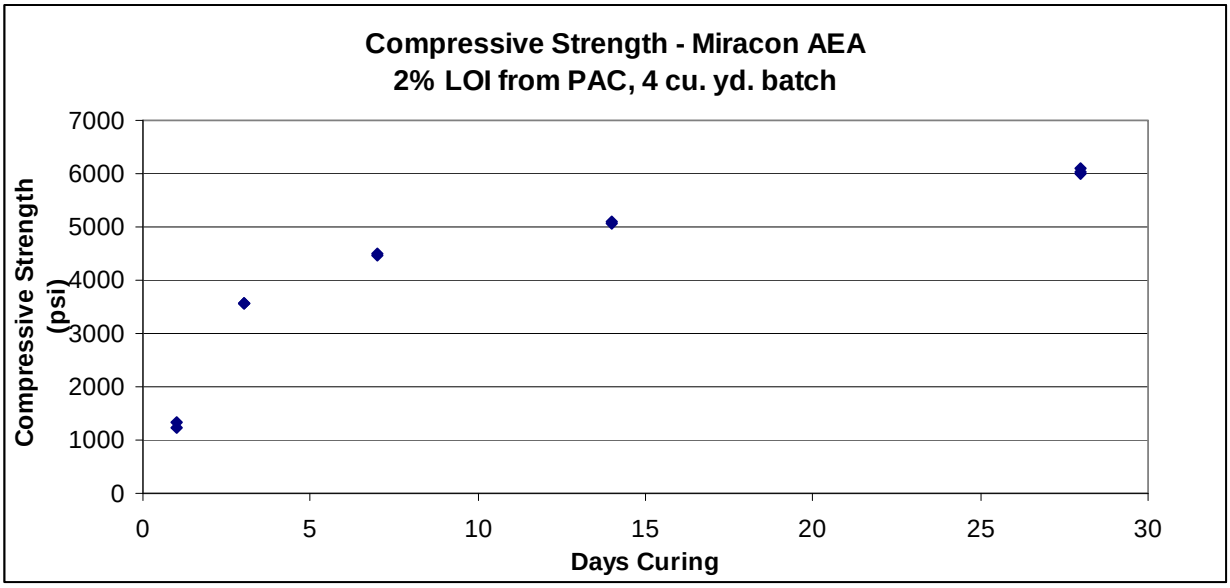

Figure 11. Compressive Strength Data - Field Test at Sky Ute S&G.

TOXECON™ ash will be used to make a 30 x 60 ft concrete pad at the Presque Isle Power Plant in May 2009. This pad will be used for bottom ash dewatering so it will be designed for freeze/thaw durability and moderately high strength (6000 psi) so that it can withstand heavy equipment use.

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

Work was suspended this quarter on updating the Preliminary Design Document. Next quarter this effort will continue, focusing on changes to the ash unloading system and ductwork that have been completed since the initial installation.

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:

- A 6-month, no-cost extension was requested by We Energies and approved by DOE, extending the project to September 30, 2009
- Quarterly Technical Progress Report delivered
- Quarterly Financial Status Report delivered
- Quarterly Federal Assistance Program/Project Status Report delivered
- Presented at the McIlvaine Hot Topic Hour in January 2009
- Presented on five topics at the EUEC in February 2009
- Presented at the EPRI Advisors meeting in March 2009
- We Energies received the Technology Transfer Award from EPRI
- Submitted an abstract to Concrete International magazine in March 2009

CONCLUSION

This is the twentieth Quarterly Technical Progress Report under Cooperative Agreement Number DE-FC26-04NT41766. A six-month no-cost extension was requested and granted by DOE, extending the project to September 30, 2009. All major construction efforts were completed during 4Q05, and only punch list items remained during the current quarter. Operational issues that were addressed included construction of a partial enclosure around the base of the ash silo, and duct temperature monitoring.

A series of alternative PAC tests were performed in February. All six sorbents were provided by ADA-ES and were tested using temporary injection equipment. Data from the parametric tests was compared with DARCO® Hg LH. All of the ADA-ES PACs performed as well or better than the LH carbon when compared at 330°F and 340°F.

Work continued on the ash management task this quarter. In January, field tests were performed at Sky Ute Sand and Gravel, a Ready Mix company in New Mexico. ADA-ES continued developing laboratory formulations for using PAC-containing fly ash in the preparation of structural concrete. Test results from several batches showed good air stability with the improved foam formulation and a high LOI ash replacement. Hardened air void analysis showed good freeze/thaw durability for all of the concrete samples tested. A full-scale demonstration of the use of high carbon ash in concrete is planned for May 2009 at PIPP. A 30 x 60 ft pad will be poured at that time using 30% LOI ash from the TOXECON™ baghouse.

Several CEM operational maintenance efforts were performed this quarter. The project team is actively involved in a number of reporting and technology transfer activities.