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

Quarterly Technical Progress Report
Reporting Period: July 1, 2006 – September 30, 2006
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DISCLAIMER

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

LIST OF FIGURES

LIST OF TABLES

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 has 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 will be responsible for construction, management, and start-up 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 July 1, 2006, through September 30, 2006. During this reporting period, work was conducted on the following tasks:

- Task 10. Erect Structural Steel, Baghouse, and Ductwork
- Task 11. Balance-of-Plant Mechanical and Civil/Structural Installations
- Task 12. Balance-of-Plant Electrical Installations
- Task 15. Operate, Test, Data Analysis, and Optimize TOXECON™ for Mercury Control
- Task 18. Revise Design Specifications, Prepare 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

Contractor mobilization was completed in 2Q05. Jamar, Boldt, Northland Electric, United Anco, PCI, Wheelabrator, and CaTS demobilized from the site during 4Q05. CaTS personnel completed their assignments and CaTS Construction Management Team demobilized from the site during 1Q06.

Task 9 – Foundation Erection

All major foundation work by Boldt Construction Company was completed during 1Q05.

Task 10 – Erect Structural Steel, Baghouse, and Ductwork

The erection work associated with this task was initiated during 2Q05.

The work effort for this task during 3Q06 was limited to some minor work associated with the siding, sealing of the baghouse enclosure, and sealing of the baghouse compartment covers to address exception/punch list items.

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

Primary work associated with this task was completed in 4Q05. The primary exception/punch list items addressed this quarter included some minor access platform work in the ID Booster Fan Enclosure, modifying the ash silo wet unloading system to prevent dusting, and maintain a controllable flow of ash/PAC mixture from the silo. In addition, data were collected for potential modifications to the ventilation system in the ID Booster Fan Enclosure.

Task 12 – Balance-of-Plant Electrical Installations

Primary work associated with this task was completed in 4Q05. Exception/punch list item completion was the primary focus during this quarter. The primary exception/punch list activity was a minor modification to the controls for the heating and ventilation system in the ID Booster Fan Enclosure.

Task 13 – Equipment Pre-Operational Testing

Pre-operational testing was completed in 4Q05.

Task 14 – Start-Up 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 3Q06, the CEMs were monitored for long-term operation and several upgrades were made to the software and hardware. In order to sample from each of the three inlet locations and enable EPA-compliant filter calibrations on both inlet and outlet CEMs, Thermo and ADA-ES engineers installed new equipment and conducted several maintenance items that periodically had an impact on performance, including the following:

- Upgraded software (analyzers and calibrators)
- Upgraded calibrators (removed the vacuum pumps and replaced them with pressure relief valves on the exhaust)
- Installed shut-off valves on all probes for isolation during filter calibrations
- Installed two new probes (Thermo 83i) and probe controllers (Thermo 82i) for Units 7 and 9. Shut-off valves were added to the new probes
- Installed stream-switching "Hydra" (Thermo 84i) on inlet to allow manual, remote, cycling through Units 7, 8, and 9 probes (Figure 1 below)

Figure 1. Inlet CEM Hydra Configuration.

Several of these modifications resulted in issues that required troubleshooting during August and September. The most significant issues were related to the calibrator modifications at the inlet, which caused faulty calibrations for most of August. Data from this time were adjusted to account for pressure differentials that affected the readings.

In addition to CEM upgrades, there were changes made to air and power supplied to the inlet CEM shelter. There was a concern that the air supply to the inlet CEM shelter was now not adequate to run three dilution extraction probes and the other CEMS equipment in the shelter. To assure enough air was available for all CEMS, part of the air was diverted from the CEM drying system through a filter/regulator. This air will now be used to feed the clean dry air required for the eductor and blowback. The existing wall-mounted dryer system provides the zero-grade instrument air and will continue to be used for the dilution air and calibration.

PIPP electricians installed a new transformer to provide power to all three inlet umbilicals and extraction probes. The umbilical requirements are:

- Unit 7, 200 ft, 13.64 amps
- Unit 8, 130 ft, 17.73 amps
- Unit 9, 170 ft, 23.18 amps

Calibration at Inlet (Probes 7 and 8)

August Span and Zero: Span was erratic until 8/19/06, span on 8/26/06 was high, otherwise range was –6.41 to 8.82% error. Zero range was –1.03 to 1.19 µg/m^3. Span value was changed from 8 to 11 µg/m^3 on 8/12/06.

September Span and Zero: Span error was high on 9/2/06 to 9/5/06, when the dilution ratio forced to adjust for pressure regulator setting. Range thereafter was –5.53 to 6.33% error. The zero range was –0.74 to 0.37 µg/m^3.

Linearity Check at Inlet (Probe 7)

The linearity check on the inlet CEM was performed in September. Probe 7 was being used at the time. Figure 2 shows the data from the linearity testing. The inlet CEM passed.

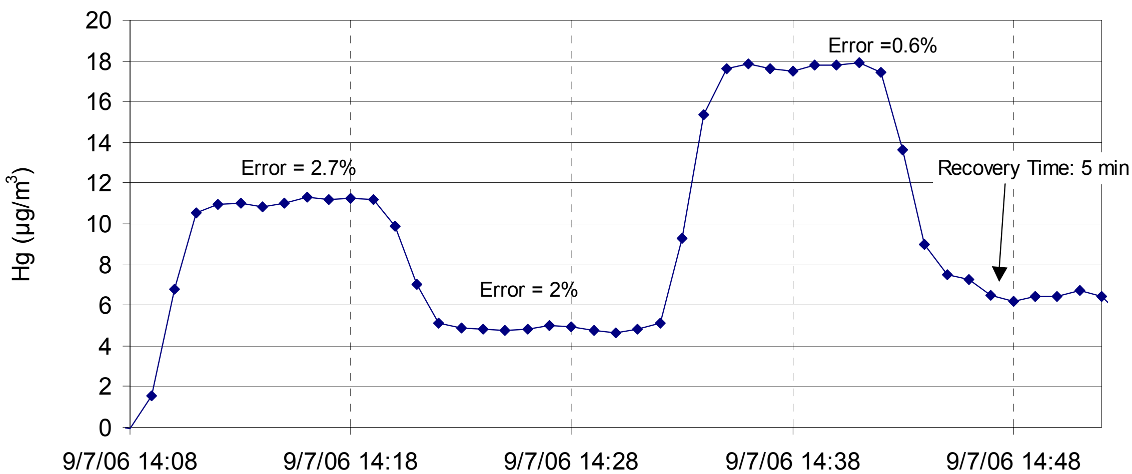


Figure 2. Linearity Check on Inlet CEM.

Calibration at Outlet

August Span and Zero: The span was low from 8/13/06 through 8/17/06. The error range was –4 to 6%. The span was changed from 11 to 5 µg/m^3 on 8/30/06. The zero reading was high on 8/16/06 and 8/17/06. The range was –1.47 to 0.52 µg/m^3.

September Span and Zero: The span was consistently high and the error ranged from 0 to 10%. The zero ranged from –0.21 to 0.49 µg/m^3.

Ash Silo

At the end of last quarter, PAC injection had been stopped due to problems unloading the ash silo. A new diffuser-type flow control valve had been installed in the wet unloader, and it proved to be inadequate for controlling the flow of PAC/ash into the pin mixer. The valve is designed to meter PAC/ash from the silo into the pin mixer, where it was then sprayed with water. The PAC/ash mixture would bridge across the opening in the valve, resulting in limited flow into the mixer. When operators would open the valve wider, the material would then drop out in a large amount, overwhelming the mixer and resulting in a considerable amount of dust as the material is discharged into the truck (Figure 3).

Figure 3. Dust Emissions during Ash Silo Unloading.

In July, the ash silo provider recommended that air cannons be installed in the silo and a fluidizing nozzle be installed for the control valve to overcome problems with fluidizing the PAC/ash during unloading into the wet mixer. An access door had to be cut into the side of the silo to allow installation of the air cannons. This work was complete in mid-August, allowing PAC injection to resume, although the new changes had not been tested.

At the end of August, the modified ash unloading system was tested and found to still be excessively dusty. Although there was improved flow control of ash into the wet mixer, excessive dusting was still an issue. Based on the results of this test, it was determined additional modifications were needed. These included adding internal baffling to the wet mixer, adding a flexible discharge chute to enclose the area of free-fall from the wet mixer to the ash truck, and changing the water spray nozzle configuration. In mid-September, these changes were tested but still did not result in dustless operation. An additional test was done using a surfactant added to the spray water. This seemed to help reduce the dusting but did not eliminate it.

In order to continue with parametric testing, an alternative method for emptying the ash silo was tried using a vacuum truck. This proved to be dustless at the plant site but resulted in difficulty unloading the truck at the ash landfill. As a result, on September 22, 2006, PAC feed was discontinued.

At the end of September, a trailer-mounted aggregate mixing plant was brought to the site. This equipment had been used successfully at other facilities to process PRB ash. Although it had never been tried on PAC/ash, there were expectations that it could provide a dustless mix and a temporary solution to the material handling problem. However, the equipment was not able to control dusting and this test was halted.

In addition, at the end of September an alternative ash unloading technique was tried. This involved using the dry ash unloader to fill a bulk hopper trailer for hauling to the ash landfill. At the landfill, a water sluicing connection was used to empty the hopper. Although this minimized any dust formation, it generated excessive water.

The vendor for the ash unloading system, United Conveyor (UCC), conducted extensive pilot-scale testing using PAC. At the end of September, they reported successfully generating a dust-free product in their test lab. They indicated that a redesign of the existing wet unloader based on their test results should effectively solve the ongoing material handling issue. The redesign would include a new mixer cover, raising the spray nozzles, dividing the mixer into three compartments, increasing the mixer speed, adding a stop to the diffusion valve, and adding a surfactant to the spray water. It was expected that the modifications to the wet unloader would be ready for testing by mid-October.

The project engineering team has been contacting other vendors of dust handling equipment to find an alternative supplier in case the UCC equipment continues to prove unsatisfactory. One approach that has been considered is using a batch-type dust mixing process. Equipment of this type has been successfully used at other facilities, primarily on PRB ash. Samples of PAC/ash have been sent out for testing to various vendors. Reports on how well they handle this material are expected next quarter.

Parametric Test Results

DARCO® Hg Activated Carbon

Parametric testing of PAC injection resumed on August 18, 2006, at 0.5 lb/MMacf using DARCO® Hg carbon. The PAC injection concentration was increased approximately every 72 hours in 0.5 lb increments up to 3.0 lb/MMacf. Figure 4 shows TOXECON™ data from August 18 through September 12, including inlet and outlet mercury readings, PAC injection concentration, flue gas temperature, flange-to-flange pressure drop, tube sheet pressure drops, total boiler load for all three units, flue gas volume entering the baghouse, and mercury removal. The inlet mercury was measured in both Unit 7 and Unit 8 during this time and showed similar mercury values.

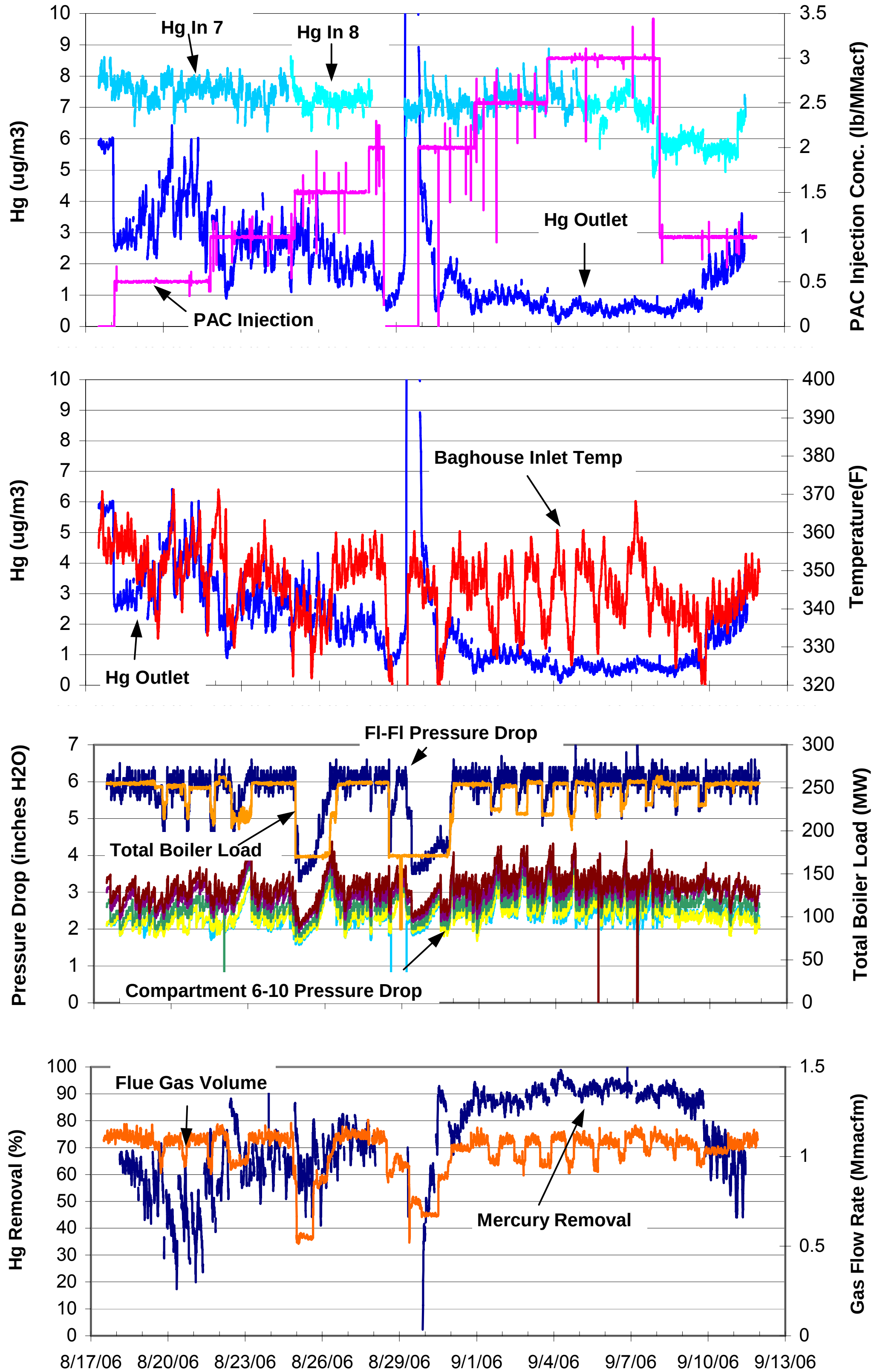


Figure 4. Baghouse Performance Data for 8/17/06 through 9/12/06.

On August 28, 2006, PAC injection was stopped because burning embers were found in compartment 6 hopper. Operators had been pulling ash every 4 hours and thought that compartments were emptying, but could not quantify this while they were on line. Compartment 6 was isolated and the hopper material was cooled and removed without incident. Ash removal frequency was increased from every 4 hours to every 2 hours with a double pull done on each compartment. The compartment was put back on line and PAC injection resumed on August 30.

A comparison of the overall removal efficiencies from the first (February 2006) and second rounds (August 2006) of parametric tests can be seen in Table 1 and Figure 5. The data from February were obtained from the CEM data files and were based on 1-minute averages. The data from August were also from the CEMs and were based on 5-minute averages, which is the preferred method according to Thermo. Mercury removal presented in this report from the February tests has been recalculated using the CEM data instead of the EDS data, which allows for better statistical calculations.

Table 1. Comparison of Parametric Tests using DARCO® Hg.

Inj. Conc. (lbs/MMacf)	Feed Rate (lbs/h)	Average Removal Efficiency 2/06 (%)	Median Removal Efficiency 2/06 (% RE)	Standard Deviation 2/06 (% RE)*	Average Removal Efficiency 8/06 (%)	Median Removal Efficiency 8/06 (% RE)	Standard Deviation 8/06 (% RE)*
0.5	30	37.4	38.7	+/- 7.6	49.1	48.0	+/- 12.6
1.0	60	69.8	70.2	+/- 4.9	67.3	66.6	+/- 7.1
1.5	90	77.5	77.4	+/- 4.4	73.7	74.4	+/- 4.3
2.0	120	93.7	93.5	+/- 3.6	79.4	80.0	+/- 5.5
2.5	150				89.7	89.9	+/- 2.0
3.0	180	95.4	95.9	+/- 3.5	89.9	89.7	+/- 1.6

*Example: At 2.5 lb/MMacf the removal efficiency is 87.7 – 91.7%

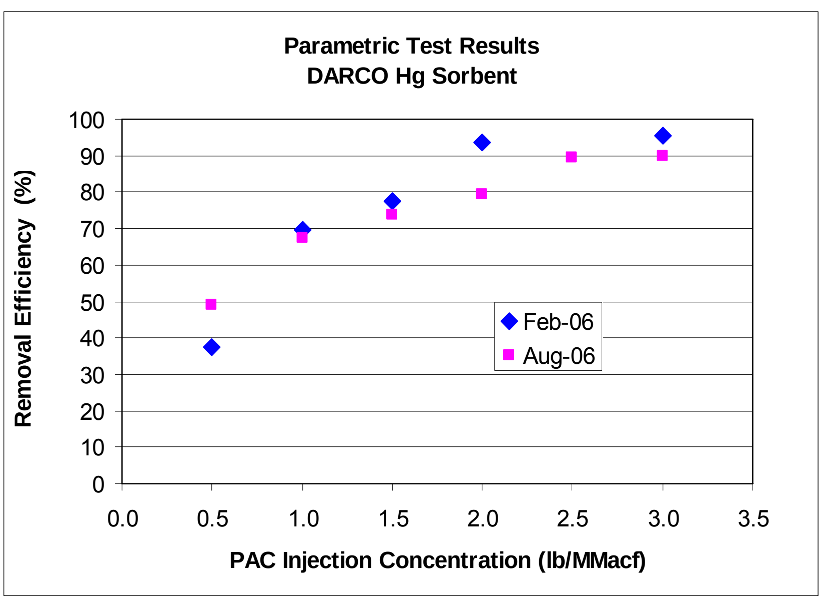


Figure 5. Mercury Removal using DARCO® Hg Sorbent.

In general, the removal efficiency was higher in February than August, especially at injection concentrations of 2.0 and 3.0 lb/MMacf. This may be due to the difference in the baghouse temperatures during winter and summer. Table 2 shows the baghouse inlet temperature ranges and averages for each injection concentration during February and August of 2006. Figure 6 shows how removal correlates with temperature. Except for 0.5 lb/MMacf, increased temperature results in lower removal using DARCO® Hg sorbent.

Table 2. Baghouse Temperature during Parametric Testing.

Inj. Conc. (lbs/MMacf)	Minimum Temp. 2/06 (F)	Maximum Temp. 2/06 (F)	Average Temp. 2/06 (F)	Minimum Temp. 8/06 (F)	Maximum Temp. 8/06 (F)	Average Temp 8/06 (F)
0.5	332	342	337	333	366	352
1.0	333	343	338	322	357	345
1.5	332	344	337	346	359	352
2.0	329	342	335	337	360	349
2.5				330	359	342
3.0	318	327	333	333	367	345

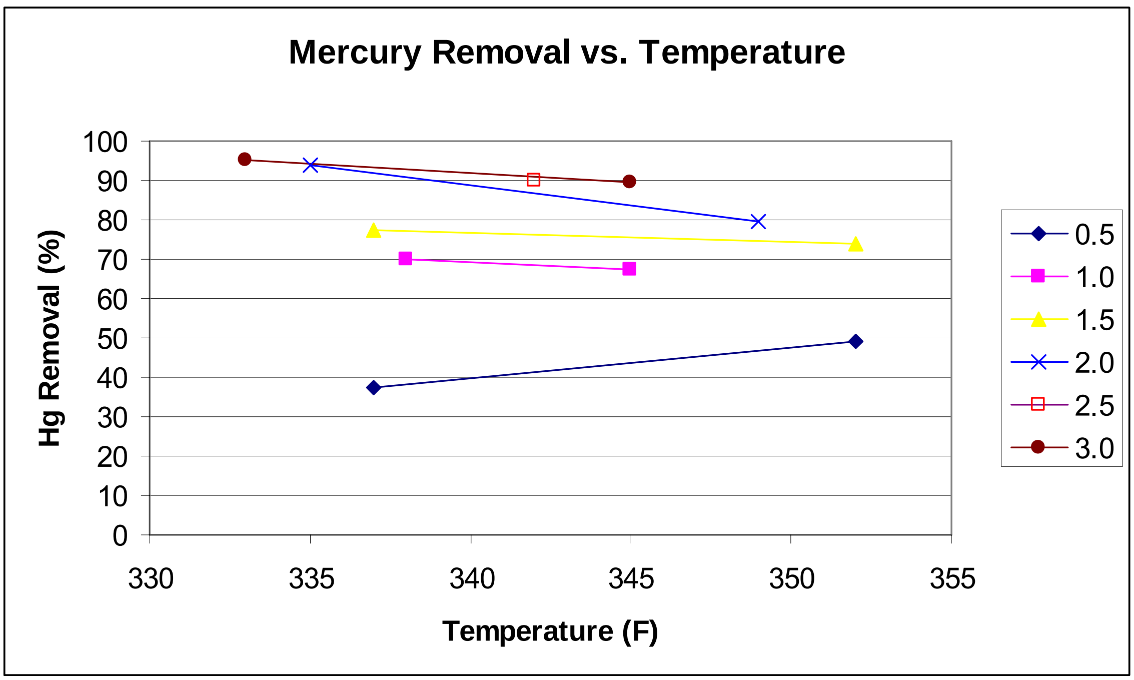


Figure 6. Effect of Temperature on Mercury Removal Using DARCO® Hg.

DARCO® Hg-LH Activated Carbon

On September 8, after the completion of the parametric testing using DARCO® Hg, a truckload of DARCO® Hg-LH was placed in the silo on top of 4.7 feet of DARCO® Hg. PAC injection was set at 1 lb/MMacf while the changeover to the LH occurred. Figure 7 shows performance data for the period covering changeover and the beginning of parametric testing of the DARCO® Hg-LH. On September 15, the outlet mercury decreased and the variability decreased, even though the flue gas temperature was increasing. This is when DARCO® Hg ran out and was replaced by the Hg-LH. During this period of injection with Hg-LH at 1 lb/MMacf, the mercury removal was between 80 and 90%.

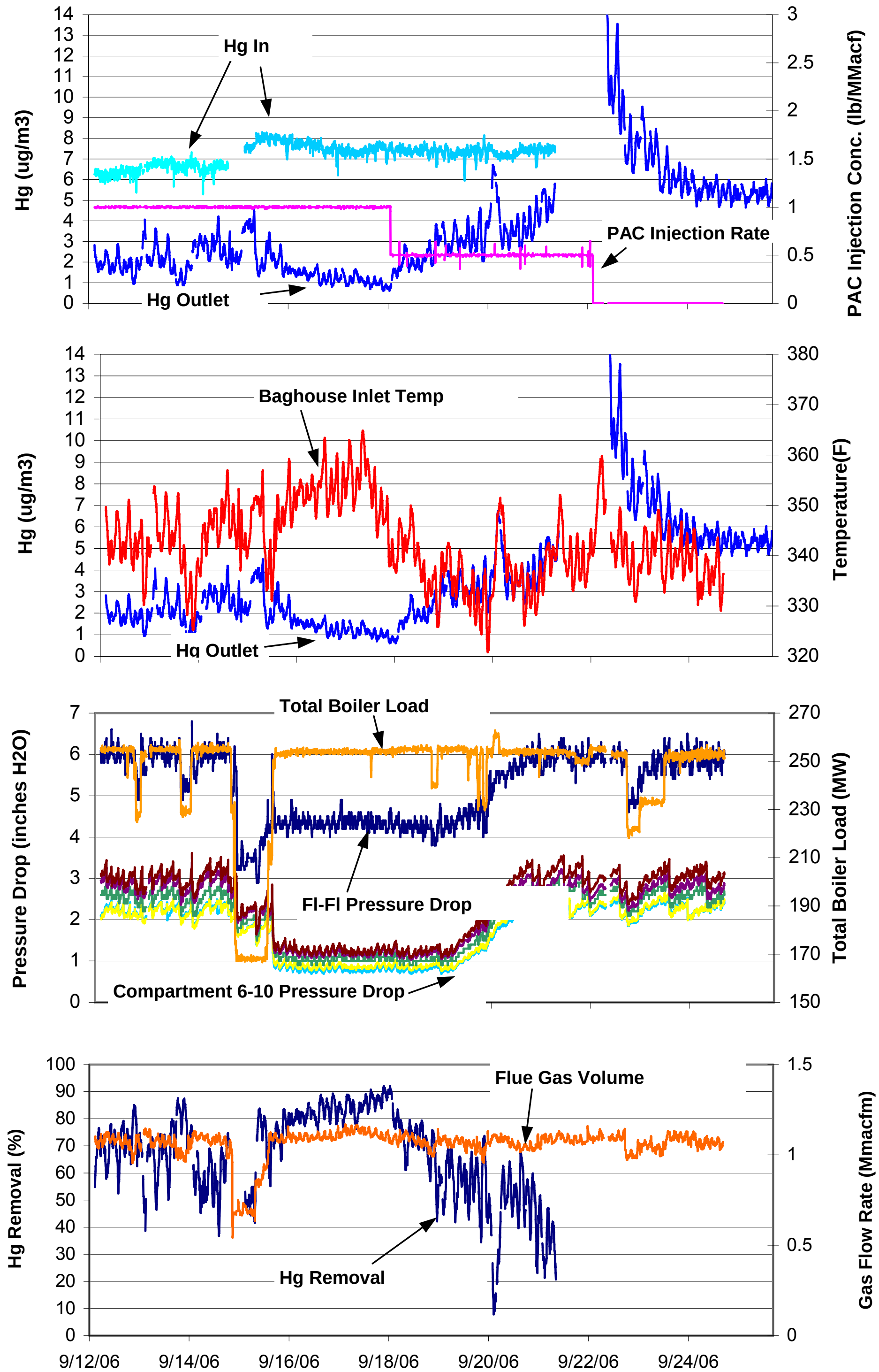


Figure 7. Change from DARCO® Hg to DARCO® Hg-LH.

The graphs show a reduction in baghouse differential pressure and compartment differential pressure both during and after the Unit 8 outage on September 15. When a unit is brought off line the flow decreases by about one-third, which significantly lowers pressure drop. To assure that the baghouse cleans at reasonable intervals, the set point to initiate a clean is lowered from 6.5 to 4.6 inches H_2O. When Unit 8 came back on line, this set point was not reset for three-unit flow and the baghouse cleaned on a more frequent basis (approximately hourly). The increased cleaning is the cause of the unusually low pressure drop between September 15–18. After the operators reset the controls for three units (on September 19), the differential slowly came back up. After reaching the normal set point of 6 inches H_2O on September 21, the baghouse cleaned approximately every 4 hours. There is a possibility that the low mercury removal corresponded to not pulsing the bags and the high mercury removal corresponded to pulsing the bags more frequently. Also, when the bags were pulsed every 4 hours rather than every hour, the mercury removal rate was worse. This possible correlation between the amount of time the carbon is on the bags and the mercury removal rate will need to be investigated with more testing.

On September 18, the injection concentration was reduced to 0.5 lb/MMacf, which marked the start of parametric testing with the brominated sorbent. When the injection concentration was reduced to 0.5 lb/MMacf, the outlet mercury concentration began to increase steadily and showed an increased sensitivity to temperature variations.

Hopper Temperatures

Figure 8 shows the wall temperatures for compartment 6 during overheating in the hopper. The wall temperature peaked at 403°F on the south wall in compartment 6. After compartment 6 overheated, the hopper heaters were set at 175°F as the low point and 200°F as high point.

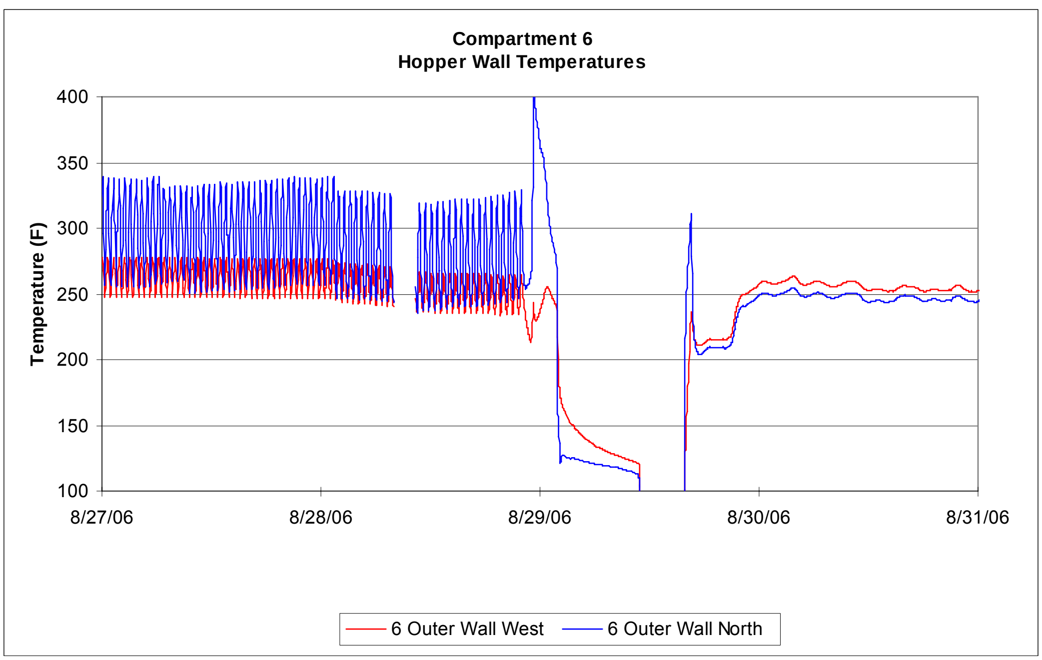


Figure 8. Compartment 6 Hopper Temperatures.

Appendix A shows detailed graphs of each compartment thermocouple for August 17 through September 24. Compartment 4 still had the four internal thermocouples that were installed in 1Q06. The set point change after overheating in compartment 6 resulted in many of the hopper heaters not cycling.

Overheating of PAC/ash

Investigations continue into the cause(s) of overheating of the ash mixture in the hoppers during February of this year. Tests are being conducted in the laboratory to determine the conditions that led to overheating. Previous thermogravimetric tests confirmed that the ignition temperature of PAC or of the PAC/ash mixture is around 850°F.

Literature searches revealed a model to predict auto-ignition of combustible materials called the Frank-Kamenetskii Model. This model predicts that spontaneous combustion can result from internal heating of a combustible solid if the solid is sufficiently porous to allow oxygen (air) to permeate it and if it produces heat faster than it can be liberated, which can happen with a highly insulating material. This phenomenon is normally associated with a relatively large mass of material (small surface to volume ratio). The model describes a relation between the radius of a specimen and the self-ignition temperature in a defined geometry.

Laboratory oven tests were conducted on different size square containers filled with PAC/ash mixtures from the hoppers at PIPP. The containers were made from carbon steel, which is the material used in the hoppers. 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 (Figure 9).

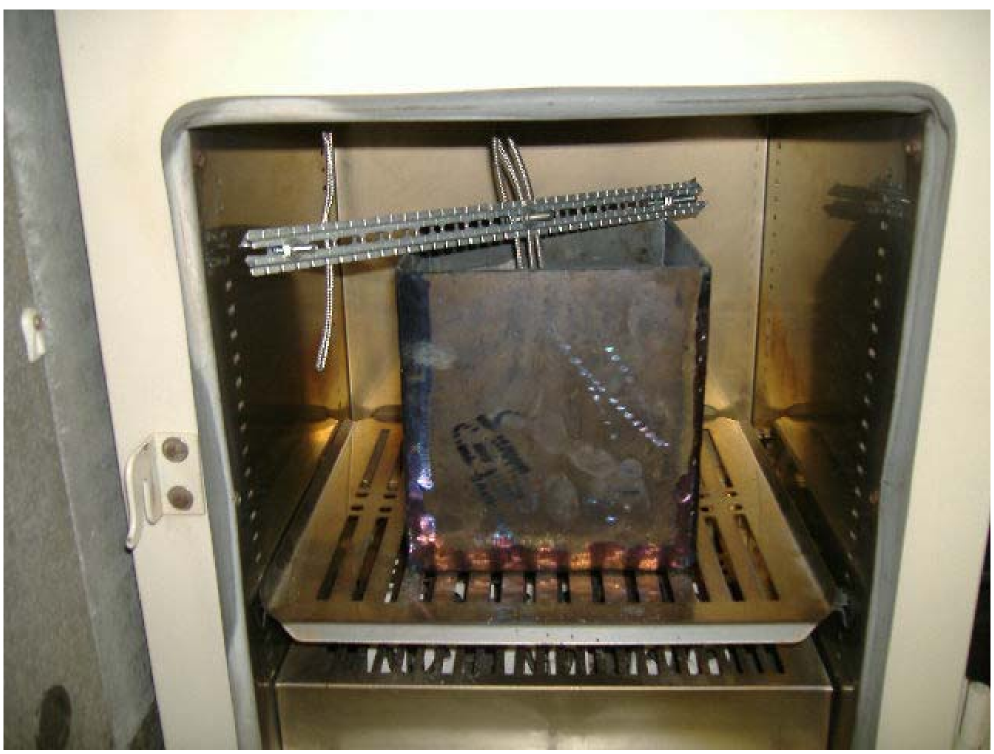


Figure 9. Laboratory Setup for Auto-Ignition Tests.

Temperature profiles from testing at 340°F and 430°F on a six-inch bed loaded with a PAC/ash material with a Loss on Ignition (LOI) of 26% are shown in Figure 10. These tests confirmed that at 430°F, sufficient heat was generated to increase the temperature of the mixture to ignition temperatures. The same test was performed using pure PAC and it showed a very similar ignition profile (Figure 11).

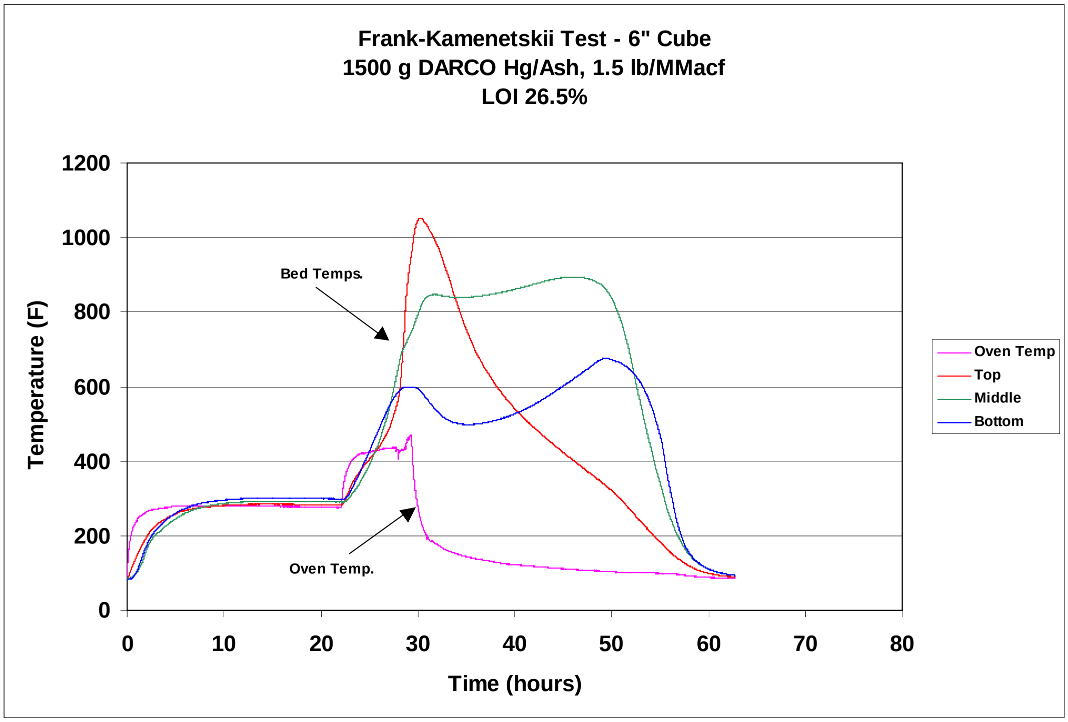


Figure 10. Auto-Ignition Test on 26% LOI PAC/Ash from the Hoppers at Presque Isle.

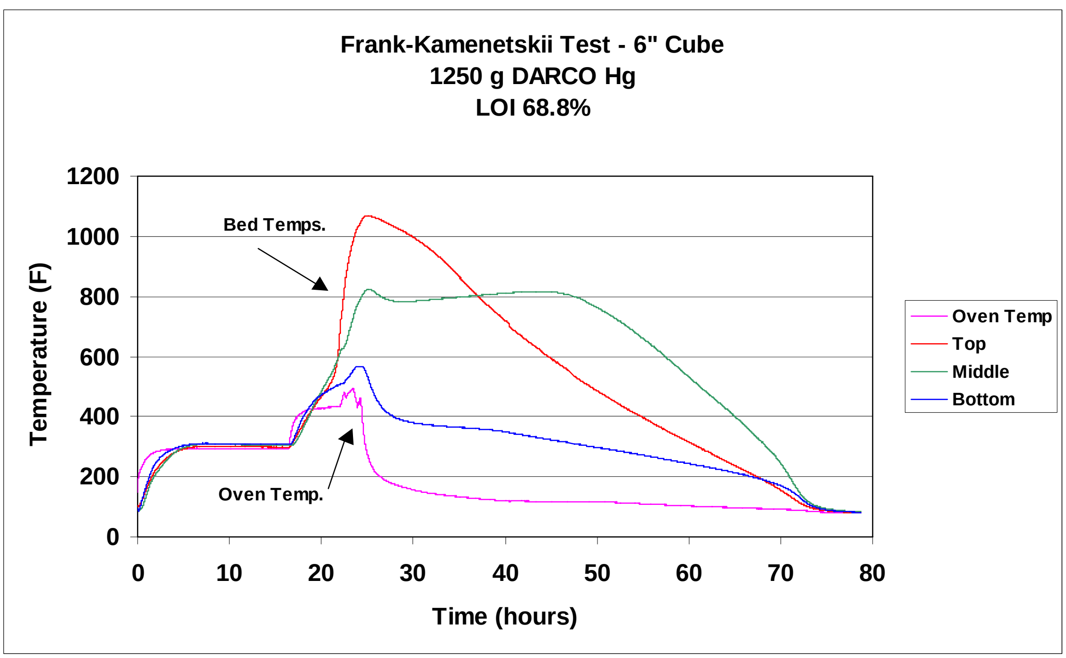


Figure 11. Auto-Ignition Test on DARCO® Hg PAC Only.

The same test was repeated using ash sampled from Presque Isle at lower injection concentrations and still using DARCO® Hg PAC. The LOI was measured at 7.8%. As seen in Figure 12, the sample overheated very little and did not auto-ignite at the same temperature as the higher LOI sample.

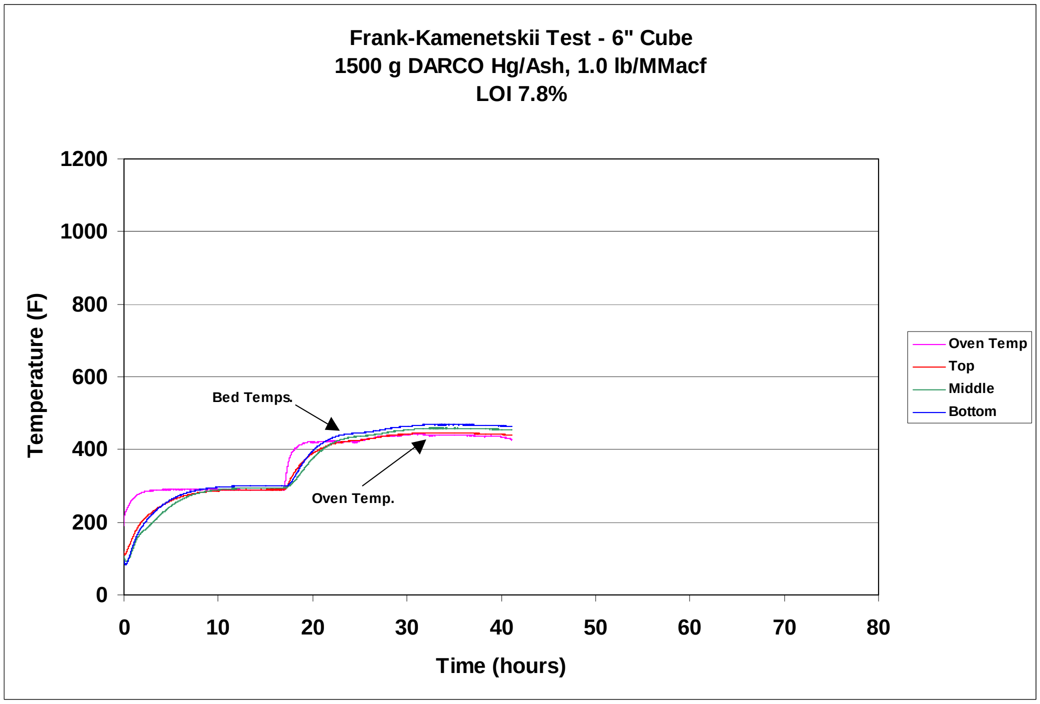


Figure 12. Auto-Ignition Test on 7.8% LOI PAC/Ash from the Hoppers at Presque Isle.

A test was performed on a sample of ash from a site with a high natural LOI in the ash (Figure 13). Approximately 35% of the LOI in the sample was natural and the remainder was from PAC injection. The overall LOI of the sample was 41.6%, which should have resulted in auto-ignition, but the sample showed very little overheating and did not auto-ignite at the same conditions as the high LOI ash at Presque Isle. This test indicates that LOI alone is not an indicator of auto-ignition risk.

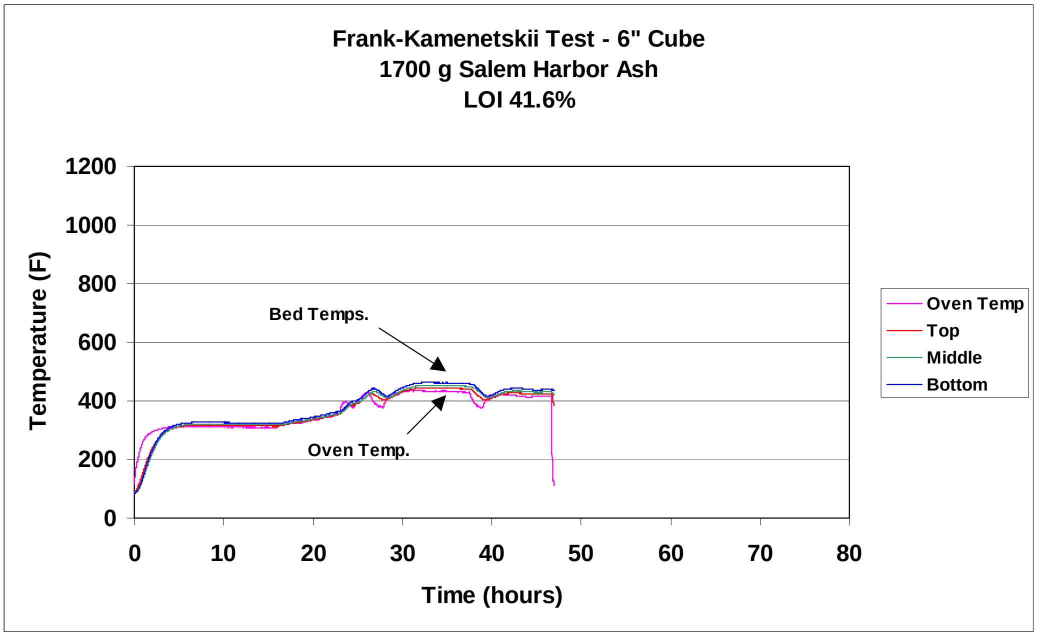


Figure 13. Auto-Ignition Test on 41.6% LOI PAC/Ash Sample.

The LOI was measured for various samples. Samples tested to date showed that PAC/ash mixtures with an LOI of 15% or lower did not ignite at the same conditions as those of 26% and higher. Further testing will be done next quarter to determine if there is a minimum LOI required for auto-ignition.

Tests are ongoing to determine the effect of the following on auto-ignition:

- LOI: Low LOI samples did not ignite at the same temperature as higher LOI
- Bed size: Smaller beds require higher temperatures to auto-ignite
- Oxygen concentration: Will a lower oxygen environment in the flue gas reduce the amount of heat generated?
- Carbon type: High natural LOI does not seem to ignite at the same temperature as high surface area carbon

Mercury Quality Index Test

Background and Objective

The standard tests used for quality assurance testing of activated carbon (iodine number, etc.) are not specific to mercury. Work began in 1Q06 to develop a test method for mercury uptake in sorbents, referred to as the "Mercury Quality Index," or MQI.

Work to Date

Several components were redesigned this quarter. Testing and further refinement of the apparatus will continue in the next quarter.

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

No work was done on this task during this reporting period.

Task 17 – Carbon/Ash Management System

No work was done on this task during this reporting period.

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

Work continued on preparation of C&B as-built drawings for the project during this reporting period.

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.
- Conducted tours for the following groups:
    - Thunder Bay Generating Station
    - Neill & Gunter
    - DTE
    - Consumer Energy
    - BW&L
    - AEP
    - MSSP
    - FTC&H
    - Environmental Testing Services
    - EON US
    - Louisville Gas & Electric
- Attended Reinhold's "APC Roundtable" in July 2006.
- Presented a paper at the MEGA Symposium in August 2006.
- Presented at the American Coal Council PRB Coal Users Conference in August 2006.

- Presented a poster at the 8th International Mercury as a Global Pollutant Conference in August 2006.
- Gave a workshop at Coal-Gen in August 2006, with ESP and baghouse design in a high-carbon environment as the topic.
- Presented at the Thermo Super Group Meeting in September 2006.
- Submitted a paper for the Symposium on Western Fuels.
- Submitted a paper for POWER-GEN International 2006.
- Submitted an abstract for the 2007 EUEC.
- Submitted an abstract for the Electric Power Conference.
- Working with ICAC to write a paper addressing the issue at PIPP, as well as other industry experience with overheating in high-carbon environments.
- Technical papers and presentations for future meetings include:
  - Symposium on Western Fuels (October 2006)
  - POWER-GEN International 2006 (November 2006)
  - EUEC (January 2007)
  - Electric Power Conference (May 2007)

CONCLUSION

This is the tenth 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. Work performed on punch list items included sealing the baghouse enclosure, sealing compartment covers, completing baghouse siding, completing the access platform in the ID booster fan enclosure, and modifications for the heating and ventilation system in the ID booster fan enclosure.

Upgrades to the mercury CEMS software and hardware were conducted this quarter. Two new probes were installed in Units 7 and 9 ducts. The stream-switching “Hydra” was installed and currently allows switching to sample flue gas from Units 7, 8, or 9. The inlet shelter air and power were upgraded to supply the new lines and probes for the Hydra.

Problems regarding the ash silo unloading and wet mixer operation continued this quarter. The ash flow control valve was replaced, which allowed better metering of the ash into the mixer. An access door, a fluidizing nozzle, and air cannons were installed in the silo to aid with ash removal from the silo into the mixer. Mixing still proved to be too dusty, so investigations into modifications to the mixer were undertaken by the equipment provider. These modifications will be installed and tested next quarter.

Because of problems with the wet unloader process, the dry unloader was tested and proven satisfactory. Mixing the dry ash at the landfill with water minimized dust formation, but generated excessive water.

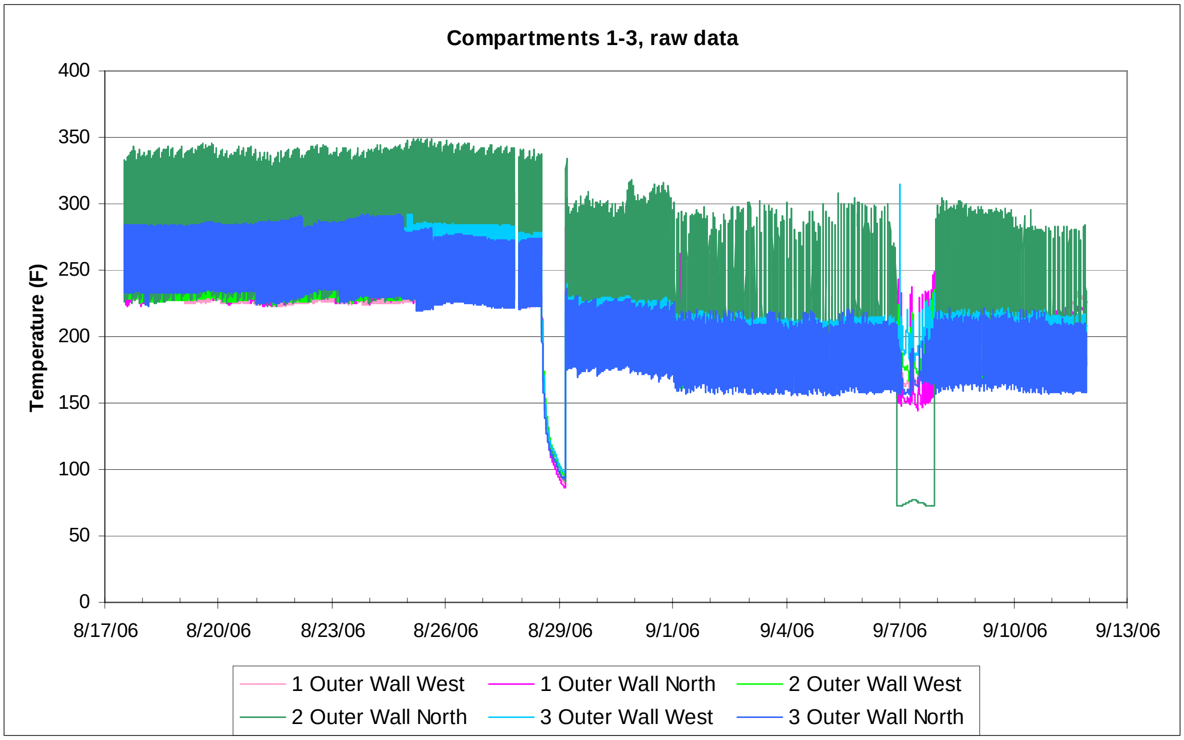
Parametric testing during August and early September was completed using DARCO® Hg carbon. Average removal ranged from 49.1% at 0.5 lb/MMacf to 89.9% at 3.0 lb/MMacf. Removal at 3.0 lb/MMacf in February of 2006 was 95.9%. Mercury removal was affected adversely by increased flue gas temperature at nearly all injection concentrations using this particular carbon. Parametric testing using DARCO® Hg LH, a brominated carbon, began in September but was halted due to problems with the ash mixer described earlier. Parametric testing will be resumed next quarter after modifications to the mixer are completed.

Laboratory tests on PAC and PAC/ash mixtures from Presque Isle showed that small volumes of this material could auto-ignite at temperatures in the low 400ºF range. Further work will be performed next quarter to determine the effect of bed size, LOI, and temperature on auto-ignition properties.

A Mercury Quality Index apparatus was designed and fabricated in 1Q06. Testing on the apparatus continued in this quarter after several changes were made to the design. Testing will continue into next quarter.

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

APPENDIX A - HOPPER TEMPERATURES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100
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8/20/06
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8/29/06
9/1/06
9/4/06
9/7/06
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9/13/06
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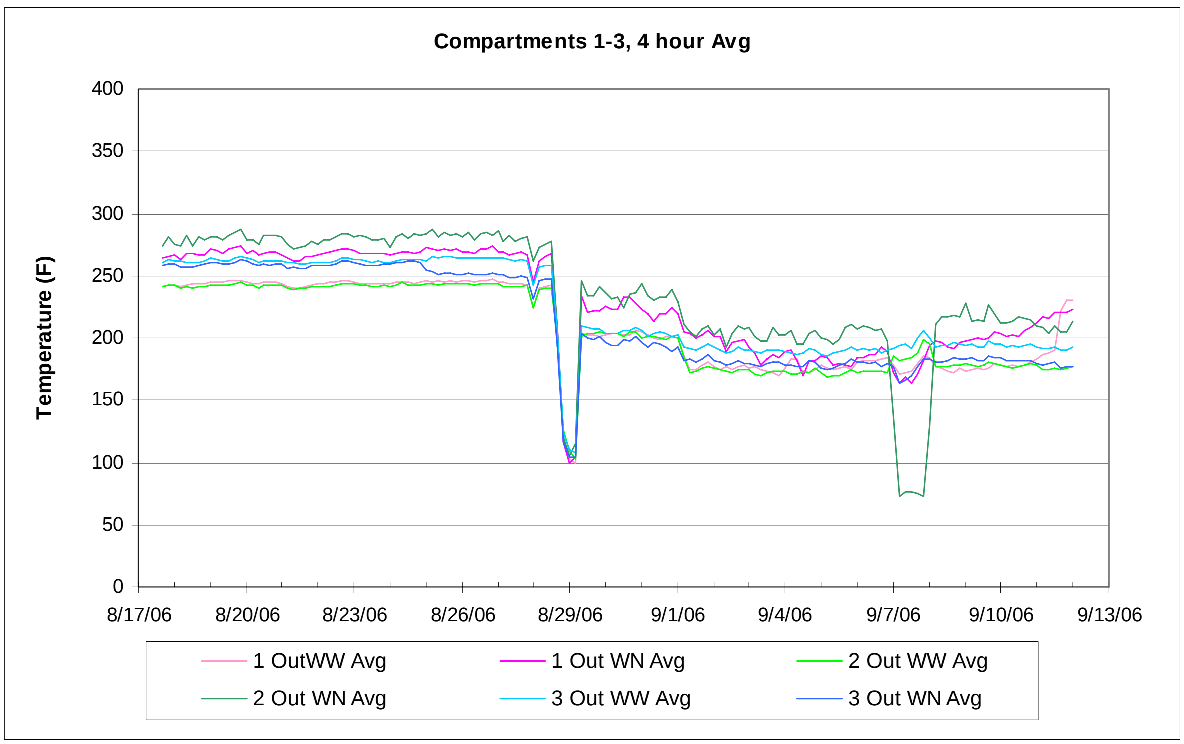
1 Outer Wall North
2 Outer Wall West
2 Outer Wall North
3 Outer Wall West
3 Outer Wall North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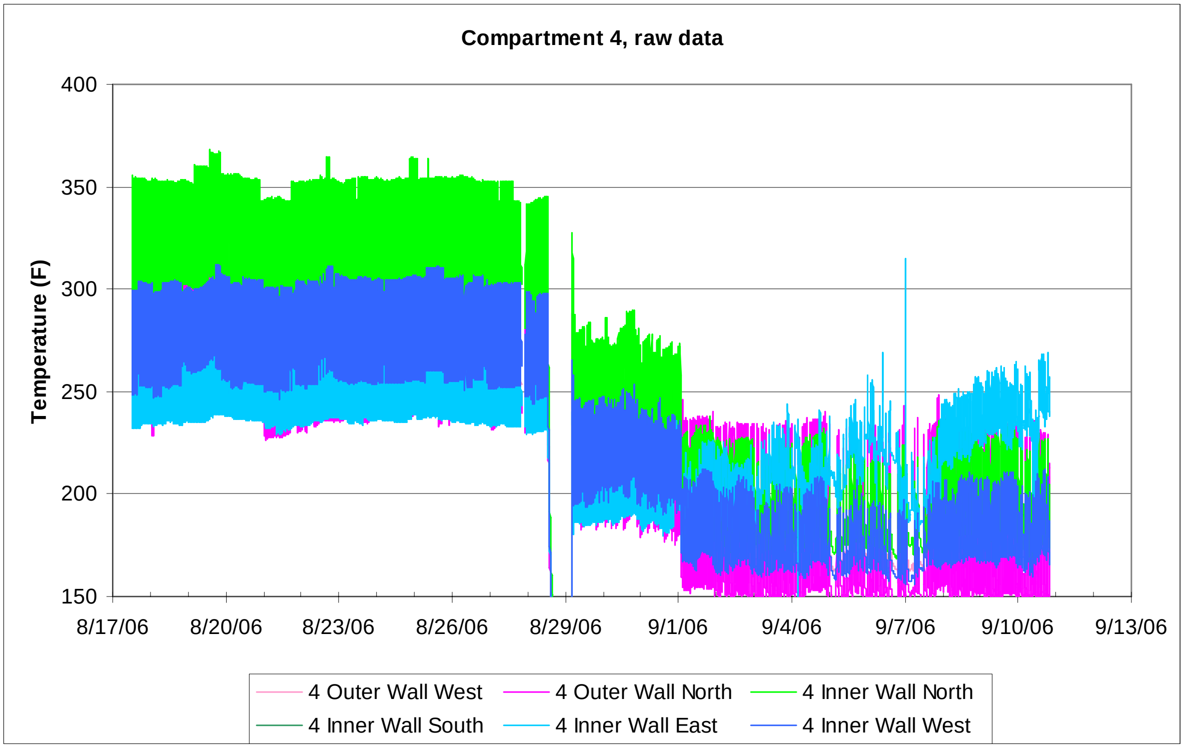
3 Out WN Avg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200
150
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9/4/06
9/7/06
9/10/06
9/13/06
4 Outer Wall West
4 Outer Wall North
4 Inner Wall North
4 Inner Wall South
4 Inner Wall East
4 Inner Wall West


Compartment 4, 4 hours Avg
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350
300
250
200
150
Temperature (F)
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8/20/06
8/23/06
8/26/06
8/29/06
9/1/06
9/4/06
9/7/06
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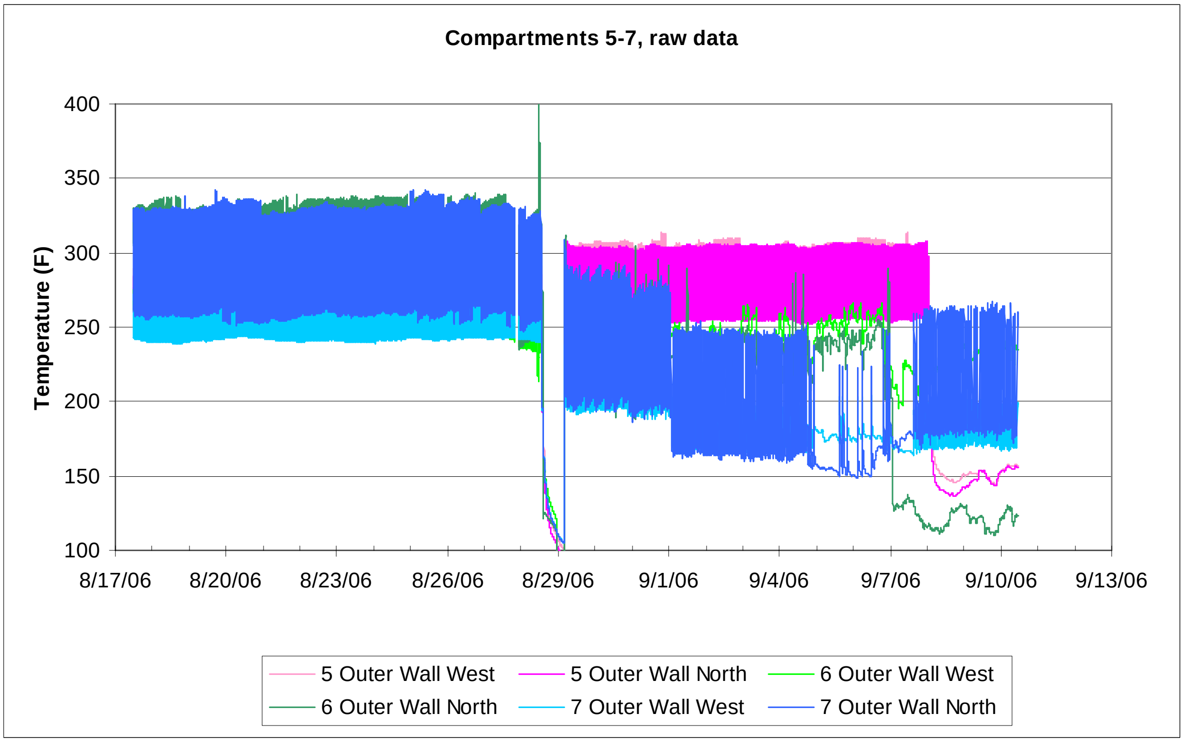
4 Inner WW Avg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9/1/06
9/4/06
9/7/06
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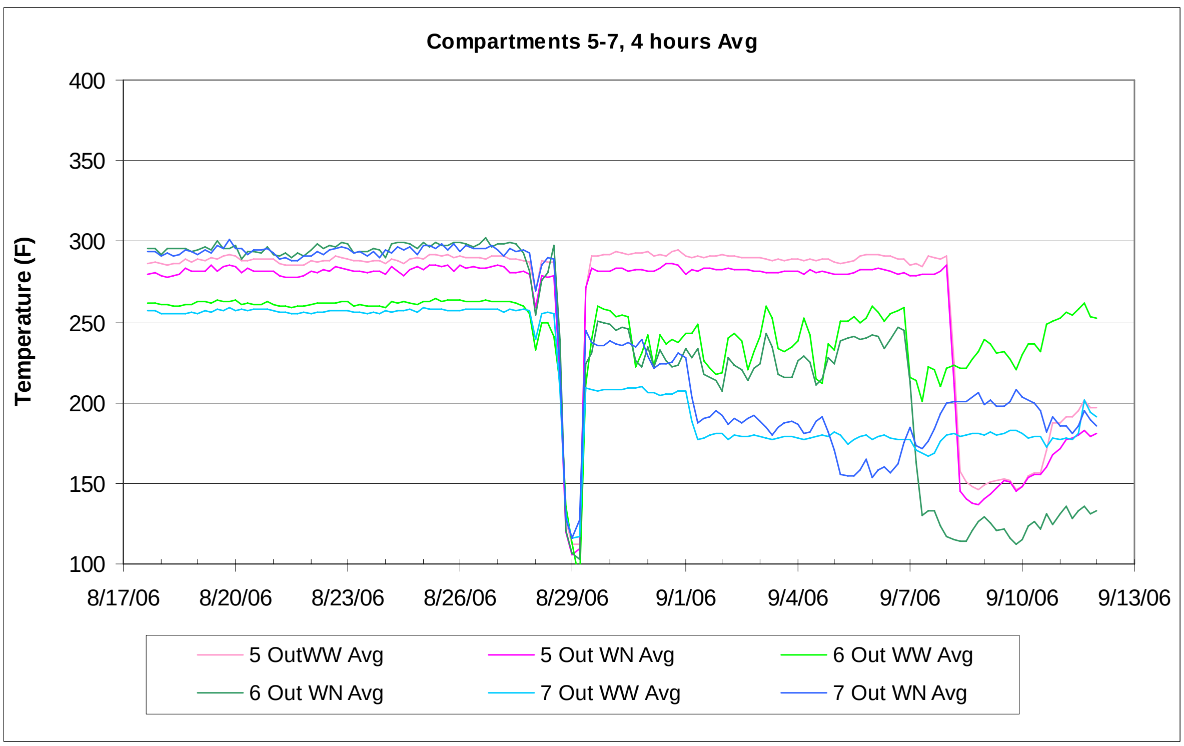
7 Outer Wall West
7 Outer Wall North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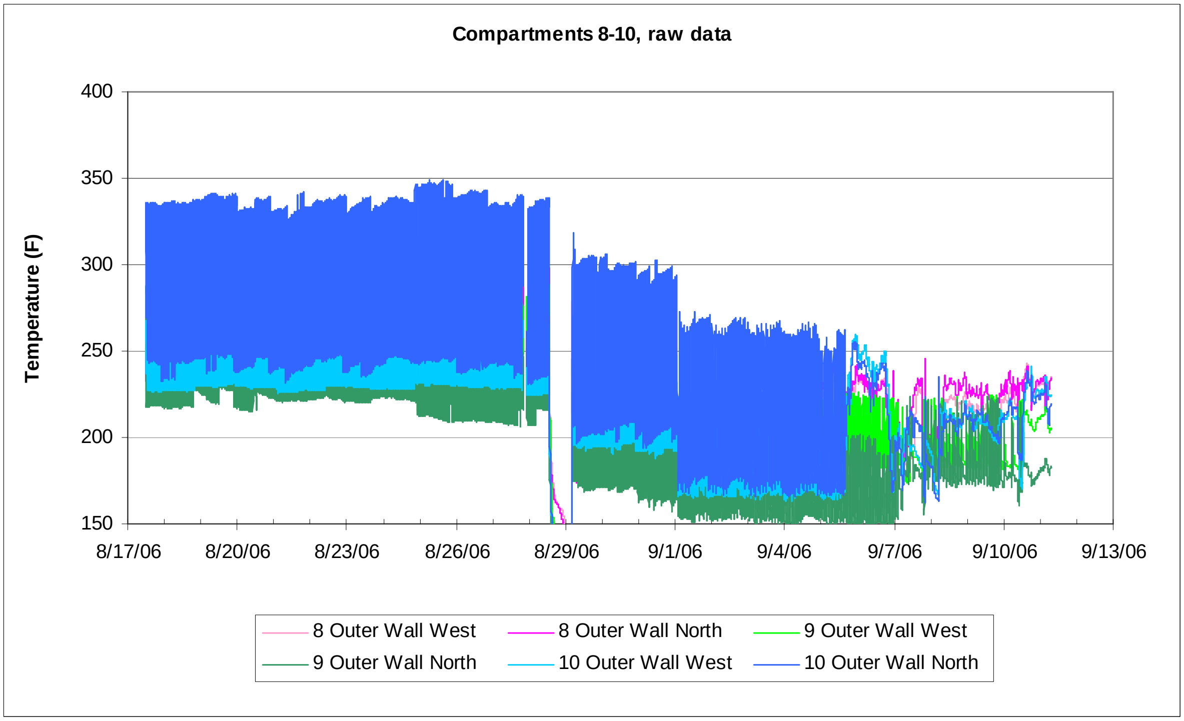
8/29/06
9/1/06
9/4/06
9/7/06
9/10/06
9/13/06
5 OutWW Avg
5 Out WN Avg
6 Out WW Avg
6 Out WN Avg
7 Out WW Avg
7 Out WN Avg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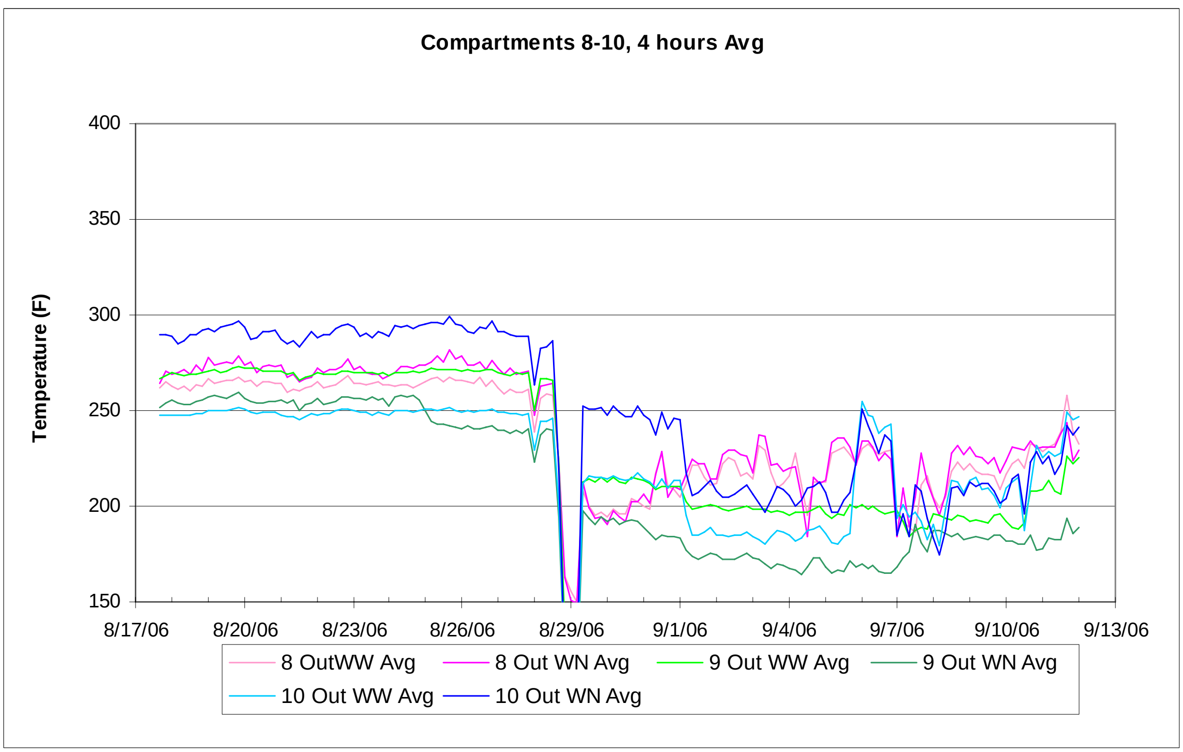
9/1/06
9/4/06
9/7/06
9/10/06
9/13/06
8 Outer Wall West
8 Outer Wall North
9 Outer Wall West
9 Outer Wall North
10 Outer Wall West
10 Outer Wall North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9/10/06
9/13/06
8 OutWW Avg
8 Out WN Avg
9 Out WW Avg
9 Out WN Avg
10 Out WW Avg
10 Out WN Avg