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Monthly

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LIST OF COMMON ABBREVIATIONS

A-S-H.....	Allen Sherman Hoff
BES.....	Bulk Entrainment Separator
CRG.....	Clean Raw Gas
CLS.....	Clear Liquor Scrubbing
DBA.....	Di-Basic Acid
DRG.....	Dirty Raw Gas
ECTC.....	Environmental Control Technology Center
EDR.....	Electrodialysis Reversal Membrane Unit
ESP.....	Electrostatic Precipator
FF.....	Fabric Filter
FGD.....	Flue Gas Desulfurization
FLRT.....	First Loop Reaction Tank
FRP.....	Fiberglass Reinforced Plastic
G/C.....	Gilbert/Commonwealth Inc.
GEESI.....	General Electric Environmental Services Inc.
HME.....	Horizontal Mist Eliminator
HSSD.....	High Sulfur Spray Dryer
HYPAS.....	Hybrid Pollution Abatement System
ID.....	Induced Draft
L/G.....	Liquid to Gas Ratio, (gal/1000ft ³)
MFT.....	Master Fuel Trip
MRT.....	Main Reaction Tank
NTU.....	Number of Transfer Units
NYSEG.....	New York State Gas & Electric
O&M.....	Operations & Maintenance
PJFF.....	Pulse Jet Fabric Filter
RTD.....	Resistance Temperature Detector
RWST.....	Recycle Water Storage Tank
SCBA.....	Scott Air Packs
SDA.....	Spray Dry Absorber
UMIST.....	Univ. of Manchester Inst. of Science & Technology
VME.....	Vertical Mist Eliminator
VSD.....	Variable Speed Drive
WDPF.....	Westinghouse Distributed Process Control System

EXECUTIVE SUMMARY

Operations and maintenance continued this month at the Electric Power Research Institute's Environmental Control Technology Center. Testing on the 4.0 MW Pilot Wet FGD unit continued this month with the Trace Element Removal test block (TER) as the Pilot was operated under forced oxidation conditions. With this testing, the mercury measurement (Method 29) studies also continued as investigations into various activated carbons, metal amalgams, and impinger capture solutions were conducted. Following these studies, a brief test of the Pilot High Velocity FGD configuration (PHV) was conducted. This test block will be continued at the end of the month after the Fall outage is completed.

The 1.0 MW Cold-Side Selective Catalytic Reduction (SCR) unit remained idle this month in a cold-standby mode. During this month's outage, the inlet and outlet damper plates were sealed to isolate the SCR system from flue gas. Also, the internals of the heat pipe heat exchanger (HPHE) and catalyst reactor tower were inspected and cleaned so that the system could be available for future test activities. Monthly inspections of all SCR system equipment placed in this cold-standby mode, as well as the fire safety systems in the SCR building, will continue to be conducted by the ECTC maintenance department and will include manual rotation of the booster fan.

Pilot Testing Highlights

Trace Element Removal Tests

The Pilot Trace Elements Removal (TER) test block continued in October as part of EPRI's overall program to develop control technology options for trace element emissions. This experimental program investigates mercury removal efficiencies and mercury speciation across a wet scrubber under different operating conditions. The 1995 six-month program is being performed on a 4.0 MW wet FGD pilot unit at EPRI's Environmental Control Technology Center (ECTC).

Background

Wet FGD systems have the ability to remove solid-phase and vapor-phase trace elements present in flue gas streams. With only a limited amount of test data to quantify mercury removal efficiencies across full-scale FGD systems, additional research is needed to better understand the removal mechanisms which may aid in the development of processes to increase the mercury removal efficiencies. Several test programs investigating trace elements removal have been conducted. The most important results from full-scale and pilot-scale testing for trace elements control by wet FGD systems are:

- Mercury is the primary vapor-phase trace element of interest to coal-fired power plants. Preliminary data show that the chemical form of the mercury can greatly affect the removal efficiency. Mercuric chloride is effectively removed by FGD systems, while elemental mercury is not.
- Mercury removal data collected at the ECTC and elsewhere are difficult to interpret because the currently available mercury speciation methods, especially when used at the FGD inlet location, do not yield successful speciation under all conditions.
- Solid-phase trace elements removal can be approximated by the bulk particulate removal efficiency for the FGD system as long as the mass of condensed sulfuric acid and scrubber carryover are considered.
- Measured bulk particulate removal efficiencies across full-scale FGD systems are generally greater than 50% and are usually greater than theoretical efficiencies. These higher-than-predicted removal efficiencies may be a result of an electrical charge on the inlet particles that causes an attraction to the slurry droplets, thereby improving particulate removal efficiency for the scrubber.

PILOT HIGH VELOCITY SCRUBBING TESTS

Overview

Phase II of the Pilot High Velocity (PHV) test block was continued in October. These tests were continued from six weeks of testing started in January 1995. These earlier tests were suspended to make the necessary facility modifications to test gas flows greater than 15 ft/s. Phase I of the PHV test block was completed in September of 1994. A total of 15 PHV tests were completed on the ECTC's 4.0 MW pilot system in October after NYSEG's outage. The tests in October were performed using the Munters type mist eliminators using the following parameters:

- 140 mM Ca^{++}
- 85 mM Mg^{++}
- 94% limestone utilization
- 2000 ppm inlet SO_2
- Forced oxidation

The basic operating conditions for the 1995 tests differ from the 1994 tests in that feed forward control is used for reagent addition instead of pH control to maintain approximately 94% limestone utilization. Also, during the 1994 tests, the highest gas velocity tested was 15 ft/s. Facility modifications have now made it possible to maintain 20 ft/s during the 1995 tests.

EXECUTIVE SUMMARY

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- 94% limestone utilization
- 2000 ppm inlet SO_2
- Forced oxidation

The basic operating conditions for the 1995 tests differ from the 1994 tests in that feed forward control was used for reagent addition instead of pH control to maintain approximately 94% limestone utilization. Also, during the 1994 tests, the highest gas velocity tested was 15 ft/s. Facility modifications have made it possible to maintain 20 ft/s during the 1995 tests.

SECTION I FACILITY STATUS

GENERAL

The NYSEG Kintigh Station provided flue gas to the Center 45% of the time during this performance period. As the Kintigh Station operated with a variety of coals, fluctuations in the Center's inlet SO₂ concentrations were experienced. The ECTC was off-line this month from 10/6 through 10/23 due to the scheduled Fall Outage for the NYSEG Kintigh Station. During this outage, a series of preventive maintenance activities and equipment repairs were completed to maintain the high level of flexibility and capability that the ECTC possesses with its process equipment and systems.

Safety training for the month was conducted by the O&M Superintendent, Maintenance Supervisor and Shift Supervisors. "Outage Safety" was the topic of the month. Inspections of the ECTC Facility and safety equipment (SCR air-packs, fire extinguishers, etc.) were completed and recorded this month. All systems were found to be in good condition. By continuing to emphasize safe work habits at the Center, we have raised the total number of days without a lost time injury to 1244 as of 10/31/95.

The monthly safety meeting with the NYSEG Kintigh Station and ECTC staff was postponed this month due to the scheduled outage and the numerous activities ongoing at each facility. This meeting has been tentatively rescheduled for the beginning of November. A thorough review and discussion of the outage work activities and safety issues will be conducted at that time.

PILOT WET FGD SYSTEM

The equivalent and actual availabilities for the ECTC 4.0 MW Pilot Wet FGD System testing this month were 98% and 35% respectively during this period. The Pilot Wet FGD System did not operate during the following periods this month:

- October 6 - 23 for 408 hours due to the NYSEG Fall Outage.
- October 25 for 5 hours due to pluggage in a recirculation header nozzle.

The Trace Element Removal (TER) test block was continued this month with the followings: T-23-TY (intratrain mercury spiking after flue gas sampling), T23-EXY1 (comparison gas sampling), and T23-EXY2 (comparison gas sampling). These mercury removal tests were conducted under forced oxidation conditions with the injection of elemental mercury and/or mercuric chloride (oxidized mercury). Also, various activated carbons, metal amalgams, and impinger capture solutions were used during these tests. The operational parameters for the Pilot Wet Scrubber during this test block included: gas flow of 8,250 scfm (3.69 m³/s); 1600 ppm (1600 mg/kg) inlet SO₂; a recycle slurry flow 1300 gpm (0.08 m³/s); 440 scfm (0.20 m³/s) oxidation air; and an absorber inlet temperature of 315 °F (157 °C).

Before the ECTC went off-line this month for the Fall Outage, a 24-hour test of the Pilot High Velocity FGD process configuration (PHV) was conducted from 10/5 through 10/6. During this test, it was determined that a gas flow of 20,000 scfm ($8.95 \text{ m}^3/\text{s}$) could be consistently achieved for extended periods of ECTC operation. However, the system fans in this configuration required protection from high operating temperatures at this maximum gas velocity. To accommodate this, a 30 hp (22380 W) blower was installed in the ECTC process room to move outside air, through collapsible ductwork, to the Booster Fan motors for additional cooling.

As the Fall Outage was completed, the Pilot High Velocity (PHV) test block was continued with the following tests: PHV-200X; PHV-200; PHV-201; PHV-201R; PHV-202; PHV-203; PHV-204; PHV-205; PHV-205R; PHV-206; PHV-206; PHV-207; PHV-208; PHV-208R; PHV-209; PHV-210; PHV-211; PHV-212; PHV-213; PHV-214. These tests consisted of a series of 4-hour and 24-hour investigations to evaluate SO_2 removal, mist eliminator performance, and spray nozzle performance at higher gas velocities. The operational parameters for the Pilot Wet Scrubber during this test block included: gas flows of 19,900 scfm ($8.90 \text{ m}^3/\text{s}$), 17,400 scfm ($7.78 \text{ m}^3/\text{s}$), 14,900 scfm ($6.66 \text{ m}^3/\text{s}$), and 10,000 scfm ($4.47 \text{ m}^3/\text{s}$); 2000 ppm (2000 mg/kg) inlet SO_2 ; recycle slurry flows of 650 gpm ($0.04 \text{ m}^3/\text{s}$), 1300 gpm ($0.08 \text{ m}^3/\text{s}$), and 1700 gpm ($0.11 \text{ m}^3/\text{s}$); 440 scfm ($0.20 \text{ m}^3/\text{s}$) oxidation air; and an absorber inlet temperature of 315°F (157°C).

PILOT WET FGD SYSTEM - OUTAGE ACTIVITIES

In preparation for this Phase II of the Pilot High Velocity (PHV) test block, a series of duct modifications and system reconfigurations were conducted during an ECTC scheduled outage on 6/8 through 6/20 (for major activities list see 6/95 ECTC O&M report). During this month's Fall Outage, the remaining activities necessary to conduct this testing, as well as the Trace Element Removal (TER) test block in December, were completed.

The following list highlights the major maintenance work activities completed during the scheduled Fall Outage:

ESP

- The ESP was inspected, washed, and repaired as necessary.
- The brushes and seat on the main drive motor were replaced
- The fields were inspected and the gaps were measured
- The inlet & outlet plenums were cleaned.
- The rapper and ground connections were checked. The wire rapper insulators were replaced on "A" and "B" fields (these insulators are not the ceramic material, they are made of a melamine resin).
- The T/R control cabinets, rapper control cabinet, and reactors were checked.

PILOT FGD SYSTEM

- The booster fan cooling equipment was installed.
- The booster fan motor was rebuilt and aligned.
- The Pilot booster fan motor temperature was connected to the WDPF system.
- The in-line pressure gauges on the recirculation headers were cleaned and repaired.
- Several flow transmitters were inspected and calibrated.
- Scheduled maintenance was completed on the Air Compressors and Dryer towers.
- Pilot flow control valve-022 was repaired.
- The Pilot absorber pH probe assembly was inspected and cleaned.
- The reagent preparation weigh belts were calibrated.
- The P-5A unit was cleaned, checked, and calibrated.
- The FLRT level monitor was calibrated.
- The Mini Pilot reaction tank agitators were repaired.
- The CRG scoop dampers were inspected and opened.
- The steel chemical addition tank was recoated.
- The VME wash headers were removed and cleaned while the VME spool was removed to install the Munters VME sections for the PHV testing.
- The centrifuge was removed from service, repaired, and installed and aligned.
- The quench nozzle header assembly was repaired.
- All CEM/WDPF/VAX systems were inspected, cleaned, and repaired as necessary

MISCELLANEOUS

The Ball Mill operation was normal this month during the preparation of Beachville limestone. The limestone grind prepared for ECTC operations was 90% passing 325 mesh screen.

The P-5A demonstration project with Watson Process Systems and Environmental Systems Corporation (ESC) continued this month as measurements were conducted to determine droplet carryover and entrained mist exiting the Pilot wet scrubber vertical mist eliminator (VME) section. By tracking the P-5A monitor readings to various ECTC flue gas/operating parameters, relationships will be developed between the P-5A readings and the amount of liquid carryover after the final mist eliminator.

During the Fall Outage, a thorough inspection of the P-5A unit and probe assembly was conducted to insure that all of the systems' components were in good working order for the Pilot High Velocity testing. Some minor preventive maintenance was necessary to clean the various components and calibrate the unit before it could be placed in-service for the Pilot Scrubber.

FINANCIAL REPORT

The Financial Report for the four Operations and Maintenance contract tasks are summarized below for the month of October 1995, the year to date, and the contract total. All expenses reported below are expressed in terms of U. S. currency dollars.

Task Definitions:

Task 100: Operations and Maintenance Labor

Task 200: Purchased Materials

Task 300: Engineering Support

Task 400: Training

Table i.
Monthly Operating Costs by Task

	October	Year to Date	Contract Total
Task 100	\$ 95,360	\$ 1,044,685	\$ 13,457,376
Task 200	\$ 32,263	\$ 450,613	\$ 7,868,388
Task 300	\$ 5,533	\$ 55,679	\$ 1,125,715
Task 400	\$ 720	\$ 14,959	\$ 49,763
	\$		
TOTAL*	\$ 133,876	\$ 1,565,936	\$ 22,501,242

* Includes \$168,455 unbudgeted, contracted cost of Pilot High Velocity modifications in 6/95

The attached graph illustrates the budgeted and actual expenses for ECTC O&M activities through October 1995.

Figure i.
1995 Operation & Maintenance Costs

SECTION II PILOT AND MINI-PILOT TEST ACTIVITY

PILOT

Overview

The following progress report discusses the results from the test programs performed in October at EPRI's Environmental Control Technology Center (ECTC). The Trace Elements Removal (TER) test block was continued, and the Pilot High Velocity (PHV) test block was started. The results for the TER and PHV test blocks are detailed below.

Trace Element Removal Tests

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Background

Wet FGD systems have the ability to remove solid-phase and vapor-phase trace elements present in flue gas streams. With only a limited amount of test data to quantify mercury removal efficiencies across full-scale FGD systems, additional research is needed to better understand the removal mechanisms which may aid in the development of processes to increase the mercury removal efficiencies. Several test programs investigating trace elements removal have been conducted. The most important results from full-scale and pilot-scale testing for trace elements control by wet FGD systems are:

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- Mercury removal data collected at the ECTC and elsewhere are difficult to interpret because the currently available mercury speciation methods, especially when used at the FGD inlet location, do not yield successful speciation under all conditions.
- Solid-phase trace elements removal can be approximated by the bulk particulate removal efficiency for the FGD system as long as the mass of condensed sulfuric acid and scrubber carryover are considered.

- Measured bulk particulate removal efficiencies across full-scale FGD systems are generally greater than 50% and are usually greater than theoretical efficiencies. These higher-than predicted removal efficiencies may be a result of an electrical charge on the inlet particles that causes an attraction to the slurry droplets, thereby improving particulate removal efficiency for the scrubber.

Objectives

The 1995 TER test block will focus on up to five research areas, depending on experimental results. These areas are:

- Mercury speciation methods
- Effect of FGD system operating variables on mercury removal
- Novel methods for elemental mercury control
- Catalytic methods for converting elemental mercury to oxidized mercury
- Electrostatic charging of particulate material in the FGD inlet flue gas stream

Testing in October included Tris impinger solution comparison to peroxide impinger solution. One of the overall objectives of the TER testing is to investigate the mercury speciation abilities of EPA Method 29 and to test methods of improvement if possible. This objective will be studied by:

- Spiking elemental mercury (Hg^0) into the gas sampling train (intratrain spiking) to determine the percent spike recovery in the various impinger solutions
- Spiking the inlet flue gas with Hg^0 and HgCl_2 to determine the percent spike recovery in the various impinger solutions
- Using novel impinger solutions to investigate the effect of these solutions on speciation capabilities

Summary of Operations

A detailed summary of operations for October is presented in Table 1. NYSEG had an outage from October 6 to October 23 for maintenance and repairs. Testing for the TER test block was performed before the outage. A simplified process flow diagram for the absorber process, as configured for the trace element testing in October, is shown in Figure 1. Figure 2 shows the locations of the mercury spiking and gas sampling ports used during all of the TER test block. During the month of October, before the Fall outage, NYSEG continued with its 25% petroleum coke blend. From September 26 to the start of the October outage, Chalmette refinery petroleum coke was fired in NYSEG's boiler.

During October, three TER tests were performed: one intratrain spiking test and two Tris buffer solution tests. The test conditions for the TER tests completed in October

are presented in Table 2. A complete description of all the TER tests completed to date, as well as a detailed gas sampling summary and process summary report for the October tests, have been appended to this report.

Summary of TER Results

Intrain Spiking Tests

One intrain spiking test, T23-IY*, was performed to verify test T9-IX* results gathered in June. Table 3 compares test T23-IY* with previous intrain spiking tests. Notice in Table 3 that when spiking Hg^0 (intrain) and sampling ambient air (test T0-IA), the elemental mercury spike is not captured in the peroxide impingers. However, when spiking Hg^0 (intrain) and sampling flue gas (test T4-IY), approximately 22% of the mercury spike is captured in the peroxide impingers. Consequently, tests T9-IX* and T23-IY* were performed to determine whether the elemental mercury spike was reacting with the flue gas (creating a more soluble mercury species) or whether some component of the flue gas was changing the impinger solution (causing increased solubility of mercury). These tests were conducted by sampling flue gas at the wet scrubber inlet location, followed by sampling ambient air with simultaneous elemental mercury intrain spiking. During test T23-IY*, the mercury injection vessel was cooled in an ice bath to ensure that elemental mercury vapor captured in the impingers was due to solution effects rather than condensation effects in the impingers. Approximately 15% of the mercury spike was captured in the peroxide impingers during test T9-IX* while 19% was captured during test T23-IY*. These data suggest that the elemental mercury intrain spike was captured in the peroxide impingers due to solution effects rather than a gas-phase reaction between mercury and flue gas.

If solution effects are the cause of the enhanced solubility of mercury in the peroxide impingers, an increase in gas sampling volume might be expected to increase the solubility of the mercury as the concentration of the flue gas species in the impingers increase. It might also be expected that the enhanced solubility in the first impinger would be greater than in the fourth impinger since the first impinger should have higher concentrations of the flue gas species. In Figure 3, the removal efficiency data from tests T9-IX* and T23-IY* are plotted versus gas sampling volume. In general, it appears that the greater the gas volume during sampling, the higher the capture efficiency of the elemental mercury vapor spike. The first impinger also appears to have a higher capture efficiency than the fourth, as expected. These relationships will be investigated further in December.

Tris Impinger Solution Tests

The investigation of alternate impinger solutions continued in October with the Tris buffer solution. Two tests (T23-EXY1 and T23-EXY2) were completed in October to supplement previous tests using the Tris buffer solution. Test conditions for these two tests are listed in Table 4. The objective of these tests was to determine the effect of sample recovery and sampling time on total mercury recovery.

Recall that in August and September, low total mercury recoveries were observed in Tris buffer samples (as compared to peroxide trains). Improved analytical results had been reported by other researchers when hydrochloric acid was added to impinger samples as a preservative. Consequently, HCl was added incrementally to preserve the Tris samples at the ECTC; however, low mercury recoveries were still observed. Table 5 shows the mercury concentrations for individual Tris buffer impinger samples preserved and digested using different methods. The top portion of Table 5 shows the individual mercury concentrations using the regular ECTC digestion procedures for peroxide samples. The total mercury concentration for each impinger was generally low with the regular digestion procedure but varied by more than a factor of two for most samples.

Based on these results, the regular digestion procedure, used successfully for peroxide samples, was replaced with a slightly modified version of EPA SW846 Method 7470. The data from this modified analytical method are also shown in Table 5 and indicate better analytical reproducibility with higher overall recoveries. In addition, the overall QA/QC for these samples improved with the use of the modified Method 7470 over the regular digestion procedure. (With the regular digestion procedure, sample duplicates with Tris solution and matrix spike recoveries rarely passed the $\pm 15\%$ criteria; with the modified Method 7470, they rarely fail the QC criteria.) All of the analytical procedures used at the ECTC are modified versions of EPA Method 245.1 or EPA SW846 Method 7470 and are briefly described in the footnotes of Table 5. These methods have been modified to suit the equipment available at the ECTC and to meet the time and personnel constraints for sample analysis.

Samples from both Tris tests completed in October were analyzed using the modified Method 7470 procedure. Results from these tests have been summarized in Table 6. Note that the main difference between test T23-EXY1 and test T23-EXY2 is that the samples in the first test were recovered immediately after sampling without dismantling the glassware, while the samples in the second test were recovered in the laboratory approximately one hour after sampling and dismantling the glassware. The data in Table 6 indicate that test T23-EXY1 resulted in closer agreement with the peroxide train than the results from test T23-EXY2. These data indicate that sample preservation of the Tris sampling train impinger solutions should be performed at the location before disassembly.

One possible cause for the poor mercury recoveries for the Tris impinger solutions may be that the pH of the solution after sampling is low enough to allow the liquid sulfite concentrations to reduce the oxidized form of the mercury. While the role of solution pH is important, the critical pH value at which sulfite reacts instantly with oxidized mercury, according to Equation 1, is unknown at this time.

The pH of the Tris impinger solutions was measured immediately following gas sampling during tests T23-EXY1 and T23-EXY2. The pH data, shown in Figure 4,

indicate that a pH greater than 7 can be maintained while sampling up to 40 standard cubic feet (scf) of flue gas at the pilot unit inlet (1600 ppmv SO₂) with impingers containing 150 ml of 1.0 M Tris buffer solution.

If the reaction shown in Equation 1 plays a significant role during gas sampling with Tris buffer solutions, then elemental Hg will be evolved from the Tris impingers and captured in the permanganate impingers. The preliminary data indicate that even for test T23-EXY1 (run #4), where the pH decreased to 6 in the first Tris impinger, there is less mercury captured in the permanganate impingers than the total elemental mercury spiked. Therefore, the reaction indicated by Equation 1 is not significant in Tris impinger solutions with a pH of 6, which is approximately equivalent to sampling 50 scf of flue gas at 1600 ppmv SO₂. Additional tests with Tris buffer are planned for December.

PILOT HIGH VELOCITY SCRUBBING TESTS

Overview

Phase II of the Pilot High Velocity (PHV) test block was continued in October. These tests were continued from the six weeks of testing started in January 1995. These earlier tests were suspended during the ECTC outage (June 1995) to make the necessary facility modifications to test gas flows greater than 15 ft/s. Phase I of the PHV test block was completed in September of 1994. A total of 15 PHV Phase II tests were completed this month on the ECTC's 4.0 MW pilot system after NYSEG's Fall outage. The tests in October were performed using the Munters type vertical mist eliminator (VME) under the following parameters:

- 140 mM Ca⁺⁺
- 85 mM Mg⁺⁺
- 94% limestone utilization
- 2000 ppm inlet SO₂
- Forced oxidation

The basic operating conditions for the 1995 tests differ from the 1994 tests in that feed forward control was used for reagent addition instead of pH control to maintain approximately 94% limestone utilization. Also, during the 1994 tests, the highest gas velocity tested was 15 ft/s. Facility modifications have made it possible to maintain 20 ft/s during the 1995 tests.

Background

Operating FGD systems with higher gas velocities through the scrubber has potential benefits for electric utilities planning their Clean Air Act compliance strategy. For new system designs, a higher gas velocity reduces the scrubber diameter and, corresponding capital costs. In some existing systems operating with gas by-pass or

with an adjacent uncontrolled unit, SO₂ emissions can be reduced with little capital cost by scrubbing this additional gas in the existing scrubber. To provide utilities information about FGD system performance at high gas velocities (>10 ft/s), EPRI sponsored Phase I of the five month Pilot High Velocity (PHV) test program on their 4.0 MW wet FGD system in 1994.

The objectives of EPRI's 1994 PHV test program were:

- To determine the effect of gas velocity on SO₂ removal efficiency and other FGD performance parameters
- To evaluate the effect of gas velocity on mist eliminator performance for two high velocity mist eliminator designs
- To determine the effect of liquid rate (L/G) and nozzle type on performance at high flue gas velocities

The PHV data also provided a wide variety of conditions to evaluate the predictive capabilities of FGDPRISM at high flue gas velocities. The 4.0 MW wet FGD system located at EPRI's ECTC was used to achieve these objectives. The pilot system was operated as a counter current spray tower with variations in the gas rate, liquid rate, nozzle type, and internal configuration (open tower vs. tray tower).

The PHV Phase I test block was completed in September 1994 and produced some interesting results. At a constant liquid rate, SO₂ removal efficiency remained nearly constant as the absorber gas velocity was increased from 12 to 15 ft/s. In addition, increasing the Sauter mean diameter (SMD) droplet size from 1500 μ to 1900 μ (using spiral nozzles) and to 3500 μ (using tangential flow nozzles) did not significantly affect SO₂ removal. Finally, at gas velocities of up to 17 ft/s through the mist eliminators, no significant slurry carryover was observed.

The PHV Phase I test results indicated that operating at higher flue gas velocities has many potential benefits, and further evaluation of the FGD performance at even higher gas velocities is warranted. Unfortunately, due to limitations in the pilot booster fan capacity, absorber velocities higher than 15 ft/s could not be tested in 1994. Operating at velocities higher than 15 ft/s is of interest to determine the effect on SO₂ removal efficiency and to determine the velocity at which significant carryover occurs across the mist eliminator system. Testing lower pressure nozzles with a larger droplet size is also of interest.

Based on the evaluation of the 1994 PHV Phase I test results, EPRI decided to conduct a second phase of PHV testing in 1995 to evaluate scrubber and mist eliminator performance at even higher velocities (up to 20 ft/s). Additionally, the predictive capabilities of the EPRI FGDPRISM model are also to be evaluated during testing at these higher gas velocities. Recall that to conduct this testing, several modifications had to be made to the ECTC pilot plant equipment and gas path configuration (see June 1995 report).

Test Block Objectives

The goal of Phase II of the Pilot High Velocity test program is to provide further information about FGD performance at high gas velocity conditions in a counter-current spray tower. SO₂ removal efficiency and mist eliminator performance are to be evaluated over a range of flue gas velocities and liquid rates. Different nozzle types will also be tested, including a very low-pressure spiral nozzle. The continuation of the test program is currently planned for approximately one month during October and November 1995. Some of the specific objectives of Phase II are:

- To determine the affect of flue gas velocity on SO₂ removal efficiency and other FGD performance parameters for a counter-current spray tower operating at velocities up to 20 ft/s
- To determine the effect of absorber spray nozzle type on SO₂ removal efficiency at velocities up to 20 ft/s
- To determine the gas velocity at which significant mist eliminator break-through occurs for two different chevron-type mist eliminators
- To provide data for FGDP RISM to further evaluate the predictive capabilities of this model at high gas velocities
- To repeat specific test conditions evaluated during earlier PHV tests that yielded inconsistent results

Summary of Operations

A detailed summary of operations for October is presented in Table 1. It was discovered in early January that the fans were not capable of operation at gas flow rates greater than 15 ft/s without major facility modifications. As a result, some tests with gas rates of 15 ft/s or lower were performed initially. The tests with higher gas rates were started in October, after facility modifications had been completed.

Figure 1 shows a simplified process flow diagram for the pilot unit, as configured for the TER testing. During PHV testing, the tray was removed and various recirculation rates required use of all three absorber spray headers: flow to header #1 was either zero or 650 gpm; flow to header #3 was always set at 650 gpm; and flow to header #5 had either zero or 400 gpm. A total of 15 tests were completed in October. All of these tests used the baseline spiral nozzles (BETE FST88XPN). Note that the nozzles on header #5 were always the baseline spiral nozzles (BETE FST88XPN), regardless of the nozzle type on headers #1 and #3.

Summary of Results

Test conditions and results for the PHV tests performed in October are summarized in Table 7. Complete analytical data tables and process data summary reports for the tests completed in October are appended to this report.

SO₂ Removal Results

As mentioned earlier, the evaluation of process performance is one of the objectives of the PHV test block. SO₂ removal results, expressed as the number of transfer units (NTU), are shown as a function of absorber gas velocity in Figures 5, 6, and 7 for the baseline nozzles. In all plots, a decrease in the SO₂ removal is seen as the gas velocity increases and L/G drops. For each of these plots, the limestone utilization has been noted next to the data point. Note that, in general, the limestone loading (which is inversely proportional to limestone utilization) appears to have a significant effect on SO₂ removal efficiency, particularly at the higher gas velocities. Difficulty in controlling utilization resulted in values between 93% and 98% (or limestone loadings from 4.9 to 1.2 g/L). The tests that had high utilization (96% and greater) will be rerun during November.

Recall that in 1994, the SO₂ removal efficiency did not drop off significantly at the higher gas rates as might be expected. The 1995 data appears to show a severe drop in SO₂ removal at the higher gas rates. This effect may be due to the higher limestone utilizations maintained during the 1995 tests. However, when looking at the 1995 data alone, Figure 7 appears to show the SO₂ removal efficiency leveling at gas velocities greater than 17.5 ft/s.

In addition to lower limestone utilizations during some tests in 1994, another difference could be the gas distribution through the absorber during 1995. Recall that plugged mist eliminators had a deleterious effect on gas flow distribution and SO₂ removal in early 1995. It was discovered in November 1994 that one of the supports on the horizontal mist eliminator had failed, resulting in the first mist eliminator bank being tipped until the top was supported by the second bank. This failure may have caused a different flow path through the absorber.

1995 Operating Parameters

Inspection of the 1994 data showed that the VME type did not affect SO₂ removal; thus, the 1994 data in the figures of this report include results from tests using both types of VMEs. However, the Munters type mist eliminator was the only type used during October 1995 tests. The pertinent nozzle information at the liquid flow rates used during this test block is shown below for the four nozzles obtained from BETE:

Parameter	Baseline Spiral	Low-Press. Spiral	V. Low Press. Spiral	Tangential
Nozzle ID	FST88XPN	FST96XPN	FST112XPN	TH34020
Spray Angle	90°	90°	90°	90°
Spray Pattern	Full Cone	Full Cone	Full Cone	Hollow Cone
Nozzle P	14 psi	9 psi	4 psi	10 psi
Droplet Size*	1500μ	1900μ	2600μ	3500 μ
Material	Stellite	Hastelloy C	Stellite	Hastelloy C

*Sauter mean diameter

A very-low-pressure spiral nozzle (BETE FST112XPN) was chosen for the 1995 testing; this nozzle was not used in the 1994 test program. During all the testing, baseline nozzles will be used on header #5. It is not expected that the difference in droplet characteristics between nozzles on the lowest header would significantly impact SO₂ removal because of the relatively short gas-liquid contact time. The droplets from the lowest header also should not have a significant effect on the mist eliminator carryover. Therefore, for convenience and savings in cost and time, the lower header nozzles will remain the same throughout the test program. If the test block becomes limited by time constraints, the low pressure nozzles will not be tested.

Future Tests

Phase II of the 1995 PHV test block will continue in November. Initially, carryover testing will be performed with the Munters mist eliminators. Testing of tangential and very low-pressure nozzles will be performed; any remaining tests focusing on the low pressure nozzles will be conducted if time allows. Carryover tests with the Koch mist eliminators will be performed at the end of the test block. In December, the TER test block will continue with investigations into mercury capture efficiency and the effects of varying the volumes of flue gas and elemental mercury vapor spiked.

Figure 1. Wet FGD Process Flow Diagram for TER Tests

Figure 2. EPRI ECTC Pilot Wet FGD Toxics Gas Path

Figure 3. Effect of Gas Sampling Volume on Elemental Mercury Spike Removal Efficiency

Figure 4. Effect of Gas Sampling Volume on Tris Impinger Solution pH for Tests T23-EXY1 and -EXY2

Figure 5. Effect of Absorber Gas Velocity on SO₂ Removal
(Baseline Spiral Nozzles, 650 gpm)

Figure 6. Effect of Absorber Gas Velocity on SO₂ Removal
(Baseline Spiral Nozzles, 1300 gpm)

Figure 7. Effect of Absorber Gas Velocity on SO₂ Removal
(Baseline Spiral Nozzles, 1700 gpm)

Table 1. October Process Operating Conditions Summary

<u>Date</u>	<u>Test ID#</u>	<u>Process Summary</u>	<u>Gas Summary</u>
Sun. 10/1	T23 8250 scfm L/G=130 12 ft. reaction tank O:SO ₂ = 16 pH = 5.5		
Mon. 10/2	T23-IY*		Gas sampling at the scrubber inlet followed by Hg ⁰ intratrain spiking with ambient air after the first impinger.
Tues. 10/3	T23-EXY1		Gas sampling at the CRG with Tris comparison at the wet scrubber inlet and Hg ⁰ injection during sampling.
Wed. 10/4	T23-EXY2		Gas sampling at the CRG with Tris comparison at the wet scrubber inlet and Hg ⁰ injection during sampling.
Thurs. 10/5		Pilot absorber operating at High Velocity parameters to evaluate booster fan performance	
Fri. 10/6 - Sun. 10/22		NYSEG KINTIGH STATION 1995 FALL OUTAGE	
Mon. 10/23		NYSEG Station back on-line at 0100 hrs. ECTC began gas flow at 0700 hrs. to bypass the pilot absorber and warm the ESP for operation. The Pilot reagent feed pump and centrifuge were tested during the facility warmup.	

Table 1. October Process Operating Conditions Summary (cont.)

Date	Test ID#	Process Summary	Gas Summary
Tues. 10/24		Began ball mill operations overnight. The Pilot absorber came on-line at 0800 hrs. A circuit breaker on one of the air compressors was replaced. Wet ash from the ESP was removed. The Pilot absorber inlet and outlet CEM systems were inspected.	
Wed. 10/25		The pilot absorber was taken off-line to remove a plugged nozzle in header #1. The pilot venturi was spanned for 30" w.c. and the ports were inspected and cleaned. A velocity traverse was performed at 10,000 scfm.	
Thurs. 10/26	PHV-204,205	The pilot venturi constants were adjusted and velocity traverses were performed at 10,000 and 20,000 scfm.	
Fri. 10/27	PHV-206, 207 205R, 203, 202	A ball valve on the HME drain line feeding the HME carryover collection tank was replaced. The reagent feed pump logic was modified so that it could be better controlled with the WDPF.	
Sat. 10/28	PHV-201, 200, 201R, 209, 208, 210	The feed rates to the vacuum belt filter and the centrifuge were maintained at 12 wt. % as the gas flow velocity was held at 20 ft/s.	
Sun. 10/29	PHV-211, 208R, and PHV-214 (carryover test at 15 ft/s and 1700 gpm)	Began carryover test with the Munter's VME. Began CaCl_2 addition (50 lbs.) at midnight. The pressure regulator on the SO_2 tank was increased to 11psi to maintain 2000 ppm at the inlet.	
Mon. 10/30	PHV-213 (carryover test at 17.5 ft/s and 1700 gpm)		
Tues. 10/31	PHV-212 (carryover test at 20 ft/s and 1700 gpm)	Opacity spikes noticed when the ESP rappers are in service.	

Table 2
Trace Element Removal Impinger Test Conditions

Test ID	Test Description	Gas Sample Source	Spiking Conditions		Sampling Methods		
			Species Spiked	Spike Location	Method 29 Used?	Method 29* Used?	Sol'n of Extra Imp.
T23-IY*	WS inlet sample followed by intratrain gas spike with ambient air	WS inlet/Air	Hg(0)	Duct Injection	No	Yes	Peroxide
T23-EXY1	Tris comparison at WS inlet, Tris pH vs gas volume, and sample recovery at sampling location	CRG/WS inlet	Hg(0)	Duct Injection	No	Yes	Tris
T23-EXY2	Tris comparison at WS inlet, Tris pH vs gas volume, and sample recovery in the lab	CRG/WS inlet	Hg(0)	Duct Injection	No	Yes	Tris

Table 3
Capture Efficiency of Intratrain Elemental Mercury Spike
While Sampling Flue Gas, Air After Flue Gas, and Air

Test ID	Impinger Number	Baseline Hg (w/o Spike) ($\mu\text{g}/\text{Nm}^3$)	Spiked Hg ($\mu\text{g}/\text{Nm}^3$)	Capture Efficiency (%)
T4-IY (Flue gas)	1	5.38	3.17	24.2
	2	0.45	2.34	23.5
	3	0.16	1.64	21.6
	4	0.09	1.12	18.7
	KMnO4	0.22	4.84	-
	Total:	6.29	13.10	22.0 avg
T9-IX* (Flue gas/Air)	1	4.96	2.56	17.2
	2	0.34	1.90	15.5
	3	0.05	1.46	14.1
	4	<0.01	1.11	12.5
	KMnO4	0.07	7.80	-
	Total:	5.43	14.82	14.8 avg
T23-IY* (Flue gas/Air)	1	4.89	2.68	19.2
	2	0.42	2.46	21.8
	3	0.11	1.60	18.1
	4	<0.01	1.20	16.6
	KMnO4	0.14	6.04	-
	Total:	5.56	13.97	18.9 avg
T0-IA (Air)	1	<0.01	0.12	0.7
	2	<0.01	0.11	0.7
	3	<0.01	0.12	0.7
	4	<0.01	0.04	0.3
	KMnO4	<0.02	16.18	-
	Total:	0.06	16.57	0.6 avg

T4-IY sampled on 4/20/95. Spiking while sampling flue gas.

T9-IX* sampled on 6/23/95. Flue gas sampled, followed by spiking in ambient air.

T23-IY* sampled on 10/2/95. Injector in ice bath to match impinger temperature.

Flue gas sampled, followed by spiking in ambient air.

T0-IA sampled on 5/2/95. Spiking in ambient air.

Table 4
Alternate Impinger Solutions Summary
October

Test ID	Alternate Impinger Solution	Solution Composition	Sampling Time (min)	Spiking Conditions		Sample Recovery	Observations
				Species Spiked	Spike Location		
T23-EXY1	Tris	1 M Tris	20, 30, 40, and 50.	Hg(0)	duct injection	25 mls of 30% peroxide and 20 mls HNO ₃ were added to the first two impingers after gas sampling, but before removing from the sampling location. 10 mls HCl was added during recovery.	Analyzed with modified Method 7470.
T23-EXY2	Tris	1 M Tris	25, 40, 45, and 55.	Hg(0)	duct injection	25 mls of 30% peroxide and 20 mls HNO ₃ were added to the first two impingers in the laboratory 0.5-1.5 hours after gas sampling. 10 mls HCl was added during recovery.	Analyzed with modified Method 7470.

Table 5
Effect of Sample Preservation and Digestion Method
On Individual Tris Impinger Mercury Concentrations

Sample ID:	Impinger Mercury Concentration (ng/ml)				Date Analyzed	Sample Preservative	Digestion Used
	U250-1	U253-1	U256-1	U256-2			
	3.12	4.46	4.28	0.82	9/18/95	2.5 mLs HCl/sample	Regular *
	2.32	11.50	9.34	0.34	9/19/95	7.5 mLs HCl/sample	Regular *
	7.62	8.87	10.60	0.16	9/20/95	12.5 mLs HCl/sample	Regular *
	1.83	10.90	11.90	1.26	9/21/95	12.5 mLs HCl/sample	Regular with HCl **
	6.66	9.03	10.18	1.31	10/6/95	12.5 mLs HCl/sample	Modified Method 7470 ‡
	7.08	9.57	10.72	1.47	10/9/95	12.5 mLs HCl/sample	Modified Method 7470 ‡

Sample ID:	Impinger Mercury Concentration (ng/ml)				Date Analyzed	Sample Preservative	Digestion Used
	U354-1	U354-2	U362-1	U362-2			
	11.30	2.95	18.60	2.90	10/5/95	10 mLs HCl/sample	Modified Method 7470 ‡
	10.38	2.43	16.85	2.87	10/6/95	10 mLs HCl/sample	Modified Method 7470 ‡
	11.90	2.89	18.47	2.88	10/9/95	10 mLs HCl/sample	Modified Method 7470 ‡
Average	11.19	2.76	17.97	2.88			
Std Dev	0.77	0.28	0.97	0.02			

* Regular Digestion: 0.65-0.75 grams KMnO₄, 10 mLs DI water, 10 mLs sample or blank, 10 mLs 12% (w/v) hydroxylamine sulfate solution.

** Regular Digestion with HCl: same as the regular digestion except 0.5 mLs HCl is added before the sample is added.

‡ Modified Method 7470: 0.65-0.75 grams of KMnO₄, 6.0 mLs DI water, 1.0 mLs H₂SO₄, 0.5 mLs HNO₃, 0.5 mLs HCl, 10 mLs sample or blank, 2.0 mLs 5% (w/v) K₂S₂O₈ solution, and 10 mLs 12% (w/v) hydroxylamine sulfate solution.

Table 6
Comparison of 1M Tris Buffer Solution With Peroxide

Test ID	Sampling Time (min)	Species Spiked	Total Hg (µg/Nm3)		Recovery Difference (µg/Nm3)	Tris Train Recovery (% of Peroxide)
			Peroxide Train	Tris Train		
Samples Preserved At Sampling Location (a)						
T23-EXY1 (Run 1)	20	Hg(0)	26.5	26.3	-0.2	99.2
T23-EXY1 (Run 2)	30	Hg(0)	26.6	26.1	-0.5	98.1
T23-EXY1 (Run 3)	40	Hg(0)	25.9 *	24.3	-1.6 *	94.0 *
T23-EXY1 (Run 4)	50	Hg(0)	25.1	24.7	-0.4	98.4
Samples Preserved In Laboratory (b)						
T23-EXY2 (Run 1)	25	Hg(0)	28.1	-	-	-
T23-EXY2 (Run 2)	40	Hg(0)	28.4	19.7	-8.7	69.4
T23-EXY2 (Run 3)	45	Hg(0)	27.1	24.4	-2.7	90.0
T23-EXY2 (Run 4)	55	Hg(0)	28.2	23.3	-4.9	82.6

a Samples were preserved at the location immediately following gas sampling.

b Samples were preserved in the laboratory 0.5-1.5 hours following gas sampling.

* Peroxide data is the average of Run #2 and Run #3.

Table 7

Summary of Pilot High Velocity Phase II Test Conditions and Results

Test ID	Absorber Gas Velocity (ft/s)	Slurry Recirc. Rate (gpm)	L/G (gal/macf)	FLRT pH	Absorber pH	Reaction Tank Slurry wt. %	Liquid Calcium (mM)	SO2 Removal (%)	SO2 Removal (NTU)	VME ΔP (in H2O)	Absorber ΔP (in H2O)	Direct Carryover Rate (gpm/112)	Tank Level Carryover Rate (gpm/112)	Limestone Loading (g/L)	Limestone Utilization (%)
<i>Baseline Spiral Nozzles</i>															
PHV-200	20.0	1,700	72	5.59	4.20	11.98	142	86.7	2.02	1.10	13.8	-	-	4.7	94
PHV-201	17.5	1,700	83	5.54	4.16	12.19	-	82.3	1.73	0.40	10.0	-	-	3.4	96
PHV-202	15.1	1,700	96	5.55	4.50	12.78	-	82.1	1.72	0.20	7.7	-	-	3.4	96
PHV-203	10.1	1,700	144	5.78	4.94	12.50	-	90.0	2.30	0.10	4.7	-	-	4.9	94
PHV-201R	17.5	1,700	83	5.61	4.67	10.67	-	85.9	1.96	0.30	9.9	-	-	4.4	96
PHV-204	20.2	1,300	55	4.45	3.46	13.03	154	67.1	1.11	1.10	11.8	-	-	3.3	96
PHV-205	18	1,300	63	4.82	3.66	12.41	-	74.9	1.38	0.43	8.7	-	-	4.4	95
PHV-206	15.0	1,300	73	5.15	3.77	12.02	-	76.8	1.46	0.20	6.6	-	-	4.6	94
PHV-207	10.0	1,300	110	5.36	4.33	11.73	120	83.9	1.83	0.10	4.0	-	-	4.8	94
PHV-205R	17.6	1,300	63	5.22	4.53	13.16	-	74.0	1.35	0.40	16.5	-	-	4.1	95
PHV-208	20.1	650	27	5.59	4.25	12.40	-	39.5	0.50	0.80	8.1	-	-	3.0	96
PHV-209	17.5	650	32	5.84	4.44	10.76	-	44.8	0.59	0.30	5.8	-	-	4.2	94
PHV-210	15.0	650	37	5.25	4.00	12.12	-	35.7	0.44	0.20	4.5	-	-	1.7	98
PHV-211	10.0	650	55	5.12	3.92	11.05	-	42.7	0.56	0.10	2.5	-	-	1.2	98
PHV-208R	20.0	650	28	5.48	4.08	11.41	-	35.9	0.44	0.70	8.2	-	-	2.0	97

APPENDIX A
TEST SCHEDULES

EPRI ENVIRONMENTAL CONTROL TECHNOLOGY CENTER TEST CALENDAR

October 1995 (Updated Nov. 11)

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 Trace Element Rem. T23 Baseline FGD 1600 inlet SO2 Forced Oxidation	2 Trace Element Rem. T23-IY* Tris comparison at WS Inlet Intrain spiking	3 Trace Element Rem. T23-EXY1 Tris comparison at WS Inlet	4 Trace Element Rem. T23-EXY2 Tris comparison at WS Inlet	5 High Velocity Fan Test 20000 scfm	6 High Velocity Fan Test 20000 scfm	7 NYSEG's 1995 OUTAGE
8 NYSEG's 1995 OUTAGE	9 NYSEG's 1995 OUTAGE	10 NYSEG's 1995 OUTAGE	11 NYSEG's 1995 OUTAGE	12 NYSEG's 1995 OUTAGE	13 NYSEG's 1995 OUTAGE	14 NYSEG's 1995 OUTAGE
15 NYSEG's 1995 OUTAGE	16 NYSEG's 1995 OUTAGE	17 NYSEG's 1995 OUTAGE	18 NYSEG's 1995 OUTAGE	19 NYSEG's 1995 OUTAGE	20 NYSEG's 1995 OUTAGE	21 NYSEG's 1995 OUTAGE
22 NYSEG's 1995 OUTAGE	23 High Velocity Phase II NYSEG ON-LINE ESP SETUP	24 High Velocity Phase II PHV-200X Baseline Spiral Nozzles 1300 gpm Munters Mist Elim.	25 High Velocity Phase II PHV-200X Baseline Spiral Nozzles 1300 gpm	26 High Velocity Phase II PHV-211X,204,205 Baseline Spiral Nozzles Various Rates	27 High Velocity Phase II PHV-206,207,205R PHV-203,202 Baseline Spiral Nozzles Various Rates	28 High Velocity Phase II PHV-201,200,201R PHV-209,208,210 Baseline Spiral Nozzles Various Rates
29 High Velocity Phase II PHV-211,208R,214 Baseline Spiral Nozzles Various Rates	30 High Velocity Phase II PHV-214 Carryover Test 15 ft/sec, 1700 gpm Munters Mist Elim.	31 High Velocity Phase II PHV-213 Carryover Test 17.5 ft/sec, 1700 gpm Munters Mist Elim.				

EPRI ENVIRONMENTAL CONTROL TECHNOLOGY CENTER TEST CALENDAR

November 1995 (Updated Nov. 27)

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1 High Velocity Phase II PHV-215 Carryover Test 20 ft/sec, 1300 gpm Munter's ME	2 High Velocity Phase II PHV-264,211R,210R Various Rates Baseline Nozzles	3 High Velocity Phase II PHV-265,208RR PHV-210RR,206R Various Rates Baseline Nozzles	4 High Velocity Phase II PHV-265R,204R PHV-205RR Various Rates Baseline Nozzles
5 High Velocity Phase II PHV-221 10 ft/sec, 650 gpm Baseline Nozzles DBA Additive	6 High Velocity Phase II PHV-220,218 Baseline Nozzles DBA Additive	7 High Velocity Phase II NYSEG OUTAGE Installation of Tangential Nozzles	8 High Velocity Phase II Pilot Off-line Installation of Koch Mist Eliminators	9 High Velocity Phase II PHV-266,267 PHV-268,269 Tangential Nozzles DBA Additive	10 High Velocity Phase II PHV-270,271 PHV-269R,267R Tangential Nozzles DBA Additive	11 High Velocity Phase II Pilot Start Up After DBA Dump Tangential Nozzles Koch ME
12 High Velocity Phase II PHV-246,247,245R 249,248,250 Various Rates Tangential Nozzles	13 High Velocity Phase II PHV-251,248R,240 241,242,243 Various Rates Tangential Nozzles	14 High Velocity Phase II PHV-240R,244R,246R 247R,249R,250R Various Rates Tangential Nozzles	15 High Velocity Phase II PHV-245RR,224	16 High Velocity Phase II PHV-224 Carryover Test 15 ft/sec, 1700 gpm Koch ME	17 High Velocity Phase II PHV-223 Carryover Test 17.5 ft/sec, 1700 gpm Koch ME	18 High Velocity Phase II PHV-222 Carryover Test 20 ft/sec, 1700 gpm Koch ME
19 High Velocity Phase II PHV-225 Carryover Test 20 ft/sec, 1300 gpm Koch ME	20 High Velocity Phase II PHV-224R PHV-272,273,274 Carryover Test 15 ft/sec, 1700 gpm Koch ME	21 High Velocity Phase II PHV-275,276,232 Baseline Nozzles PHV-232,233 VLP Nozzles	22 High Velocity Phase II PHV-234,235,233R 238 Various Rates VLP Nozzles	23 High Velocity Phase II Various Rates VLP Nozzles	24 High Velocity Phase II Various Rates VLP Nozzles	25 High Velocity Phase II Various Rates VLP Nozzles
26 High Velocity Phase II Various Rates VLP Nozzles	27 High Velocity Phase II Change to Baseline Nozzles	28 Trace Element Rem. T24 High Velocity Rem. No Spiking	29 Trace Element Rem. T24 High Velocity Rem. Hg(0) Spiking	30 Trace Element Rem. T24 High Velocity Rem. HgCl, Spiking		

PILOT

MINI-PILOT

1994											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
UNIT DOWN		SUNCOR	High Velocity Scrubbing	TECO High Vel. Packing	High Velocity Scrubbing (B&W tray testing)	Air Toxics Tests	Outage	Air Toxics Tests			
Limestone CLS Phase II (cont.)	Redox Sulfur testing	LCLS Phase II (cont.)	UNIT DOWN	SUNCOR II	UNIT DOWN						

PILOT

MINI-PILOT

1995												
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
High-Velocity FGD Testing	Lime/DBA Gypsum tests	Carbon injection	Wet FGD Toxics Testing				Carbon injection	Wet FGD Toxics Testing- Pet coke	Outage	Carbon Injection	High-Velocity FGD Testing	Wet FGD Toxics Testing
			Lime/DBA Gypsum tests									
			Lime/DBA Gypsum tests									
UNIT DOWN						UNIT DOWN						

PILOT

1996											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PRDA - Mercury and HAPs Control			High-Velocity FGD Testing			Wet FGD Toxics Testing			PRDA - Clear Liquor FGD Testing		

ECTC Pilot-scale Testing Schedule ('94-'96)

APPENDIX B
PILOT TESTING PROCESS SUMMARY REPORTS

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	93.1	96.9	90.9	1.6	166
SO2 Removal (NTU)	2.71	3.47	2.40	0.27	166
L/G Ratio (gal/macf)	132	134	129	1	166
Reaction Tank pH	5.50	5.53	5.48	0.01	166
Absorber pH	4.85	5.26	4.27	0.17	166
Flue Gas Flow Rate (scfm)	8250	8284	8146	9	166
Header 1 Flow (gpm)	650	650	650	0	166
Header 3 Flow (gpm)	650	650	624	2	166
Header 5 Flow (gpm)	0	0	0	0	166
Blowdown to Sump Rate (gpm)	-	-	-	-	-
Centrifuge Feed Rate (gpm)	4.84	6.00	3.51	0.56	166
Reagent Feed to FLRT (gpm)	1.14	2.16	0.77	0.32	166
Facility Inlet SO2 Conc. (ppm)	1393	1811	697	222	166
Inlet SO2 Concentration (ppm)	1600	1610	1592	3	166
Outlet SO2 Concentration (ppm)	104	136	47	24	166
Inlet O2 Concentration (%)	9.82	14.32	8.53	1.19	166
Outlet O2 Concentration (%)	9.70	13.98	8.52	1.12	166
Absorber Gas Velocity (ft/sec)	8.36	8.41	8.24	0.04	166
Inlet Gas Temperature (F)	310	321	281	8	166
Outlet Gas Temperature (F)	121	124	115	2	166
SO2 Absorbed (mmole/L)	2.99	3.11	2.91	0.05	166
Solids Residence Time (hrs)	18.5	19.0	17.8	0.3	166
Slurry Residence Time (min)	4.39	4.48	4.38	0.01	166
Absorber Pressure Drop (in H2O)	3.65	3.70	3.52	0.03	166
Spray Zone Pressure Drop (in H2O)	1.68	1.73	1.61	0.02	166
Tray Pressure Drop (in H2O)	1.41	1.45	1.34	0.02	166
ME Pressure Drop (in H2O)	0.34	0.37	0.33	0.01	166
Oxidation Air to Rxn Tank (scfm)	440	441	439	0	166
NYSEG Load (MW)	586	706	177	154	166

PHV-204 Process Summary Report
(10/26/95 18:00:00 to 10/26/95 20:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	67.1	68.0	66.1	0.9	2
SO2 Removal (NTU)	1.11	1.14	1.08	0.03	2
L/G Ratio (gal/macf)	55	55	55	0	2
Reaction Tank pH	4.45	4.48	4.42	0.03	2
Absorber pH	3.46	3.49	3.44	0.02	2
Flue Gas Flow Rate (scfm)	19901	19901	19900	1	2
Header 1 Flow (gpm)	650	650	650	0	2
Header 3 Flow (gpm)	650	650	650	0	2
Header 5 Flow (gpm)	0	0	0	0	2
Blowdown to Sump Rate (gpm)	0.26	0.31	0.21	0.05	2
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	10.00	10.00	10.00	0.00	2
Reagent Feed to FLRT (gpm)	1.53	1.56	1.50	0.03	2
Facility Inlet SO2 Conc. (ppm)	1671	1681	1660	10	2
Inlet SO2 Concentration (ppm)	2001	2004	1999	3	2
Outlet SO2 Concentration (ppm)	614	631	598	17	2
Inlet O2 Concentration (%)	6.38	6.52	6.25	0.13	2
Outlet O2 Concentration (%)	6.45	6.57	6.34	0.11	2
Absorber Gas Velocity (ft/sec)	20.17	20.17	20.17	0.00	2
Inlet Gas Temperature (F)	339	339	339	0	2
Outlet Gas Temperature (F)	126	127	126	0	2
SO2 Absorbed (mmole/L)	6.50	6.60	6.40	0.10	2
Solids Residence Time (hrs)	8.3	8.4	8.2	0.1	2
Slurry Residence Time (min)	4.39	4.39	4.39	0.00	2
Absorber Pressure Drop (in H2O)	11.77	11.81	11.73	0.04	2
Spray Zone Pressure Drop (in H2O)	2.84	2.85	2.84	0.00	2
VME Pressure Drop (in H2O)	1.10	1.10	1.09	0.00	2
Oxidation Air to Rxn Tank (scfm)	439	440	439	1	2
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	641	662	619	22	2

PHV-205 Process Summary Report
(10/26/95 22:00:00 to 10/27/95 00:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	74.9	75.7	74.1	0.8	2
SO2 Removal (NTU)	1.38	1.42	1.35	0.03	2
L/G Ratio (gal/macf)	63	63	63	0	2
Reaction Tank pH	4.82	4.86	4.77	0.05	2
Absorber pH	3.66	3.68	3.64	0.02	2
Flue Gas Flow Rate (scfm)	17401	17404	17398	3	2
Header 1 Flow (gpm)	650	650	650	0	2
Header 3 Flow (gpm)	650	650	650	0	2
Header 5 Flow (gpm)	0	0	0	0	2
Blowdown to Sump Rate (gpm)	0.31	0.31	0.31	0.00	2
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	10.50	10.50	10.50	0.00	2
Reagent Feed to FLRT (gpm)	1.63	1.64	1.62	0.01	2
Facility Inlet SO2 Conc. (ppm)	1674	1697	1650	24	2
Inlet SO2 Concentration (ppm)	1997	2001	1994	4	2
Outlet SO2 Concentration (ppm)	471	487	454	17	2
Inlet O2 Concentration (%)	6.51	6.74	6.28	0.23	2
Outlet O2 Concentration (%)	6.68	6.89	6.47	0.21	2
Absorber Gas Velocity (ft/sec)	17.53	17.54	17.52	0.01	2
Inlet Gas Temperature (F)	317	317	316	1	2
Outlet Gas Temperature (F)	124	125	124	0	2
SO2 Absorbed (mmole/L)	6.34	6.40	6.28	0.06	2
Solids Residence Time (hrs)	8.5	8.6	8.5	0.1	2
Slurry Residence Time (min)	4.39	4.39	4.39	0.00	2
Absorber Pressure Drop (in H2O)	8.68	8.68	8.68	0.00	2
Spray Zone Pressure Drop (in H2O)	4.04	4.04	4.04	0.00	2
VME Pressure Drop (in H2O)	0.43	0.53	0.34	0.09	2
Oxidation Air to Rxn Tank (acfm)	440	440	439	0	2
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	638	674	602	36	2

PHV-206 Process Summary Report
(10/27/95 01:00:00 to 10/27/95 04:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	76.8	77.4	76.0	0.6	3
SO2 Removal (NTU)	1.46	1.49	1.43	0.03	3
L/G Ratio (gal/macf)	73	74	73	0	3
Reaction Tank pH	5.15	5.20	5.09	0.04	3
Absorber pH	3.71	3.73	3.69	0.02	3
Flue Gas Flow Rate (scfm)	14902	14905	14901	2	3
Header 1 Flow (gpm)	650	650	650	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	0	0	0	0	3
Blowdown to Sump Rate (gpm)	0.31	0.31	0.31	0.00	3
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	7.89	8.50	6.97	0.66	3
Reagent Feed to FLRT (gpm)	1.38	1.39	1.37	0.01	3
Facility Inlet SO2 Conc. (ppm)	1265	1539	995	222	3
Inlet SO2 Concentration (ppm)	1990	1995	1983	5	3
Outlet SO2 Concentration (ppm)	432	449	419	12	3
Inlet O2 Concentration (%)	9.49	11.45	7.54	1.60	3
Outlet O2 Concentration (%)	9.38	11.14	7.63	1.43	3
Absorber Gas Velocity (ft/sec)	15.03	15.06	14.98	0.03	3
Inlet Gas Temperature (F)	315	316	314	1	3
Outlet Gas Temperature (F)	121	123	119	2	3
SO2 Absorbed (mmole/L)	5.55	5.57	5.50	0.03	3
Solids Residence Time (hrs)	9.8	9.8	9.7	0.1	3
Slurry Residence Time (min)	4.39	4.39	4.39	0.00	3
Absorber Pressure Drop (in H2O)	6.63	6.65	6.63	0.01	3
Spray Zone Pressure Drop (in H2O)	3.27	3.27	3.26	0.01	3
VME Pressure Drop (in H2O)	0.18	0.19	0.18	0.01	3
Oxidation Air to Rxn Tank (acfm)	440	440	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	355	532	213	133	3

PHV-207 Process Summary Report
(10/27/95 05:00:00 to 10/27/95 08:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	83.9	84.4	83.6	0.3	3
SO2 Removal (NTU)	1.83	1.86	1.81	0.02	3
LAG Ratio (gal/mact)	110	111	110	0	3
Reaction Tank pH	5.36	5.39	5.31	0.03	3
Absorber pH	4.33	4.49	4.20	0.12	3
Flue Gas Flow Rate (scfm)	9998	10001	9995	3	3
Header 1 Flow (gpm)	650	650	650	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	0	0	0	0	3
Blowdown to Sump Rate (gpm)	0.31	0.35	0.26	0.04	3
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	5.40	5.74	5.19	0.24	3
Reagent Feed to FLRT (gpm)	1.06	1.07	1.05	0.01	3
Facility Inlet SO2 Conc. (ppm)	1125	1296	956	139	3
Inlet SO2 Concentration (ppm)	2011	2023	2000	9	3
Outlet SO2 Concentration (ppm)	305	310	297	6	3
Inlet O2 Concentration (%)	10.80	12.18	9.37	1.15	3
Outlet O2 Concentration (%)	10.60	12.07	9.14	1.20	3
Absorber Gas Velocity (ft/sec)	9.99	10.00	9.98	0.01	3
Inlet Gas Temperature (F)	285	287	284	2	3
Outlet Gas Temperature (F)	117	119	116	1	3
SO2 Absorbed (mmole/L)	4.11	4.13	4.07	0.03	3
Solids Residence Time (hrs)	13.2	13.3	13.1	0.1	3
Slurry Residence Time (min)	4.39	4.39	4.39	0.00	3
Absorber Pressure Drop (in H2O)	3.95	3.96	3.94	0.01	3
Spray Zone Pressure Drop (in H2O)	2.29	2.30	2.28	0.01	3
VME Pressure Drop (in H2O)	0.10	0.11	0.09	0.01	3
Oxidation Air to Rxn Tank (scfm)	440	440	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	255	339	187	63	3

PHV-205R Process Summary Report
(10/27/95 09:00:00 to 10/27/95 12:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	74.0	74.7	72.9	0.8	3
SO2 Removal (NTU)	1.35	1.37	1.31	0.03	3
LAG Ratio (gal/mact)	63	63	63	0	3
Reaction Tank pH	5.22	5.24	5.20	0.02	3
Absorber pH	4.05	4.08	4.01	0.03	3
Flue Gas Flow Rate (scfm)	17396	17403	17391	5	3
Header 1 Flow (gpm)	650	650	650	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	0	0	0	0	3
Blowdown to Sump Rate (gpm)	0.08	0.31	0.00	0.13	3
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	10.00	10.00	10.00	0.00	3
Reagent Feed to FLRT (gpm)	1.58	1.62	1.53	0.04	3
Facility Inlet SO2 Conc. (ppm)	1435	1470	1386	36	3
Inlet SO2 Concentration (ppm)	2004	2008	1999	3	3
Outlet SO2 Concentration (ppm)	488	508	475	14	3
Inlet O2 Concentration (%)	6.77	7.09	6.59	0.22	3
Outlet O2 Concentration (%)	6.62	6.88	6.48	0.19	3
Absorber Gas Velocity (ft/sec)	17.60	17.62	17.58	0.01	3
Inlet Gas Temperature (F)	325	325	324	0	3
Outlet Gas Temperature (F)	125	126	125	1	3
SO2 Absorbed (mmole/L)	6.28	6.35	6.19	0.07	3
Solids Residence Time (hrs)	8.6	8.7	8.5	0.1	3
Slurry Residence Time (min)	4.39	4.39	4.39	0.00	3
Absorber Pressure Drop (in H2O)	8.77	8.84	8.71	0.06	3
Spray Zone Pressure Drop (in H2O)	4.06	4.07	4.06	0.01	3
VME Pressure Drop (in H2O)	0.35	0.35	0.35	0.00	3
Oxidation Air to Rxn Tank (scfm)	440	440	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	626	674	560	48	3

PHV-203 Process Summary Report
(10/27/95 14:00:00 to 10/27/95 18:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	90.0	90.2	89.5	0.3	4
SO2 Removal (NTU)	2.30	2.33	2.25	0.03	4
LAG Ratio (gal/macf)	144	144	143	0	4
Reaction Tank pH	5.78	5.81	5.73	0.03	4
Absorber pH	4.94	4.97	4.89	0.03	4
Flue Gas Flow Rate (scfm)	10000	10000	9999	1	4
Header 1 Flow (gpm)	650	650	650	0	4
Header 3 Flow (gpm)	650	650	650	0	4
Header 5 Flow (gpm)	400	400	400	0	4
Blowdown to Sump Rate (gpm)	0.33	0.47	0.31	0.07	4
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	5.00	5.00	5.00	0.00	4
Reagent Feed to FLRT (gpm)	1.14	1.20	1.09	0.04	4
Facility Inlet SO2 Conc. (ppm)	1374	1433	1314	44	4
Inlet SO2 Concentration (ppm)	2000	2005	1995	4	4
Outlet SO2 Concentration (ppm)	189	199	184	6	4
Inlet O2 Concentration (%)	7.66	8.11	7.11	0.36	4
Outlet O2 Concentration (%)	7.62	8.01	7.12	0.32	4
Absorber Gas Velocity (ft/sec)	10.06	10.07	10.05	0.01	4
Inlet Gas Temperature (F)	292	295	291	2	4
Outlet Gas Temperature (F)	122	122	121	0	4
SO2 Absorbed (mmole/L)	3.35	3.36	3.34	0.01	4
Solids Residence Time (hrs)	12.3	12.4	12.3	0.0	4
Slurry Residence Time (min)	3.36	3.36	3.36	0.00	4
Absorber Pressure Drop (in H2O)	4.72	4.73	4.69	0.02	4
Spray Zone Pressure Drop (in H2O)	2.85	2.86	2.84	0.01	4
VME Pressure Drop (in H2O)	0.09	0.09	0.09	0.00	4
Oxidation Air to Rxn Tank (acfm)	440	440	440	0	4
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	566	599	543	21	4

PHV-202 Process Summary Report
(10/27/95 21:00:00 to 10/27/95 24:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	82.1	82.2	82.0	0.1	3
SO2 Removal (NTU)	1.72	1.73	1.71	0.01	3
LAG Ratio (gal/macf)	96	96	96	0	3
Reaction Tank pH	5.55	5.56	5.54	0.01	3
Absorber pH	4.50	4.52	4.48	0.02	3
Flue Gas Flow Rate (scfm)	14901	14903	14900	2	3
Header 1 Flow (gpm)	650	650	650	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	400	400	400	0	3
Blowdown to Sump Rate (gpm)	0.47	0.47	0.47	0.00	3
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	11.00	11.00	11.00	0.00	3
Reagent Feed to FLRT (gpm)	1.55	1.55	1.55	0.00	3
Facility Inlet SO2 Conc. (ppm)	1223	1288	1140	62	3
Inlet SO2 Concentration (ppm)	1996	1998	1995	2	3
Outlet SO2 Concentration (ppm)	336	338	333	2	3
Inlet O2 Concentration (%)	8.10	8.73	7.57	0.48	3
Outlet O2 Concentration (%)	7.91	8.51	7.39	0.46	3
Absorber Gas Velocity (ft/sec)	15.07	15.08	15.06	0.01	3
Inlet Gas Temperature (F)	315	316	315	0	3
Outlet Gas Temperature (F)	124	125	123	1	3
SO2 Absorbed (mmole/L)	4.55	4.55	4.54	0.00	3
Solids Residence Time (hrs)	9.1	9.1	9.1	0.0	3
Slurry Residence Time (min)	3.36	3.36	3.36	0.00	3
Absorber Pressure Drop (in H2O)	7.65	7.67	7.62	0.02	3
Spray Zone Pressure Drop (in H2O)	4.06	4.06	4.05	0.01	3
VME Pressure Drop (in H2O)	0.20	0.22	0.19	0.02	3
Oxidation Air to Rxn Tank (acfm)	440	440	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	499	550	418	58	3

PHV-201 Process Summary Report
(10/28/95 01:00:00 to 10/28/95 04:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	82.3	82.9	81.8	0.4	3
SO2 Removal (NTU)	1.73	1.76	1.70	0.02	3
LAG Ratio (gal/macf)	83	83	83	0	3
Reaction Tank pH	5.54	5.56	5.52	0.02	3
Absorber pH	4.16	4.19	4.13	0.03	3
Flue Gas Flow Rate (scfm)	17400	17400	17399	0	3
Header 1 Flow (gpm)	650	650	650	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	400	400	400	0	3
Blowdown to Sump Rate (gpm)	0.47	0.47	0.47	0.00	3
Vacuum Belt Feed Rate	2.26	3.25	0.29	1.39	3
Centrifuge Feed Rate (gpm)	9.35	10.93	6.87	1.78	3
Reagent Feed to FLRT (gpm)	1.85	1.87	1.81	0.03	3
Facility Inlet SO2 Conc. (ppm)	1070	1111	1031	33	3
Inlet SO2 Concentration (ppm)	2000	2007	1988	8	3
Outlet SO2 Concentration (ppm)	331	340	322	7	3
Inlet O2 Concentration (%)	9.40	9.66	9.12	0.22	3
Outlet O2 Concentration (%)	9.06	9.26	8.84	0.17	3
Absorber Gas Velocity (ft/sec)	17.49	17.49	17.49	0.00	3
Inlet Gas Temperature (F)	316	316	315	0	3
Outlet Gas Temperature (F)	122	123	122	0	3
SO2 Absorbed (mmole/L)	5.33	5.38	5.27	0.05	3
Solids Residence Time (hrs)	7.8	7.9	7.7	0.1	3
Slurry Residence Time (min)	3.36	3.36	3.36	0.00	3
Absorber Pressure Drop (in H2O)	9.95	9.96	9.92	0.02	3
Spray Zone Pressure Drop (in H2O)	3.27	3.27	3.26	0.01	3
VME Pressure Drop (in H2O)	0.35	0.35	0.34	0.00	3
Oxidation Air to Rxn Tank (acfm)	440	441	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	234	243	225	7	3

PHV-200 Process Summary Report
(10/28/95 05:00:00 to 10/28/95 08:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	86.7	87.6	85.5	0.9	3
SO2 Removal (NTU)	2.02	2.09	1.93	0.07	3
LAG Ratio (gal/macf)	72	72	72	0	3
Reaction Tank pH	5.59	5.62	5.56	0.02	3
Absorber pH	4.20	4.23	4.15	0.03	3
Flue Gas Flow Rate (scfm)	19900	19901	19899	1	3
Header 1 Flow (gpm)	650	650	650	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	400	400	400	0	3
Blowdown to Sump Rate (gpm)	0.47	0.47	0.47	0.00	3
Vacuum Belt Feed Rate	4.86	5.01	4.58	0.20	3
Centrifuge Feed Rate (gpm)	11.00	11.00	11.00	0.00	3
Reagent Feed to FLRT (gpm)	2.28	2.29	2.25	0.02	3
Facility Inlet SO2 Conc. (ppm)	1005	1023	987	15	3
Inlet SO2 Concentration (ppm)	2006	2026	1994	14	3
Outlet SO2 Concentration (ppm)	249	273	230	18	3
Inlet O2 Concentration (%)	10.40	10.52	10.14	0.18	3
Outlet O2 Concentration (%)	9.81	9.95	9.59	0.16	3
Absorber Gas Velocity (ft/sec)	20.03	20.03	20.02	0.01	3
Inlet Gas Temperature (F)	332	332	332	0	3
Outlet Gas Temperature (F)	123	123	122	0	3
SO2 Absorbed (mmole/L)	6.44	6.49	6.42	0.03	3
Solids Residence Time (hrs)	6.4	6.4	6.4	0.0	3
Slurry Residence Time (min)	3.36	3.36	3.36	0.00	3
Absorber Pressure Drop (in H2O)	13.80	13.84	13.73	0.05	3
Spray Zone Pressure Drop (in H2O)	3.27	3.27	3.26	0.01	3
VME Pressure Drop (in H2O)	1.07	1.07	1.07	0.00	3
Oxidation Air to Rxn Tank (acfm)	440	440	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	198	206	192	6	3

PHV-201R Process Summary Report
(10/28/95 09:00:00 to 10/28/95 12:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	85.9	86.3	85.6	0.3	3
SO2 Removal (NTU)	1.96	1.99	1.94	0.02	3
L/G Ratio (gal/macf)	83	83	83	0	3
Reaction Tank pH	5.61	5.63	5.60	0.01	3
Absorber pH	4.67	4.69	4.66	0.01	3
Flue Gas Flow Rate (scfm)	17400	17401	17400	1	3
Header 1 Flow (gpm)	650	650	650	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	400	400	400	0	3
Blowdown to Sump Rate (gpm)	0.47	0.47	0.47	0.00	3
Vacuum Belt Feed Rate	2.80	5.03	0.00	2.09	3
Centrifuge Feed Rate (gpm)	11.00	11.00	11.00	0.00	3
Reagent Feed to FLRT (gpm)	2.25	2.25	2.25	0.00	3
Facility Inlet SO2 Conc. (ppm)	1066	1127	1031	43	3
Inlet SO2 Concentration (ppm)	2003	2009	1997	5	3
Outlet SO2 Concentration (ppm)	264	269	257	5	3
Inlet O2 Concentration (%)	10.17	10.53	9.59	0.42	3
Outlet O2 Concentration (%)	9.69	10.01	9.16	0.38	3
Absorber Gas Velocity (ft/sec)	17.46	17.47	17.45	0.01	3
Inlet Gas Temperature (F)	315	315	315	0	3
Outlet Gas Temperature (F)	121	121	120	0	3
SO2 Absorbed (mmole/L)	5.57	5.59	5.55	0.02	3
Solids Residence Time (hrs)	7.4	7.5	7.4	0.0	3
Slurry Residence Time (min)	3.36	3.36	3.36	0.00	3
Absorber Pressure Drop (in H2O)	9.88	9.92	9.84	0.03	3
Spray Zone Pressure Drop (in H2O)	3.27	3.27	3.26	0.01	3
VME Pressure Drop (in H2O)	0.34	0.35	0.34	0.00	3
Oxidation Air to Rxn Tank (acfm)	440	440	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	192	199	185	6	3

PHV-209 Process Summary Report
(10/28/95 13:00:00 to 10/28/95 16:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	44.8	46.5	43.1	1.4	3
SO2 Removal (NTU)	0.59	0.63	0.56	0.03	3
L/G Ratio (gal/macf)	32	32	32	0	3
Reaction Tank pH	5.84	5.92	5.77	0.06	3
Absorber pH	4.44	4.51	4.38	0.05	3
Flue Gas Flow Rate (scfm)	17399	17400	17399	0	3
Header 1 Flow (gpm)	0	0	0	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	0	0	0	0	3
Blowdown to Sump Rate (gpm)	0.53	0.63	0.47	0.07	3
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	6.00	6.00	6.00	0.00	3
Reagent Feed to FLRT (gpm)	1.10	1.10	1.10	0.00	3
Facility Inlet SO2 Conc. (ppm)	1090	1161	1047	51	3
Inlet SO2 Concentration (ppm)	2005	2022	1993	12	3
Outlet SO2 Concentration (ppm)	1037	1077	1002	31	3
Inlet O2 Concentration (%)	10.10	10.42	9.73	0.28	3
Outlet O2 Concentration (%)	9.59	9.86	9.28	0.24	3
Absorber Gas Velocity (ft/sec)	17.46	17.46	17.46	0.00	3
Inlet Gas Temperature (F)	316	316	316	0	3
Outlet Gas Temperature (F)	120	121	120	0	3
SO2 Absorbed (mmole/L)	7.61	7.88	7.38	0.21	3
Solids Residence Time (hrs)	14.2	14.7	13.7	0.4	3
Slurry Residence Time (min)	8.79	8.79	8.79	0.00	3
Absorber Pressure Drop (in H2O)	5.76	5.77	5.74	0.01	3
Spray Zone Pressure Drop (in H2O)	1.59	1.59	1.58	0.00	3
VME Pressure Drop (in H2O)	0.29	0.29	0.29	0.00	3
Oxidation Air to Rxn Tank (acfm)	440	440	439	1	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	203	222	188	14	3

PHV-208 Process Summary Report
(10/28/95 17:00:00 to 10/28/95 18:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	39.5	40.7	38.5	0.6	12
SO2 Removal (NTU)	0.50	0.52	0.49	0.01	12
L/G Ratio (gal/macf)	27	28	27	0	12
Reaction Tank pH	5.59	5.61	5.55	0.02	12
Absorber pH	4.25	4.39	4.14	0.07	12
Flue Gas Flow Rate (scfm)	19900	19908	19892	5	12
Header 1 Flow (gpm)	0	0	0	0	12
Header 3 Flow (gpm)	650	651	649	0	12
Header 5 Flow (gpm)	0	0	0	0	12
Blowdown to Sump Rate (gpm)	0.63	2.00	0.00	0.88	12
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	7.50	7.50	7.50	0.00	12
Reagent Feed to FLRT (gpm)	1.09	1.11	1.08	0.01	12
Facility Inlet SO2 Conc. (ppm)	1269	1320	1254	18	12
Inlet SO2 Concentration (ppm)	2005	2032	1976	16	12
Outlet SO2 Concentration (ppm)	1130	1165	1097	17	12
Inlet O2 Concentration (%)	8.26	8.65	7.78	0.21	12
Outlet O2 Concentration (%)	7.88	8.49	7.29	0.37	12
Absorber Gas Velocity (ft/sec)	20.08	20.09	20.06	0.01	12
Inlet Gas Temperature (F)	334	335	333	1	12
Outlet Gas Temperature (F)	124	124	123	0	12
SO2 Absorbed (mmole/L)	7.68	7.83	7.44	0.11	12
Solids Residence Time (hrs)	14.1	14.5	13.8	0.2	12
Slurry Residence Time (min)	8.79	8.80	8.78	0.01	12
Absorber Pressure Drop (in H2O)	8.09	8.29	8.00	0.09	12
Spray Zone Pressure Drop (in H2O)	2.19	2.25	2.17	0.02	12
VME Pressure Drop (in H2O)	0.75	0.91	0.70	0.07	12
Oxidation Air to Rxn Tank (acfm)	440	443	437	2	12
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	397	433	369	17	12

PHV-210 Process Summary Report
(10/28/95 21:00:00 to 10/28/95 24:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	35.7	36.1	35.5	0.3	3
SO2 Removal (NTU)	0.44	0.45	0.44	0.00	3
L/G Ratio (gal/macf)	37	37	37	0	3
Reaction Tank pH	5.25	5.27	5.23	0.02	3
Absorber pH	4.00	4.01	3.99	0.01	3
Flue Gas Flow Rate (scfm)	14901	14904	14899	2	3
Header 1 Flow (gpm)	0	0	0	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	0	0	0	0	3
Blowdown to Sump Rate (gpm)	0.63	0.63	0.63	0.00	3
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	5.62	6.00	5.00	0.44	3
Reagent Feed to FLRT (gpm)	0.79	0.79	0.79	0.00	3
Facility Inlet SO2 Conc. (ppm)	1264	1283	1238	19	3
Inlet SO2 Concentration (ppm)	1999	2001	1996	2	3
Outlet SO2 Concentration (ppm)	1204	1210	1196	6	3
Inlet O2 Concentration (%)	8.41	8.68	8.25	0.19	3
Outlet O2 Concentration (%)	8.07	8.29	7.90	0.17	3
Absorber Gas Velocity (ft/sec)	15.01	15.03	15.01	0.01	3
Inlet Gas Temperature (F)	313	315	312	1	3
Outlet Gas Temperature (F)	121	121	120	0	3
SO2 Absorbed (mmole/L)	5.18	5.23	5.15	0.04	3
Solids Residence Time (hrs)	20.9	21.0	20.7	0.1	3
Slurry Residence Time (min)	8.79	8.79	8.79	0.00	3
Absorber Pressure Drop (in H2O)	4.45	4.46	4.45	0.01	3
Spray Zone Pressure Drop (in H2O)	1.25	1.25	1.25	0.00	3
VME Pressure Drop (in H2O)	0.19	0.20	0.19	0.01	3
Oxidation Air to Rxn Tank (acfm)	440	440	440	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	429	463	385	32	3

PHV-211 Process Summary Report
(10/29/95 01:00:00 to 10/29/95 04:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	42.7	43.1	42.0	0.5	3
SO2 Removal (NTU)	0.56	0.56	0.55	0.01	3
L/G Ratio (gal/macf)	55	55	55	0	3
Reaction Tank pH	5.12	5.17	5.08	0.04	3
Absorber pH	3.92	3.93	3.91	0.01	3
Flue Gas Flow Rate (scfm)	10000	10000	10000	0	3
Header 1 Flow (gpm)	0	0	0	0	3
Header 3 Flow (gpm)	650	650	650	0	3
Header 5 Flow (gpm)	0	0	0	0	3
Blowdown to Sump Rate (gpm)	0.63	0.63	0.63	0.00	3
Vacuum Belt Feed Rate	-	-	-	-	-
Centrifuge Feed Rate (gpm)	3.20	3.20	3.20	0.00	3
Reagent Feed to FLRT (gpm)	0.63	0.65	0.62	0.01	3
Facility Inlet SO2 Conc. (ppm)	1077	1248	899	143	3
Inlet SO2 Concentration (ppm)	1996	2003	1987	7	3
Outlet SO2 Concentration (ppm)	1078	1096	1065	13	3
Inlet O2 Concentration (%)	9.93	11.27	8.71	1.05	3
Outlet O2 Concentration (%)	9.50	10.72	8.43	0.94	3
Absorber Gas Velocity (ft/sec)	10.01	10.02	10.01	0.00	3
Inlet Gas Temperature (F)	293	294	291	2	3
Outlet Gas Temperature (F)	117	118	116	1	3
SO2 Absorbed (mmole/L)	4.15	4.17	4.10	0.03	3
Solids Residence Time (hrs)	26.1	26.4	25.9	0.2	3
Slurry Residence Time (min)	8.79	8.79	8.79	0.00	3
Absorber Pressure Drop (in H2O)	2.45	2.46	2.44	0.01	3
Spray Zone Pressure Drop (in H2O)	0.95	0.96	0.95	0.00	3
VME Pressure Drop (in H2O)	0.10	0.10	0.10	0.00	3
Oxidation Air to Rxn Tank (acfm)	440	440	439	0	3
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	283	354	211	58	3

PHV-208R Process Summary Report
(10/29/95 07:00:00 to 10/29/95 08:00:00)

Process Variable	Average	Max	Min	Std.Dev.	Points
SO2 Removal (%)	37.2	38.7	36	0.90	12
SO2 Removal (NTU)	0.47	0.49	0	0.01	12
L/G Ratio (gal/macf)	28	28	28	0	12
Reaction Tank pH	5.48	5.55	5	0.04	12
Absorber pH	4.08	4.21	4	0.13	12
Flue Gas Flow Rate (scfm)	19899	19908	19888	6.23	12
Header 1 Flow (gpm)	0	0	0	0.00	12
Header 3 Flow (gpm)	650	650	650	0.13	12
Header 5 Flow (gpm)	0	0	0	0.00	12
Blowdown to Sump Rate (gpm)	0.63	2.00	0	0.77	12
Vacuum Belt Feed Rate (gpm)	-	-	-	-	-
Centrifuge Feed Rate (gpm)	5.51	6.00	5	0.49	12
Reagent Feed to FLRT (gpm)	1.10	1.20	1	0.07	12
Facility Inlet SO2 Conc. (ppm)	1036	1104	969	46.23	12
Inlet SO2 Concentration (ppm)	2008	2056	1961	30.86	12
Outlet SO2 Concentration (ppm)	1175	1222	1129	33.13	12
Inlet O2 Concentration (%)	10.25	10.85	10	0.42	12
Outlet O2 Concentration (%)	9.59	10.40	9	0.48	12
Absorber Gas Velocity (ft/sec)	19.99	20.02	20	0.02	12
Inlet Gas Temperature (F)	329	330	328	0.60	12
Outlet Gas Temperature (F)	121	122	119	0.62	12
SO2 Absorbed (mmole/L)	7.15	7.31	7	0.11	12
Solids Residence Time (hrs)	14.9	15.4	15	0.22	12
Slurry Residence Time (min)	8.68	8.68	9	0.00	12
Absorber Pressure Drop (in H2O)	8.10	8.38	8	0.13	12
Spray Zone Pressure Drop (in H2O)	2.17	2.24	2	0.03	12
VME Pressure Drop (in H2O)	0.72	0.89	1	0.08	12
Oxidation Air to Rxn Tank (scfm)	440	441	439	0.64	12
DBA Addition Rate (mL/min)	-	-	-	-	-
NYSEG Load (MW)	234	253	213	13.71	12

APPENDIX C
MERCURY GAS SAMPLING RESULTS

October 1995

ECTC Pilot Trace Elements Removal Testing
Mercury Gas Sampling Results
Pilot Pre-Spiking Inlet Location
(CRG)

Test ID	Date	Start Time	Other Imp. Cont.	ID	Gas Volume (dscf)	Moisture (% H ₂ O)	Other Sample [Hg] (ng/ml)	Other Sample [Hg] (ng/ml)	H ₂ O ₂ Sample [Hg] (ng/ml)	H ₂ O ₂ Sample [Hg] (ng/ml)	KMnO ₄ Sample [Hg] (ng/ml)	Other Sample Mass (g)	Other Sample Mass (g)	H ₂ O ₂ Sample Mass (g)	H ₂ O ₂ Sample Mass (g)	KMnO ₄ Sample Mass (g)	Other [Hg] In Gas (µg/Nm ³)	Other [Hg] In Gas (µg/Nm ³)	H ₂ O ₂ [Hg] In Gas (µg/Nm ³)	H ₂ O ₂ [Hg] In Gas (µg/Nm ³)	KMnO ₄ [Hg] In Gas (µg/Nm ³)	Total [Hg] In Gas (µg/Nm ³)
Intrastain Hg @ WS In Solution																						
T23-IY*	Mon-10/2	08:00	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-IY*	Mon-10/2	08:00	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-IY*	Mon-10/2	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-IY*	Mon-10/2	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																						
Tris Comp @ WS In																						
T23-EXY1	Tue-10/3	08:00	H	U346	96.54	5.46	45.00	5.08	1.10	0.94	0.25	270.1	241.7	222.3	209.2	443.4	4.77	0.48	0.10	0.08	0.04	5.47
T23-EXY1	Tue-10/3	08:00	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY1	Tue-10/3	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY1	Tue-10/3	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY1	Tue-10/3	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY1	Tue-10/3	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY1	Tue-10/3	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY1	Tue-10/3	11:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																						
Tris Comp @ WS In																						
T23-EXY2	Wed-10/4	08:00	H	U356	114.94	5.60	53.50	6.66	2.01	1.04	0.68	265.1	199.8	241.3	211.9	464.0	4.67	0.44	0.16	0.07	0.10	5.45
T23-EXY2	Wed-10/4	08:00	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY2	Wed-10/4	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY2	Wed-10/4	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY2	Wed-10/4	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY2	Wed-10/4	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY2	Wed-10/4	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T23-EXY2	Wed-10/4	11:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																						

*C = CEM's not operating correctly, data from 9/7. Shaded areas= problems with sampling. Italicized areas=mercury values below low standard. A=Acetate. H=Peroxide. PH=Phosphate. Tris=Tris Buffer

ECTC Pilot Trace Elements Removal Testing
Mercury Gas Sampling Results
Pilot Post-Spiking Inlet Location
(WS Inlet)

					Solid Hg												Other												H2O2												KMnO4												Solid Hg												Other												H2O2												H2O2												KMnO4												Solid Hg												Other												H2O2												H2O2												KMnO4												Total																																																																																																																																																																																																																																																																									
Test ID	Date	Start Time	Other Imp. Cont.	ID	Gas Volume (dscf)	Moisture (% H2O)	Inlet O2 (%)	Sample [Hg] (ppm)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas (μg/Nm3)	[Hg] In Gas

*C = CEM's not operating correctly, data from 9/7. Shaded areas = problems with sampling. Italicized areas = mercury values below low standard. A=Acetate, H=Peroxide, PH=Phosphate, Tris=Tris Buffer

ECTC Pilot Trace Elements Removal Testing
Mercury Gas Sampling Results
Pilot Outlet Location
(WS Outlet)

Test ID	Date	Start Time	Other Imp. Cont.	ID	Gas		Out O2 (%)	Solid Hg	Other	Other	H2O2	H2O2	KMnO4	Solid Hg	Other	Other	H2O2	H2O2	KMnO4	Solid Hg	Other	Other	H2O2	H2O2	KMnO4	Total	
					Volume (dscf)	Moisture (% H2O)		Sample [Hg] (ppm)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample [Hg] (ng/ml)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	Sample Mass (g)	[Hg] In Gas (ug/Nm3)	[Hg] In Gas (ug/Nm3)	[Hg] In Gas (ug/Nm3)	[Hg] In Gas (ug/Nm3)	[Hg] In Gas (ug/Nm3)	[Hg] In Gas (ug/Nm3)	[Hg] In Gas (ug/Nm3)	[Hg] In Gas (ug/Nm3)
Intrabrain Hg @ WS In Solution																											
T23-IY*	Mon-10/2	08:00	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-IY*	Mon-10/2	08:00	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-IY*	Mon-10/2	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-IY*	Mon-10/2	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Averages																											
Tris Comp @ WS In																											
T23-EXY1	Tue-10/3	08:00	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY1	Tue-10/3	08:00	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY1	Tue-10/3	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY1	Tue-10/3	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY1	Tue-10/3	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY1	Tue-10/3	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY1	Tue-10/3	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY1	Tue-10/3	11:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Averages																											
Tris Comp @ WS In																											
T23-EXY2	Wed-10/4	08:00	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY2	Wed-10/4	08:00	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY2	Wed-10/4	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY2	Wed-10/4	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY2	Wed-10/4	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY2	Wed-10/4	09:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY2	Wed-10/4	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T23-EXY2	Wed-10/4	11:30	Tris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Averages																											

ECTC Pilot Trace Elements Testing
Mercury Gas Sampling Results
Removal Summary
 (Normalized to 5% O2)

			Other						H2O2						KMnO4						Total Vapor					
Test ID	Date	Start Time	Other Imp. Cont.	Pre-Spike Inlet (µg/Nm3)	Post-Spike Inlet (µg/Nm3)	Outlet [Hg] (µg/Nm3)	Hg Spiked (µg/Nm3)	Hg Removal (%)	Pre-Spike Inlet (µg/Nm3)	Post-Spike Inlet (µg/Nm3)	Outlet [Hg] (µg/Nm3)	Hg Spiked (µg/Nm3)	Hg Removal (%)	Pre-Spike Inlet (µg/Nm3)	Post-Spike Inlet (µg/Nm3)	Outlet [Hg] (µg/Nm3)	Hg Spiked (µg/Nm3)	Hg Removal (%)	Pre-Spike Inlet (µg/Nm3)	Post-Spike Inlet (µg/Nm3)	Outlet [Hg] (µg/Nm3)	Total Hg Spiked (µg/Nm3)	Hg Removal (%)			
Intrastain Hg @ WS In Solution																										
T23-IY*	Mon-10/2	08:00	H	-	7.26	-	-	-	-	0.16	-	-	-	-	0.18	-	-	-	-	7.61	-	-	-			
T23-IY*	Mon-10/2	08:00	H	-	12.08	-	4.82	-	-	2.83	-	2.67	-	-	9.85	-	9.66	-	-	24.76	-	17.15	-			
T23-IY*	Mon-10/2	09:30	H	-	7.49	-	-	-	-	0.32	-	-	-	-	0.25	-	-	-	-	8.06	-	-	-			
T23-IY*	Mon-10/2	09:30	H	-	15.20	-	7.71	-	-	4.55	-	4.22	-	-	9.23	-	8.98	-	-	28.98	-	20.92	-			
T23-IY*	Mon-10/2	11:30	H	-	7.61	-	-	-	-	0.14	-	-	-	-	0.19	-	-	-	-	7.94	-	-	-			
T23-IY*	Mon-10/2	11:30	H	-	16.18	-	8.58	-	-	4.30	-	4.16	-	-	4.05	-	3.86	-	-	24.54	-	16.60	-			
T23-IY*	Mon-10/2	11:30	H	-	7.64	-	-	-	-	0.13	-	-	-	-	0.15	-	-	-	-	7.92	-	-	-			
T23-IY*	Mon-10/2	11:30	H	-	15.63	-	7.99	-	-	4.82	-	4.69	-	-	11.71	-	11.56	-	-	32.16	-	24.25	-			
Averages																										
Tris Comp @ WS In																										
T23-EKY1	Tue-10/3	08:00	H	7.72	17.14	-	9.42	-	0.25	3.92	-	3.67	-	0.06	5.43	-	5.36	-	8.03	26.48	-	18.45	-			
T23-EKY1	Tue-10/3	08:00	Tris	-	9.09	-	1.37	-	-	0.91	-	0.65	-	-	16.32	-	16.26	-	-	26.31	-	18.28	-			
T23-EKY1	Tue-10/3	09:30	H	-	17.96	-	10.24	-	-	4.02	-	3.77	-	-	4.59	-	4.52	-	-	26.57	-	18.53	-			
T23-EKY1	Tue-10/3	09:30	Tris	-	8.40	-	0.68	-	-	1.17	-	0.92	-	-	16.49	-	16.42	-	-	26.05	-	18.02	-			
T23-EKY1	Tue-10/3	09:30	H	-	0.69	-	-7.03	-	-	0.04	-	-0.21	-	-	<0.03	-	-0.04	-	-	0.76	-	-	-			
T23-EKY1	Tue-10/3	09:30	Tris	-	8.26	-	0.54	-	-	0.49	-	0.24	-	-	15.54	-	15.47	-	-	24.28	-	16.25	-			
T23-EKY1	Tue-10/3	11:30	H	-	16.72	-	9.00	-	-	3.38	-	3.13	-	-	5.03	-	4.96	-	-	25.13	-	17.10	-			
T23-EKY1	Tue-10/3	11:30	Tris	-	8.83	-	1.11	-	-	0.29	-	0.04	-	-	15.57	-	15.51	-	-	24.69	-	16.66	-			
Averages																										
Tris Comp @ WS In																										
T23-EKY2	Wed-10/4	08:00	H	7.19	17.85	-	10.66	-	0.33	4.41	-	4.08	-	0.15	5.83	-	5.68	-	7.66	28.09	-	20.43	-			
T23-EKY2	Wed-10/4	08:00	Tris	-	0.06	-	-7.13	-	-	0.14	-	-0.19	-	-	<0.05	-	-0.10	-	-	0.25	-	-	-			
T23-EKY2	Wed-10/4	09:30	H	-	18.34	-	11.15	-	-	4.44	-	4.11	-	-	5.63	-	5.49	-	-	28.41	-	20.75	-			
T23-EKY2	Wed-10/4	09:30	Tris	-	5.46	-	-1.73	-	-	0.87	-	0.54	-	-	13.34	-	13.19	-	-	19.67	-	12.00	-			
T23-EKY2	Wed-10/4	09:30	H	-	18.22	-	11.03	-	-	3.64	-	3.31	-	-	5.28	-	5.13	-	-	27.14	-	19.48	-			
T23-EKY2	Wed-10/4	09:30	Tris	-	6.96	-	-0.23	-	-	0.60	-	0.28	-	-	16.81	-	16.66	-	-	24.37	-	16.71	-			
T23-EKY2	Wed-10/4	11:30	H	-	18.61	-	11.43	-	-	4.46	-	4.13	-	-	5.14	-	4.99	-	-	28.21	-	20.55	-			
T23-EKY2	Wed-10/4	11:30	Tris	-	6.41	-	-0.78	-	-	0.52	-	0.19	-	-	16.38	-	16.24	-	-	23.31	-	15.65	-			
Averages																										

*C = CEM's not operating correctly, data from 9/7. Shaded areas= problems with sampling. Bolded areas=mercury values below low standard. A=Acetate, H=Peroxide, PH=Phosphate, Tris=Tris Buffer

Test ID	Date	Start Time	Other Imp. Cont.	Spike Recovery			Spike Capture (By Impinger)					Spiked Mercury Removal Efficiency (By Impinger)					Total Hg Capture (CRG) (By Impinger)					Total Hg Capture (WS Inlet) (By Impinger)					Total Hg Capture (WS Outlet) (By Impinger)				
				Actual Spiked	Spiked Theo Hg	Percent Spike Rec	Other [Hg]	Other [Hg]	H2O2 [Hg]	H2O2 [Hg]	KMnO4 [Hg]	Other (%)	Other (%)	H2O2 (%)	H2O2 (%)	Other (%)	Other (%)	H2O2 (%)	H2O2 (%)	KMnO4 (%)	Other (%)	Other (%)	H2O2 (%)	H2O2 (%)	KMnO4 (%)	Other (%)	Other (%)	H2O2 (%)	H2O2 (%)	KMnO4 (%)	
				(µg/Nm3)	(µg/Nm3)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
Intrastain Hg @ WS In Solution																															
T23-IY*	Mon-10/2	08:00	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
T23-IY*	Mon-10/2	08:00	H	12.32	#REF!	#REF!	14.3	13.8	9.2	6.4	56.3	14.3	16.1	12.8	10.2	-	-	-	-	-	88.5	7.0	1.9	0.2	2.4	-	-	-	-		
T23-IY*	Mon-10/2	09:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	85.1	7.8	3.1	0.9	3.1	-	-	-	-		
T23-IY*	Mon-10/2	09:30	H	15.06	#REF!	#REF!	17.1	19.1	11.1	8.8	42.2	17.1	23.6	17.9	17.2	-	-	-	-	-	36.2	16.2	9.0	6.7	31.8	-	-	-	-		
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88.3	7.5	1.6	0.2	2.3	-	-	-	-		
T23-IY*	Mon-10/2	11:30	H	11.65	#REF!	#REF!	27.7	23.7	14.7	10.2	23.1	27.7	33.0	30.6	30.6	-	-	-	-	-	47.4	18.5	10.5	7.0	16.5	-	-	-	-		
T23-IY*	Mon-10/2	11:30	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	89.0	7.6	1.4	0.2	1.8	-	-	-	-		
T23-IY*	Mon-10/2	11:30	H	17.21	#REF!	#REF!	18.3	14.4	10.9	8.3	47.4	18.3	17.8	16.3	15.0	-	-	-	-	-	35.8	12.8	8.6	6.4	36.4	-	-	-	-		
Averages																															
Tris Comp @ WS In																															
T23-EXY1	Tue-10/3	08:00	H	12.56	12.60	99.7	34.7	16.3	11.3	8.5	29.1	34.7	25.0	23.2	22.7	87.2	8.8	1.8	1.4	0.8	50.7	14.0	8.4	6.4	20.5	-	-	-	-		
T23-EXY1	Tue-10/3	08:00	Tris	12.44	12.60	98.7	7.2	0.3	1.6	2.0	88.9	7.2	0.3	1.7	2.2	-	-	-	-	-	31.7	2.9	1.7	1.8	62.0	-	-	-	-		
T23-EXY1	Tue-10/3	09:30	H	12.70	12.60	100.8	36.8	18.6	11.7	8.5	24.4	36.8	29.4	26.3	25.9	-	-	-	-	-	52.0	15.6	8.7	6.4	17.3	-	-	-	-		
T23-EXY1	Tue-10/3	09:30	Tris	12.35	12.60	98.0	3.5	0.5	4.2	0.9	90.9	3.5	0.5	4.4	0.9	-	-	-	-	-	29.2	3.0	3.5	1.0	63.3	-	-	-	-		
T23-EXY1	Tue-10/3	09:30	H	4.93	12.60	-39.1	87.9	8.7	1.5	1.4	0.5	87.9	72.2	44.7	73.7	-	-	-	-	-	80.9	9.7	4.1	1.8	3.6	-	-	-	-		
T23-EXY1	Tue-10/3	09:30	Tris	11.59	12.60	92.0	4.0	0.8	1.0	0.5	93.8	4.0	0.8	1.0	0.5	-	-	-	-	-	30.7	3.3	1.2	0.8	64.0	-	-	-	-		
T23-EXY1	Tue-10/3	11:30	H	11.92	12.60	94.6	36.9	16.1	11.3	6.8	28.8	36.9	25.5	24.1	19.2	-	-	-	-	-	52.8	13.8	8.3	5.1	20.0	-	-	-	-		
T23-EXY1	Tue-10/3	11:30	Tris	11.62	12.60	92.2	6.2	1.2	-0.1	0.3	92.4	6.2	1.3	-0.1	0.3	-	-	-	-	-	32.1	3.6	0.5	0.7	63.1	-	-	-	-		
Averages																															
Tris Comp @ WS In																															
T23-EXY2	Wed-10/4	08:00	H	14.53	12.60	115.3	34.8	17.3	11.7	8.3	27.8	34.8	26.6	24.4	23.0	85.8	8.0	2.9	1.3	1.9	48.7	14.8	9.3	6.4	20.8	-	-	-	-		
T23-EXY2	Wed-10/4	08:00	Tris	5.27	12.60	-41.9	88.3	7.9	2.2	0.3	1.3	88.3	67.5	57.7	18.7	-	-	-	-	-	11.0	11.8	25.0	32.2	20.0	-	-	-	-		
T23-EXY2	Wed-10/4	09:30	H	14.24	12.60	113.0	32.6	20.8	11.3	8.7	26.7	32.6	30.8	24.2	24.6	-	-	-	-	-	47.3	17.3	9.0	6.7	19.8	-	-	-	-		
T23-EXY2	Wed-10/4	09:30	Tris	8.18	12.60	64.9	-16.2	-0.1	3.2	1.3	111.7	-16.2	-0.1	2.7	1.2	-	-	-	-	-	24.6	3.2	3.1	1.3	67.8	-	-	-	-		
T23-EXY2	Wed-10/4	09:30	H	13.45	12.60	106.7	36.8	19.6	10.6	6.5	26.6	36.8	30.9	24.3	19.6	-	-	-	-	-	50.9	16.2	8.4	5.0	19.5	-	-	-	-		
T23-EXY2	Wed-10/4	09:30	Tris	11.52	12.60	91.4	-4.0	1.7	0.9	0.7	100.7	-4.0	1.6	0.9	0.7	-	-	-	-	-	24.8	3.7	1.6	0.9	69.0	-	-	-	-		
T23-EXY2	Wed-10/4	11:30	H	14.56	12.60	115.6	37.0	18.6	12.4	7.8	24.3	37.0	29.5	27.8	24.2	-	-	-	-	-	50.3	15.7	9.8	6.0	18.2	-	-	-	-		
T23-EXY2	Wed-10/4	11:30	Tris	11.09	12.60	88.0	-6.3	1.2	1.1	0.2	103.9	-6.3	1.1	1.0	0.2	-	-	-	-	-	24.0	3.5	1.7	0.5	70.3	-	-	-	-		
Averages																															

*C = CEM's not operating correctly, data from 9/7. Shaded areas= problems with sampling. Bolded areas=mercury values below low standard. A=Acetate, H=Peroxide, PII=Phosphate, Tris=Tris Buffer

APPENDIX D

TRACE ELEMENT REMOVAL (TER) TEST SUMMARY DATA

Trace Element Removal Impinger Test Conditions

Test ID	Test Description	Gas Sample Source	Spiking Conditions		Sampling Methods		
			Species Spiked	Spike Location	Method 29 Used?	Method 29* Used?	Sol'n of Extra Imp.
T1-NX	No spiking, method comparison.	CRG	NA	NA	Yes	Yes	Peroxide
T0-IA	Intratrain Hg(0) gas spike with air.	Air	Hg(0)	Before 1st imp.	No	Yes	Peroxide
T4-IY	Intratrain Hg(0) gas spike at inlet.	WS inlet	Hg(0)	Before 1st imp.	No	Yes	Peroxide
T5-IZ	Intratrain Hg(0) gas spike at outlet.	WS outlet	Hg(0)	Before 1st imp.	No	Yes	Peroxide
T6-JZ	Intratrain Hg(0) gas spike at outlet.	WS outlet	Hg(0)	After 2nd imp.	No	Yes	Peroxide
T6-JY	Intratrain Hg(0) gas spike at inlet.	WS inlet	Hg(0)	After 2nd imp.	No	Yes	Peroxide
T7-EY	Flue gas spiking, method comparison.	WS inlet	Hg(0)	Duct Injection	Yes	Yes	Peroxide
T8-E1	Flue gas spiking.	3 Locations	Hg(0)	Duct Injection	No	Yes	Peroxide
T8-E2	Flue gas spiking.	3 Locations	Hg(0)	Duct Injection	Yes	No	NA
T0-JA	Intratrain gas spike with ambient air.	Air	Hg(0)	After 2nd imp.	No	Yes	Peroxide
T9-IX*	CRG sample followed by intratrain gas spike with ambient air.	CRG/Air	Hg(0)	Before 1st imp.	No	Yes	Peroxide
T9-E1	Flue gas spiking with acetate impingers.	3 Locations	Hg(0)	Duct Injection	No	Yes	Acetate
T9-E2	Flue gas spiking with phosphate impingers.	3 Locations	Hg(0)	Duct Injection	No	Yes	Phosphate
T10-N	Baseline measurements with phosphate impingers.	3 Locations	NA	NA	No	Yes	Phosphate
T11-IY	Intratrain Hg(0) gas spike using phosphate impingers.	WS inlet	Hg(0)	Before 1st imp.	No	Yes	Phosphate
T12-EY	Flue gas spiking, method comparison.	WS inlet	Hg(0)	Duct Injection	No	Yes	Phosphate
T12-NY	Method comparison without flue gas spiking.	WS inlet	NA	NA	No	Yes	Phosphate
T13-NY	Method comparison without flue gas spiking.	WS inlet	NA	NA	No	Yes	Phosphate
T16-EY	Baseline measurements with phosphate impingers.	WS inlet	Hg(0)	Duct Injection	No	Yes	Phosphate/ Peroxide
T0-KA	Aqueous Hg intratrain spike.	Air	Aq. Hg Std.	In 1st H2O2 & KMnO4 imp.	Yes	No	NA

Trace Element Removal Impinger Test Conditions

Test ID	Test Description	Gas Sample Source	Spiking Conditions		Sampling Methods		
			Species Spiked	Spike Location	Method 29 Used?	Method 29* Used?	Sol'n of Extra Imp.
T18L-N	Lime slurry injection upstream of the ESP.	DRG,CRG	NA	NA	No	Yes	Tris
T18S-N	Limestone slurry injection upstream of the ESP.	DRG,CRG	NA	NA	No	Yes	Tris
T18W-N	Water injection upstream of the ESP.	DRG,CRG	NA	NA	No	Yes	Tris
T19-NY	No spiking; Tris comparison at Pilot inlet.	WS inlet	NA	NA	No	Yes	Tris
T19-EXY	Flue gas spiking; Tris comparison at Pilot inlet.	CRG/WS Inlet	Hg(0)	Duct Injection	No	Yes	Tris
T19-E	Flue gas spiking; Tris comparison at the Pilot inlet	3 Locations	Hg(0)	Duct Injection	No	Yes	Tris
T20-C	Flue gas spiking; Tris comparison at the Pilot inlet	3 Locations	HgCl2	Duct Injection	No	Yes	Tris
T20-EC	Flue gas spiking; Tris comparison at the Pilot inlet	3 Locations	Hg (0) and HgCl2	Duct Injection	No	Yes	Tris
T21-N	No spiking; Mg-lime wet scrubber conditions, forced oxidation	3 Locations	NA	NA	Yes	No	NA
T21-E	Flue gas spiking; Mg-lime wet scrubber conditions, forced oxidation	3 Locations	Hg(0)	Duct Injection	Yes	No	NA
T21-EC	Flue gas spiking; Mg-lime wet scrubber conditions, forced oxidation	3 Locations	Hg (0) and HgCl2	Duct Injection	Yes	No	NA
T22-N	No spiking; Mg-lime wet scrubber conditions, inhibited oxidation.	3 Locations	NA	NA	Yes	No	NA
T22-E	Flue gas spiking; Mg-lime wet scrubber conditions, inhibited oxidation.	3 Locations	Hg(0)	Duct Injection	Yes	No	NA
T22-EC	Flue gas spiking; Mg-lime wet scrubber conditions, inhibited oxidation.	3 Locations	Hg (0) and HgCl2	Duct Injection	Yes	No	NA
T23-EY1	Tris comparison test	WS inlet	Hg(0)	Duct Injection	No	Yes	Tris
T23-EZ1	Gold amalgamation with full filter area used during gas sampling.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ2	Copper amalgamation with full filter area used during gas sampling.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA

Trace Element Removal Impinger Test Conditions

Test ID	Test Description	Gas Sample Source	Spiking Conditions		Sampling Methods		
			Species Spiked	Spike Location	Method 29 Used?	Method 29* Used?	Sol'n of Extra Imp.
T23-EZ3	Aluminum amalgamation with full filter area used during gas sampling.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ4	Sulfur amalgamation with full filter area used during gas sampling.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ5	Silver amalgamation with full filter area used during gas sampling.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ6	Zinc amalgamation with full filter area used during gas sampling.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ7	Gold amalgamation with increased gas:metal contact area.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ8	Lead amalgamation with increased gas:metal contact area.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ9	Silver amalgamation with increased gas:metal contact area.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EZ10	Iron amalgamation with increased gas:metal contact area.	WS outlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY2	Gold amalgamation with increased gas:metal contact area.	WS inlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY3	Copper amalgamation with increased gas:metal contact area.	WS inlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY4	Silver amalgamation with increased gas:metal contact area.	WS inlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY5	Aluminum amalgamation with increased gas:metal contact area.	WS inlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY6	Iodated carbon (3400:1 C:Hg ratio)	WS inlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY7	Iodated carbon (11300:1 C:Hg ratio)	WS inlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY8	Calcium chloride impregnated carbon (2800:1 C:Hg ratio)	WS inlet	Hg(0)	Duct Injection	Yes	No	NA
T23-EY9	Calcium chloride impregnated carbon (9500:1 C:Hg ratio)	WS inlet	Hg(0)	Duct Injection	Yes	No	NA

Alternate Impinger Solutions Summary

Test ID	Alternate Impinger Solution	Solution Composition	Sampling Time (min)	Spiking Conditions Species Spiked	Spike Location	Sample Recovery	Observations
T9-E1	Acetate	1 M NaC ₂ H ₃ O ₂ , 0.05 M Acetic Acid	60	Hg(0)	Duct Injection	5 ft3 of air through impingers with DI water rinse (standard peroxide impinger recovery method).	Migration of acetic acid vapor through the train consumed the permanganate in the final impingers.
T9-E2	Phosphate	0.3 M Na ₂ HPO ₄ , 0.2 M KH ₂ PO ₄	60 at Inlet 100 at Outlet	Hg(0)	Duct Injection	5 ft3 of air through impingers with DI water rinse.	Pilot fan tripped during sampling causing the data to be questionable. The pH in impinger 1 fell below 2. Solids formed in second impinger
T10-N	Phosphate	0.4 M Na ₂ HPO ₄ , 0.3 M KH ₂ PO ₄	60 at Inlet 100 at Outlet	NA	NA	5 ft3 of air through impingers with DI water rinse.	The pH in impinger 1 fell below 2. Higher total phosphate was used. Solids formed in second impinger.
T11-IY	Phosphate	0.7 M Na ₂ HPO ₄ , 0.3 M KH ₂ PO ₄	60	Hg(0)	Before 1st imp.	5 ft3 of air through impingers with DI water rinse and 15 ml peroxide.	1M total phosphate species used to increase pH. Solids formed in second impinger during gas sampling.
T12-EY	Phosphate	0.7 M Na ₂ HPO ₄ , 0.3 M KH ₂ PO ₄	60	Hg(0)	Duct Injection	5 ft3 of air through impingers with DI water rinse and 15 ml peroxide.	The pH of the 1st impinger solution dropped below 2 after 1 hour of gas sampling. Solids found in second impinger.
T12-NY	Phosphate	0.5 M Na ₃ PO ₄ , 0.5 M K ₃ PO ₄ ,	60	NA	NA	No air purge. 15 ml peroxide and 15 ml nitric added at location. 10% nitric impinger rinse.	Tribasic phosphate used to increase pH. The pH of the 1st impinger solution dropped below 2 after 1 hour of gas sampling. Solids found in second impinger.
T13-NY	Phosphate	0.5 M Na ₃ PO ₄ , 0.5 M K ₃ PO ₄ ,	20	NA	NA	No air purge. 15 ml peroxide and 15 ml nitric added at location. 10% nitric impinger rinse.	The pH of the 1st impinger solution remained above 6.5 after only 20 minutes of gas sampling. Solids found in first impinger in some runs.
T13-NY	Phosphate	0.5 M Na ₃ PO ₄ , 0.5 M K ₃ PO ₄ ,	60	NA	NA	No air purge. 15 ml peroxide and 15 ml nitric added at location. 10% nitric impinger rinse.	The pH of the 1st impinger solution was below 2 after 60 minutes of gas sampling. Solids found in second impinger.
T16-EY	Phosphate/ Peroxide	0.5 M Na ₃ PO ₄ , 0.5 M K ₃ PO ₄ , 5% peroxide	60	Hg(0)	Duct Injection	No air purge. 5 ml peroxide added. 5 ml nitric added.	Impinger solution very unstable. Peroxide decomposed over time. SO ₂ odor in the impingers after sampling.
T16-EY	Phosphate	0.4 M Na ₃ PO ₄ , 0.4 M K ₃ PO ₄ , 2.5% Bleach	60	Hg(0)	Duct Injection	No air purge. 5 ml peroxide added. 5 ml nitric added.	Could not analyze the impinger solutions, solids formed, offgassed fumes interfered with the FIMS.
T18L-N	Tris	1 M Tris	20	NA	NA	15 ml peroxide in 1st imp. 5 ml peroxide in 2nd imp.	The pH of impinger 1 remained above 6.5.

Alternate Impinger Solutions Summary

Test ID	Alternate Impinger Solution	Solution Composition	Sampling Time (min)	Spiking Conditions Species Spiked	Spike Location	Sample Recovery	Observations
T18S-N	Tris	1 M Tris	20	NA	NA	After Run #1, 15 ml of 30% peroxide and 7.5 ml of nitric acid were added to the 1st impinger. 5 ml of 30% peroxide and 7.5 ml of nitric acid were added to imp. #2. After Run #2, 8.5 g of potassium permanganate was added to each Tris impinger.	The pH of impinger 1 remained above 6.5.
T18W-N	Tris	1 M Tris	20	NA	NA	8.5 g of potassium permanganate added to first and second Tris solution impingers	The pH of impinger 1 remained above 6.5.
T19-NY	Tris	1 M Tris	60	Aq. Hg Std.	4 µg Hg(II) added to 1st imp. before run	15 g of potassium permanganate added to first and second Tris solution impingers	The pH of impinger 1 remained above 6.5.
T19-EXY	Tris	1 M Tris	30	Hg(0)	duct injection	25 ml of 30% peroxide and 20 ml of nitric acid added to 1st and 2nd Tris impinger solutions.	The pH of impinger 1 remained above 7.0
T19-EXY	Tris	1 M Tris	30	Aq. Hg Std. at CRG	4 µg Hg(II) added to 1st imp. before run	25 ml of 30% peroxide and 20 ml of nitric acid added to 1st and 2nd Tris impinger solutions.	The pH of impinger 1 remained above 7.0
T19-E	Tris	1 M Tris	20	Hg(0)	duct injection	5g of potassium permanganate added to each Tris solution impinger	The pH of impinger 1 remained above 7.0
T20-C	Tris	1 M Tris	25	HgCl ₂	duct injection	5g of potassium permanganate added to each Tris solution impinger	The pH of impinger 1 remained above 7.0
T20-EC	Tris	1 M Tris	25	Hg(0) and HgCl ₂	duct injection	5g of potassium permanganate added to each Tris solution impinger	The pH of impinger 1 remained above 7.0
T23-EY1	Tris	1 M Tris	30	Hg(0)	duct injection	25 mls of 30% peroxide and 20 mls HNO ₃ were added to the first two impingers after gas sampling, but before removing from the sampling location. 2.5 mls HCl was added during recovery.	
T23-EY1	Tris	1 M Tris	40	Hg(0)	duct injection	25 mls of 30% peroxide and 20 mls HNO ₃ were added to the first two impingers after gas sampling, but before removing from the sampling location. 2.5 mls HCl was added during recovery.	

Alternate Impinger Solutions Summary

Test ID	Alternate Impinger Solution	Solution Composition	Sampling Time (min)	Spiking Conditions		Sample Recovery	Observations
				Species Spiked	Spike Location		
T23-EY1	Tris	1 M Tris	50	Hg(0)	duct injection	25 mls of 30% peroxide and 20 mls HNO ₃ were added to the first two impingers after gas sampling, but before removing from the sampling location. 2.5 mls HCl was added during recovery.	

Tris vs. Peroxide as Impinger Solution

Test ID	Solution Composition	Sampling Time (min)	Species Spiked	Total Hg ($\mu\text{g}/\text{Nm}^3$)		Recovery Difference ($\mu\text{g}/\text{Nm}^3$)	Tris Train Recovery (% of Peroxide Train)
				Peroxide Train	Tris Train		
T18 L-N	1 M Tris	20	NA	1.6	1.2	-0.4	75.0
T18S-N	1 M Tris	20	NA	3.5	3.4	-0.1	97.1
T18W-N	1 M Tris	20	NA	5.7	6.4	0.7	112.3
T19-EXY	1 M Tris	30	Hg(0)	17.3	18.4	1.1	106.4
T19-E	1 M Tris	20	Hg(0)	19.7	20.6	0.9	104.6
T20-C	1 M Tris	25	HgCl ₂	18.4	13.8	-4.6	75.0
T20-EC	1 M Tris	25	Hg(0) and HgCl ₂	32.0	21.1	-10.9	65.9
T23-EY1 (Run 1)	1 M Tris	30	Hg(0)	16.3	15.8	-0.5	97.1
T23-EY1 (Run 2)	1 M Tris	40	Hg(0)	15.6	14.9	-0.7	95.4
T23-EY1 (Run 3)	1 M Tris	50	Hg(0)	15.5	15.3	-0.1	99.2

APPENDIX E

PILOT HIGH VELOCITY (PHV) ANALYTICAL DATA SUMMARY

**Pilot FLRT Liquid Analytical Summary:
PHV Phase II Test Block**

Test	Date	Time	FLRT pH	ABS pH	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)	L-K+ (ppm)	L=Al (ppm)	L-Fe (ppm)	L-Mn (ppm)	L-Cl- (mM)	L-CO3= (mM)	L-SO3= (mM)	L-SO4= (mM)	ICE DBA (ppm)	ICE Adipic (mM)	ICE Glutaric (mM)	ICE Succinic (mM)	CaSO3 RS	CaSO4 RS
<i>Baseline, 20 ft/s, 1700 gpm</i>																					
PHV-200X*	Tue 10/24	12:35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X*	Wed 10/25	07:19	3.92	3.15	136.26	131.39	13.93	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
PHV-200X	Wed 10/25	13:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Wed 10/25	14:00	4.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Thu 10/26	07:40	4.36	3.13	131.09	123.32	14.19	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
Averages			4.32	3.13	131.09	123.32	14.19	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
<i>Baseline, 10 ft/s, 650 gpm</i>																					
PHV-211X	Thu 10/26	10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-211X	Thu 10/26	12:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baseline, 20 ft/s, 1300 gpm</i>																					
PHV-204*	Thu 10/26	14:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	14:10	4.24	3.20	154.19	132.50	15.81	40.17	23.89	0.00	20.08	506.28	2.35	0.00	16.50	-	-	-	-	0.00	1.00
PHV-204*	Thu 10/26	15:10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	16:05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	17:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	17:40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baseline, 17.5 ft/s, 1300 gpm</i>																					
PHV-205	Thu 10/26	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205	Fri 10/27	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baseline, 15 ft/s, 1300 gpm</i>																					
PHV-206	Fri 10/27	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-206	Fri 10/27	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baseline, 10 ft/s, 1300 gpm</i>																					
PHV-207	Fri 10/27	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-207	Fri 10/27	07:59	5.34	4.75	142.23	119.63	14.42	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
PHV-207	Fri 10/27	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			5.34	4.75	142.23	119.63	14.42	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions

* = Data Not Included in Averages

PHV Phase II Test Block

X = Data Collected During Startup Conditions
• = Data Not Included in Averages

Pilot FLRT Liquid Analytical Summary:
PHV Phase II Test Block

Test	Date	Time	FLRT pH	ABS pH	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)	L-K+ (ppm)	I-Al (ppm)	L-Fe (ppm)	L-Mn (ppm)	L-Cl- (mM)	L-CO3= (mM)	L-SO3= (mM)	L-SO4= (mM)	ICE DBA (ppm)	ICE Adipic (mM)	ICE Glutaric (mM)	ICE Succinic (mM)	CsSO3 RS	CsSO4 RS
PHV-209	Sat 10/28	16:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Averages		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions
• = Data Not Included in Averages

**Pilot FLRT Liquid Analytical Summary:
PHV Phase II Test Block**

Test	Date	Time	FLRT pH	ABS pH	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)	L-K+ (ppm)	L-Al (ppm)	L-Fe (ppm)	L-Mn (ppm)	L-Cl- (mM)	L-CO3= (mM)	L-SO3= (mM)	L-SO4= (mM)	ICE DBA (ppm)	ICE Adipic (mM)	ICE Glutaric (mM)	ICE Succinic (mM)	CaSO3 RS	CaSO4 RS
<i>Baseline, 20 ft/s, 650 gpm</i>																					
PHV-208	Sat 10/28	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-208	Sat 10/28	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baseline, 15 ft/s, 650 gpm</i>																					
PHV-210	Sat 10/28	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-210	Sun 10/29	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baseline, 10 ft/s, 650 gpm</i>																					
PHV-211	Sun 10/29	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-211	Sun 10/29	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baseline, 20 ft/s, 650 gpm</i>																					
PHV-212R	Sun 10/29	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-212R	Sun 10/29	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions

• = Data Not Included In Averages

October 1995

**Pilot VME Wash Water Analytical Summary:
PHV Phase II Test Block**

**HME Collection
(VME Carryover)**

Test	Date	Time	CaCO3	RS	VME Wash	pH	Wt%	Wt%	L-Ca++	L-Mg++	L-Na+	L-Cl-	L-CO3=	L-SO3=	L-SO4=	CaSO3	CaSO4	CaCO3	Carryover	Wt%	Solids
Baseline, 20 g/s, 1700 gpm																					
PHV-200X*	Tue 10/24	12:35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X*	Wed 10/25	07:19	-	-	6.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Wed 10/25	13:45	-	-	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Wed 10/25	14:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Thu 10/26	07:40	-	-	6.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																					
			-	-	-	3.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 g/s, 650 gpm																					
PHV-211X	Thu 10/26	10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-211X	Thu 10/26	12:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																					
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 20 g/s, 1300 gpm																					
PHV-204*	Thu 10/26	14:00	-	0.00	6.60	0.01	36.69	31.52	4.52	110.93	-	0.00	7.22	-	0.04	85.40	78.67	9.08	-	-	-
PHV-204*	Thu 10/26	15:10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	16:05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	17:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	17:40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																					
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 g/s, 1300 gpm																					
PHV-205	Thu 10/26	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205	Fri 10/27	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																					
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 15 g/s, 1300 gpm																					
PHV-206	Fri 10/27	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-206	Fri 10/27	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																					
			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 g/s, 1300 gpm																					
PHV-207	Fri 10/27	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-207	Fri 10/27	07:59	-	-	6.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-207	Fri 10/27	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages																					
			-	-	-	6.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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X = Data Collected During Startup Conditions
* = Data Not Included in Averages

**Pilot VME Wash Water Analytical Summary:
PHV Phase II Test Block**

																HME Collection (VME Carryover)			
Test	Date	Time	CaCO3 RS	VME	Wt% Solids	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)	L-Cl- (mM)	L-CO3= (mM)	L-SO3= (mM)	L-SO4= (mM)	CaSO3 RS	CaSO4 RS	CaCO3 RS	VME	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)
				Wash pH												Carryover Wt% Solids			
Baseline, 17.5 ft/s, 1300 gpm																			
PHV-205R	Fri 10/27	09:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	10:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	11:20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	12:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 ft/s, 1700 gpm																			
PHV-203*	Fri 10/27	14:06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203*	Fri 10/27	15:55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	16:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	18:05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 15 ft/s, 1700 gpm																			
PHV-202	Fri 10/27	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-202	Sat 10/28	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 ft/s, 1700 gpm																			
PHV-201	Sat 10/28	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-201	Sat 10/28	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 20 ft/s, 1700 gpm																			
PHV-200	Sat 10/28	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200	Sat 10/28	07:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200	Sat 10/28	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200	Sat 10/28	08:25	-	6.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	6.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 ft/s, 1700 gpm																			
PHV-201R	Sat 10/28	10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-201R	Sat 10/28	12:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-201R	Sat 10/28	12:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 ft/s, 650 gpm																			
PHV-209	Sat 10/28	14:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions

* = Data Not Included In Averages

**Pilot VME Wash Water Analytical Summary:
PHV Phase II Test Block**

Test	Date	Time	VME				HME Collection (VME Carryover)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
			CaCO3	Wash	pH	RS	VME																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
							Wt%	Solids	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)	L-Cl- (mM)	L-CO3= (mM)	L-SO3= (mM)	L-SO4= (mM)	CaSO3 RS	CaSO4 RS	CaCO3	Wt%	Solids	Carryover																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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X = Data Collected During Startup Conditions
 * = Data Not Included in Averages

**Pilot VME Wash Water Analytical Summary:
PHV Phase II Test Block**

XIV. HME Test Block																HME Collection (VME Carryover)			
Test	Date	Time	CaCO3	VME	Wt% Solids	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)	L-Cl- (mM)	L-CO3= (mM)	L-SO3= (mM)	L-SO4= (mM)	CaSO3 RS	CaSO4 RS	CaCO3 RS	VME	L-Ca++ (mM)	L-Mg++ (mM)	L-Na+ (mM)
			RS	Wash pH												Carryover Wt% Solids			
Baseline, 20 ft/s, 650 gpm																			
PHV-208	Sat 10/28	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-208	Sat 10/28	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 15 ft/s, 650 gpm																			
PHV-210	Sat 10/28	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-210	Sun 10/29	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 ft/s, 650 gpm																			
PHV-211	Sun 10/29	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-211	Sun 10/29	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 20 ft/s, 650 gpm																			
PHV-212R	Sun 10/29	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-212R	Sun 10/29	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions
 * = Data Not Included in Averages

October 1995

**Pilot FLRT Solid Analytical Summary:
PHV Phase II Test Block**

			FLRT	Ca	Mg	SO3	SO4	CO3	Inerts	Wt Solids	Mol Solids	Solids	IR		CO3- Est.	L.S.	Thickener		Form				
Test	Date	Time	Wt% Solids	(mmol/g)	(mmol/g)	(mmol/g)	(mmol/g)	(mmol/g)	(wt%)	Closure (%)	Closure (%)	Ox. (%)	Util. (%)	Ox. (%)	Util. (%)	Util. (g/L)	CPAFC Wt%	Unit Area (ft2/tpd)	Initial Wt%	Final Settled Wt%	Filtration Rate lb/hr*sqft	Filter Cake Wt%	
Baseline, 20 ft/s, 1700 gpm																							
PHV-200X*	Tue 10/24	12:35	7.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
PHV-200X*	Wed 10/25	07:19	14.99	-	-	-	-	0.06	-	-	-	-	-	-	-	99.0	1.0	83.74	-	-	-	-	
PHV-200X	Wed 10/25	13:45	13.31	-	-	-	-	0.24	-	-	-	-	-	-	-	95.9	3.5	-	-	-	-	-	
PHV-200X	Wed 10/25	14:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
PHV-200X	Thu 10/26	07:40	10.00	-	-	-	-	0.18	-	-	-	-	-	-	-	96.9	1.9	83.96	-	-	-	-	
Averages			11.66	-	-	-	-	0.21	-	-	-	-	-	-	-	96.4	2.72	83.96	-	-	-	-	
Baseline, 10 ft/s, 650 gpm																							
PHV-211X	Thu 10/26	10:00	9.64	-	-	-	-	0.12	-	-	-	-	-	-	-	97.9	1.2	-	-	-	-	-	
PHV-211X	Thu 10/26	12:00	9.93	-	-	-	-	0.07	-	-	-	-	-	-	-	98.8	0.7	-	-	-	-	-	
Averages			9.79	-	-	-	-	0.10	-	-	-	-	-	-	-	98.4	1.0	-	-	-	-	-	
Baseline, 20 ft/s, 1300 gpm																							
PHV-204*	Thu 10/26	14:00	12.20	-	-	-	-	0.09	-	-	-	-	-	-	-	98.4	1.2	-	-	-	-	-	
PHV-204*	Thu 10/26	14:10	12.23	6.94	0.02	0.42	6.25	0.09	1.30	1.5	15.8	93.7	98.7	-	-	98.4	1.2	83.97	0.81	12.23	66.08	1504	86
PHV-204*	Thu 10/26	15:10	13.35	-	-	-	-	0.11	-	-	-	-	-	-	-	98.1	1.6	-	-	-	-	-	
PHV-204*	Thu 10/26	16:05	13.41	-	-	-	-	0.15	-	-	-	-	-	-	-	97.4	2.2	-	-	-	-	-	
PHV-204*	Thu 10/26	17:00	-	-	-	-	-	0.16	-	-	-	-	-	-	-	97.3	-	-	-	-	-	-	
PHV-204	Thu 10/26	17:40	-	-	-	-	-	0.22	-	-	-	-	-	-	-	96.2	-	-	-	-	-	-	
PHV-204	Thu 10/26	18:00	12.85	-	-	-	-	0.21	-	-	-	-	-	-	-	96.4	3.0	-	-	-	-	-	
PHV-204	Thu 10/26	20:00	13.20	-	-	-	-	0.25	-	-	-	-	-	-	-	95.7	3.6	-	-	-	-	-	
Averages			13.03	-	-	-	-	0.23	-	-	-	-	-	-	-	96.1	3.3	-	-	-	-	-	
Baseline, 17.5 ft/s, 1300 gpm																							
PHV-205	Thu 10/26	22:00	12.47	-	-	-	-	0.29	-	-	-	-	-	-	-	95.1	3.9	-	-	-	-	-	
PHV-205	Fri 10/27	00:01	12.34	-	-	-	-	0.36	-	-	-	-	-	-	-	93.9	4.8	-	-	-	-	-	
Averages			12.41	-	-	-	-	0.33	-	-	-	-	-	-	-	94.5	4.4	-	-	-	-	-	
Baseline, 15 ft/s, 1300 gpm																							
PHV-206	Fri 10/27	02:00	12.11	-	-	-	-	0.35	-	-	-	-	-	-	-	94.1	4.6	-	-	-	-	-	
PHV-206	Fri 10/27	04:00	11.92	-	-	-	-	0.36	-	-	-	-	-	-	-	93.9	4.7	-	-	-	-	-	
Averages			12.02	-	-	-	-	0.36	-	-	-	-	-	-	-	94.0	4.6	-	-	-	-	-	
Baseline, 10 ft/s, 1300 gpm																							
PHV-207	Fri 10/27	06:00	11.46	-	-	-	-	0.35	-	-	-	-	-	-	-	94.1	4.3	-	-	-	-	-	
PHV-207	Fri 10/27	07:59	11.78	-	-	-	-	0.40	-	-	-	-	-	-	-	93.2	-	82.52	-	-	-	-	
PHV-207	Fri 10/27	08:00	11.94	-	-	-	-	0.40	-	-	-	-	-	-	-	93.2	5.2	-	-	-	-	-	
Averages			11.73	-	-	-	-	0.38	-	-	-	-	-	-	-	93.5	4.8	82.52	-	-	-	-	

X = Data Collected During Startup Conditions

* = Data Not Included in Averages

**Pilot FLRT Solid Analytical Summary:
PHV Phase II Test Block**

Test	Date	Time	FLRT Wt% Solids	Ca (mmol/g)	Mg (mmol/g)	SO3 (mmol/g)	SO4 (mmol/g)	CO3 (mmol/g)	Inerts (wt%)	Wt Solids Closure (%)	Mol Solids Closure (%)	Solids Ox. (%)	Util. (%)	IR Ox. (%)	Util. (%)	CO3- Est. Util. (%)	L.S. Loading (g/L)	CPFC Wt%	Thickener Unit Area (ft ² /hr)	Initial Wt%	Final Settled Wt%	Form Filtration Rate lb/hr*sqft	Filter Cake Wt%
Baseline, 17.5 ft/s, 1300 gpm																							
PHV-205R	Fri 10/27	09:00	12.86	-	-	-	-	0.34	-	-	-	-	-	-	-	94.2	4.8	-	-	-	-	-	-
PHV-205R	Fri 10/27	10:00	13.26	-	-	-	-	0.30	-	-	-	-	-	-	-	94.9	4.4	-	-	-	-	-	-
PHV-205R	Fri 10/27	10:30	13.45	-	-	-	-	0.31	-	-	-	-	-	-	-	94.7	4.6	-	-	-	-	-	-
PHV-205R	Fri 10/27	11:20	13.12	-	-	-	-	0.28	-	-	-	-	-	-	-	95.2	4.0	-	-	-	-	-	-
PHV-205R	Fri 10/27	12:00	13.13	-	-	-	-	0.25	-	-	-	-	-	-	-	95.7	3.6	-	-	-	-	-	-
Averages			13.16	-	-	-	-	0.30	-	-	-	-	-	-	-	95.0	4.3	-	-	-	-	-	-
Baseline, 10 ft/s, 1700 gpm																							
PHV-203*	Fri 10/27	14:06	12.16	-	-	-	-	0.41	-	-	-	-	-	-	-	93.1	5.4	-	-	-	-	-	-
PHV-203*	Fri 10/27	15:55	12.36	-	-	-	-	0.42	-	-	-	-	-	-	-	92.9	5.7	-	-	-	-	-	-
PHV-203	Fri 10/27	16:00	12.38	-	-	-	-	0.43	-	-	-	-	-	-	-	92.8	5.8	-	-	-	-	-	-
PHV-203	Fri 10/27	18:00	12.94	-	-	-	-	0.38	-	-	-	-	-	-	-	93.6	5.4	-	-	-	-	-	-
PHV-203	Fri 10/27	18:05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	20:00	12.18	-	-	-	-	0.26	-	-	-	-	-	-	-	95.6	3.4	-	-	-	-	-	-
Averages			12.50	-	-	-	-	0.36	-	-	-	-	-	-	-	94.0	4.9	-	-	-	-	-	-
Baseline, 15 ft/s, 1700 gpm																							
PHV-202	Fri 10/27	22:00	12.86	-	-	-	-	0.25	-	-	-	-	-	-	-	95.7	3.5	-	-	-	-	-	-
PHV-202	Sat 10/28	00:01	12.70	-	-	-	-	0.23	-	-	-	-	-	-	-	96.1	3.2	-	-	-	-	-	-
Averages			12.78	-	-	-	-	0.24	-	-	-	-	-	-	-	95.9	3.4	-	-	-	-	-	-
Baseline, 17.5 ft/s, 1700 gpm																							
PHV-201	Sat 10/28	02:00	12.25	-	-	-	-	0.25	-	-	-	-	-	-	-	95.7	3.3	-	-	-	-	-	-
PHV-201	Sat 10/28	04:00	12.12	-	-	-	-	0.27	-	-	-	-	-	-	-	95.4	3.6	-	-	-	-	-	-
Averages			12.19	-	-	-	-	0.26	-	-	-	-	-	-	-	95.6	3.4	-	-	-	-	-	-
Baseline, 20 ft/s, 1700 gpm																							
PHV-200	Sat 10/28	06:00	12.24	-	-	-	-	0.31	-	-	-	-	-	-	-	94.7	4.1	-	-	-	-	-	-
PHV-200	Sat 10/28	07:30	12.32	-	-	-	-	0.34	-	-	-	-	-	-	-	94.2	4.6	82.27	-	-	-	-	-
PHV-200	Sat 10/28	08:00	11.63	-	-	-	-	0.38	-	-	-	-	-	-	-	93.6	4.8	-	-	-	-	-	-
PHV-200	Sat 10/28	08:25	11.74	-	-	-	-	0.41	-	-	-	-	-	-	-	93.1	5.2	-	-	-	-	-	-
Averages			11.98	-	-	-	-	0.36	-	-	-	-	-	-	-	93.9	4.7	82.27	-	-	-	-	-
Baseline, 17.5 ft/s, 1700 gpm																							
PHV-201R	Sat 10/28	10:00	10.67	-	-	-	-	0.38	-	-	-	-	-	-	-	93.6	4.4	89.94	-	-	-	-	-
PHV-201R	Sat 10/28	12:00	-	-	-	-	-	0.39	-	-	-	-	-	-	-	93.4	-	-	-	-	-	-	-
PHV-201R	Sat 10/28	12:15	-	-	-	-	-	0.45	-	-	-	-	-	-	-	92.4	-	-	-	-	-	-	-
Averages			10.67	-	-	-	-	0.41	-	-	-	-	-	-	-	93.1	4.4	89.94	-	-	-	-	-
Baseline, 17.5 ft/s, 650 gpm																							
PHV-209	Sat 10/28	14:00	10.19	-	-	-	-	0.40	-	-	-	-	-	-	-	93.2	4.4	-	-	-	-	-	-

X = Data Collected During Startup Conditions

* = Data Not Included in Averages

**Pilot FLRT Solid Analytical Summary:
PHV Phase II Test Block**

Test	Date	Time	FLRT Wt% Solids	Ca (mmol/g)	Mg (mmol/g)	SO3 (mmol/g)	SO4 (mmol/g)	CO3 (mmol/g)	Inerts (wt%)	Wt Solids Closure (%)	Mol Solids Closure (%)	Solids Ox. (%)	Util. (%)	IR Ox. (%)	Util. (%)	CO3- Est. Util. (%)	L.S. Loading (g/L)	CP/FC Wt%	Thickener Unit Area (ft ² /tpd)	Initial Wt%	Final Settled Wt%	Form Filtration Rate lb/hr*sqft	Filter Cake Wt%
PHV-209	Sat 10/28	16:00	11.32	-	-	-	-	0.33	-	-	-	-	-	-	-	94.4	4.0	-	-	-	-	-	-
	Averages		10.76	-	-	-	-	0.37	-	-	-	-	-	-	-	93.8	4.2	-	-	-	-	-	-

X = Data Collected During Startup Conditions
 * = Data Not Included in Averages

**Pilot FLRT Solid Analytical Summary:
PHV Phase II Test Block**

Test	Date	Time	FLRT	Ca	Mg	SO3	SO4	CO3	Inerts	Wt	Mol	Solids	IR	CO3-	L.S.	CPFC	Thickener		Final	Form	
			Wt% Solids							Solids Closure (%)	Solids Closure (%)						Unit Area	Initial	Settled	Filtration	Filter
				(mmol/g)	(mmol/g)	(mmol/g)	(mmol/g)	(mmol/g)	(wt%)			Ox. (%)	Util. (%)	Ox. (%)	Util. (%)		Wt%	Wt%	Wt%	lb/hr*sqft	Wt%
<i>Baseline, 20 ft/s, 650 gpm</i>																					
PHV-208	Sat 10/28	18:00	13.47	-	-	-	-	0.27	-	-	-	-	-	-	-	95.4	4.0	-	-	-	-
PHV-208	Sat 10/28	20:00	11.39	-	-	-	-	0.17	-	-	-	-	-	-	-	97.1	2.1	-	-	-	-
	Averages		12.43	-	-	-	-	0.22	-	-	-	-	-	-	-	96.2	3.0	-	-	-	-
<i>Baseline, 15 ft/s, 650 gpm</i>																					
PHV-210	Sat 10/28	22:00	11.17	-	-	-	-	0.13	-	-	-	-	-	-	-	97.8	1.6	-	-	-	-
PHV-210	Sun 10/29	00:01	13.06	-	-	-	-	0.13	-	-	-	-	-	-	-	97.8	1.9	-	-	-	-
	Averages		12.12	-	-	-	-	0.13	-	-	-	-	-	-	-	97.8	1.7	-	-	-	-
<i>Baseline, 10 ft/s, 650 gpm</i>																					
PHV-211	Sun 10/29	02:00	10.71	-	-	-	-	0.09	-	-	-	-	-	-	-	98.4	1.0	-	-	-	-
PHV-211	Sun 10/29	04:00	11.39	-	-	-	-	0.11	-	-	-	-	-	-	-	98.1	1.4	-	-	-	-
	Averages		11.05	-	-	-	-	0.10	-	-	-	-	-	-	-	98.3	1.2	-	-	-	-
<i>Baseline, 20 ft/s, 650 gpm</i>																					
PHV-212R	Sun 10/29	06:00	11.39	-	-	-	-	0.17	-	-	-	-	-	-	-	97.1	2.1	-	-	-	-
PHV-212R	Sun 10/29	08:00	11.43	-	-	-	-	0.16	-	-	-	-	-	-	-	97.3	2.0	-	-	-	-
	Averages		11.41	-	-	-	-	0.17	-	-	-	-	-	-	-	97.2	2.0	-	-	-	-

X = Data Collected During Startup Conditions

• = Data Not Included in Averages

VME Carryover Measurement Summary: PHV Phase II Test Block

PHV Phase II Test Data																	
			Overall HME Collection					Wash Water Fractions			FLRT Fractions			Estimated Carryover Rates			
														Using Wash Fractions		Using FLRT I	
Test	Date	Time	Direct	St. Dev.	Total	Number	Coeff.	Mg	Na	Average	Mg	Na	Average	Direct	Total	Direct	Hourly
			HMEC	Direct	Tank									of Data	of Determ.	HMEC	Tank
			Rate	Rate	Rate	Points	R2	(%)	(%)	Na/Mg	(%)	(%)	Na/Mg	(%)	(%)	(%)	(%)
			(gpm)	(gpm)	(gpm)									(gpm/ft2)	E-gpm/ft2	E4	(gpm/ft2)
																	E-gpm/ft2
Baseline, 20 ft/s, 1700 gpm																	
PHV-200X*	Tue 10/24	12:35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X*	Wed 10/25	07:19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Wed 10/25	13:45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Wed 10/25	14:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200X	Thu 10/26	07:40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 ft/s, 650 gpm																	
PHV-211X	Thu 10/26	10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-211X	Thu 10/26	12:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 20 ft/s, 1300 gpm																	
PHV-204*	Thu 10/26	14:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	14:10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	15:10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	16:05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204*	Thu 10/26	17:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	17:40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-204	Thu 10/26	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 ft/s, 1300 gpm																	
PHV-205	Thu 10/26	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205	Fri 10/27	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 15 ft/s, 1300 gpm																	
PHV-206	Fri 10/27	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-206	Fri 10/27	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 ft/s, 1300 gpm																	
PHV-207	Fri 10/27	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-207	Fri 10/27	07:59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-207	Fri 10/27	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions

* = Data Not Included in Averages

**VME Carryover Measurement Summary:
PHV Phase II Test Block**

PHV-205R Test Block																	
			Overall HME Collection				Wash Water Fractions			FLRT Fractions			Estimated Carryover Rates				
													Using Wash Fractions		Using FLRT I		
Test	Date	Time	Direct	St. Dev.	Total	Number of Data Points	Coeff. of Determ. R2	Mg (%)	Na (%)	Average Na/Mg (%)	Mg (%)	Na (%)	Average Na/Mg (%)	Direct	Total	Direct	Hourly
			HMEC Rate (gpm)	Direct Rate (gpm)	Tank Rate (gpm)									HMEC Rate (gpm/ft2) E3	Tank Rate (gpm/ft2) E4	HMEC Rate (gpm/ft2) E3	Tank Rate (gpm/ft2) E4
Baseline, 17.5 ft/s, 1300 gpm																	
PHV-205R	Fri 10/27	09:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	10:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	11:20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-205R	Fri 10/27	12:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 ft/s, 1700 gpm																	
PHV-203*	Fri 10/27	14:06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203*	Fri 10/27	15:55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	16:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	18:05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-203	Fri 10/27	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 15 ft/s, 1700 gpm																	
PHV-202	Fri 10/27	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-202	Sat 10/28	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 ft/s, 1700 gpm																	
PHV-201	Sat 10/28	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-201	Sat 10/28	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 20 ft/s, 1700 gpm																	
PHV-200	Sat 10/28	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200	Sat 10/28	07:30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200	Sat 10/28	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-200	Sat 10/28	08:25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 ft/s, 1700 gpm																	
PHV-201R	Sat 10/28	10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-201R	Sat 10/28	12:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-201R	Sat 10/28	12:15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 17.5 ft/s, 650 gpm																	
PHV-209	Sat 10/28	14:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions

* = Data Not Included in Averages

VME Carryover Measurement Summary:
PHV Phase II Test Block

Test	Date	Time	Overall HME Collection				Wash Water Fractions			FLRT Fractions			Estimated Carryover Rates Using Wash Fractions Using FLRT 1			
			Direct HMEC Rate (gpm)	St. Dev. Direct Rate (gpm)	Total Tank Rate (gpm)	Number of Data Points	Coeff. of Determ. R2	Mg (%)	Na (%)	Average Na/Mg (%)	Mg (%)	Na (%)	Direct HMEC Rate (gpm/lit2)	Total Tank Rate (gpm/lit2)	Direct HMEC Rate (gpm/lit2)	Hourly Tank Rate (gpm/lit2)
PHV-209	Sat 10/28	16:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions
* = Data Not Included in Averages

VME Carryover Measurement Summary: PHV Phase II Test Block

PHV Phase II Test Block													Estimated Carryover Rates				
Overall HME Collection								Wash Water Fractions			FLRT Fractions		Using Wash Fractions		Using FLRT I		
Test	Date	Time	Direct HMEC	St. Dev.	Total	Number of Data Points	Coeff. of Determ. R2	Mg (%)	Na (%)	Average Na/Mg (%)	Mg (%)	Na (%)	Average Na/Mg (%)	Direct HMEC	Total	Direct	Hourly
			Rate (gpm)	Rate (gpm)	Rate (gpm)									Rate (gpm/ft2) E3	Rate (gpm/ft2) E4	Rate (gpm/ft2) E3	Rate (gpm/ft2) E4
Baseline, 20 ft/s, 650 gpm																	
PHV-208	Sat 10/28	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-208	Sat 10/28	20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 15 ft/s, 650 gpm																	
PHV-210	Sat 10/28	22:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-210	Sun 10/29	00:01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 10 ft/s, 650 gpm																	
PHV-211	Sun 10/29	02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-211	Sun 10/29	04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baseline, 20 ft/s, 650 gpm																	
PHV-212R	Sun 10/29	06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHV-212R	Sun 10/29	08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Averages			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Data Collected During Startup Conditions
 * = Data Not Included in Averages

APPENDIX F
QA/QC REPORT SUMMARY

WET SCRUBBER QA/QC SUMMARY

The objective of the wet scrubber QA/QC program is to ensure the accuracy of key process instrumentation used on the pilot, mini-pilot, and spray dryer systems. Flow control valve flow meters, pump flow meters, tank level monitors, and flue gas flow rates are checked approximately once per month. Errors greater than 5% generally indicate that the instrument in question should be recalibrated or cleaned. The wet-scrubber continuous emission monitors (CEM's), used to measure inlet and outlet SO₂ and O₂ levels, for the pilot and mini-pilot are checked daily with span errors over 5% requiring an adjustment of the span potentiometer. The spray dryer CEM's are checked weekly with span errors over 5% requiring an adjustment of the span potentiometer. During additive tests, chemical addition rates are checked daily with adjustments made if they are outside of the test parameter. A status update for each QA/QC point out of calibration is presented below. A complete record of the process QA/QC for September and October is presented at the end of this section.

SEPTEMBER/OCTOBER 1995

Pilot Blowdown to Sump

Calibration of the blowdown to sump pump was done on September 1 and indicated low actual flow rates compared to the WDPF reading. The transmitter and orifice were taken apart and cleaned, but the WDPF error was still -10.26% on September 5. The constants on the WDPF were adjusted and the flow check on September 6 yielded an acceptable error of 0.81%. The flow check performed on October 27 however resulted in an WDPF error of 79%. The I&C Department was notified and the pump was recalibrated and flow checks showed errors of 12.22% and 13.66%. The pump was being repaired at the time this report was written.

Blowdown to Centrifuge

Flow checks were performed on Pumps 7, 8, 13, and 14 during the outage. The first flow check of pump 14 showed a WDPF error of 53%. The I&C Department was notified and the flow meter was recalibrated. Two more flow checks showed that the WDPF had an error of 37% at 5 gpm and 35.48% at 13 gpm. The flow meter was recalibrated and a fuse was replaced in the distribution box that supplied power to the flow transmitter. A subsequent calibration performed at 5 gpm showed an error of 6.75%.

P-FLRT Level

The WDPF P-FLRT level has had errors of -19.76% and -19.02% on 9/25 and 10/26 respectively. The level indicator will be inspected for repairs.

EPRI ECTC WET PROCESS QA/QC RECORD
SEPTEMBER/OCTOBER 1995

	Date	Actual	Instrument Reading	% Error	Actual	Instrument Reading	% Error	Point ID
<i>PILOT</i>								
Blowdown to Sump (gpm)	9/1	0.58	0.64	10.34	0.55	0.75	36.36	PAI039
Blowdown to Sump (gpm)	9/1	0.67	0.75	11.34				PAI021
Recycle Water to RWWT (gpm)	9/5	1.70	1.66	-2.59				PAI021
Blowdown to Vacuum Belt (gpm)	9/5	3.64	3.67	0.77				PAI032
Service Water to RWWT (gpm)	9/5	1.48	1.398	-5.54				PAI004
Velocity Traverse (scfm)	9/5	8451	8250	-2.38				PAI053
Blowdown to Sump (gpm)	9/5	0.76	0.84	10.26				PAI039
Blowdown to Sump (gpm)	9/6	0.86	0.85	-0.81				PAI039
ME-RWWT Level (ft)	9/25	4.00	4.06	1.50				PAI024
P-RSST Level (ft)	9/25	10.67	10.66	-0.09				PAI049
P-FLRT Level (ft)	9/25	12.40	9.95	-19.76				PAI045C
P-RWST Level (ft)	9/25	4.33	4.27	-1.39				PAI035
Quench (gpm)	10/5	3.58	3.39	-5.45				PAI003
VME Wash Header #1	10/5	35.00	36.40	4.00				PAI022
VME Wash Header #2	10/5	35.00	35.80	2.29				PAI023
Reagent Feed Pump	10/5	3.64	3.72	2.20				PAI020
Velocity Traverse (scfm)	10/5	19200	20259	5.52				PAI053
Reagent Feed Pump	10/18	1.19	1.19	0.08	2.84	2.82	-0.81	PAI020
Blowdown to Centrifuge-Pump 14	10/18	10.60	4.98	-53.07	17.50	7.50	-57.14	PAI012
Blowdown to Centrifuge-Pump 14	10/18	7.43	5.03	-32.36	15.50	10.00	-35.48	PAI012
Blowdown to Centrifuge-Pump 14	10/18	5.38	5.02	-6.75				PAI012
Blowdown to Vacuum Belt-Pump 8	10/19	1.98	2.01	1.57	3.98	4.04	1.43	PAI031
Blowdown to Centrifuge-Pump 13	10/19	4.98	5.03	1.06	14.15	14.05	-0.73	PAI013
Blowdown to Vacuum Belt-Pump 7	10/20	2.50	2.49	-0.56	5.08	5.09	0.26	PAI032
Velocity Traverse (scfm)	10/24	20623	19888	-3.56				PAI053
Velocity Traverse (scfm)	10/25	20140	18380	-8.74	10576	10069	-4.79	PAI053
Velocity Traverse (scfm)	10/26	10051	10002	-0.49	19226	19892	3.46	PAI053
ME-RWWT Level (ft)	10/26	3.94	3.90	-0.93				PAI024
P-RSST Level (ft)	10/26	11.83	11.84	0.02				PAI049
P-FLRT Level (ft)	10/27	11.41	9.24	-19.02				PAI045
P-RWST Level (ft)	10/27	4.54	4.30	-5.31				PAI035
Blowdown to Sump (gpm)	10/27	0.57	1.02	78.95				PAI039
Service Water to RWST (gpm)	10/27	4.15	4.08	-1.71				PAI004
Recycle Water to RWST (gpm)	10/27	3.20	3.18	-0.66				PAI021
Blowdown to Sump (gpm)	10/30	1.89	2.12	12.22	0.90	1.02	13.67	PAI039

ECTC Laboratory Quality Control/Quality Assurance

During the second quarter of 1995, the ICAPES developed communication problems between the controlling computer and the unit. Typically the analysis can be performed with the unit, but occasionally the analyst has to restart the analytical procedure because of the software miscommunication. The manufacturer has been consulted and suggested that the power supplied to the unit be investigated for noise. We have conducted short investigations of the ICAPES computer power supply and the electrical power supplies to the ICAPES unit. Nothing appears abnormal at this time, but we need to conduct longer term tests and correlate them with the communications problems.

The Flow-Injection Mercury System (FIMS) has been operating reliably throughout the quarter. The computer used to control the FIMS unit had a hardware problem with the static RAM buffer. The static RAM chip does not fit properly in the socket. The manufacturer is aware of this problem in all of its units. The Perkin Elmer Company supplied us with an updated version of the flash BIOS system (Basic Input Output System). After installing that update, the FIMS unit has operated without any problems. Apparently the new BIOS has changed the timing on the computer motherboard to compensate for the inefficient link to the static RAM buffer.

The QA/QC data continues to be compiled, graphed, and submitted to the program manager in a quarterly memorandum. In general, the QA/QC data indicate very good data quality. Those samples which fail the QA/QC criteria are typically rerun as necessary.

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