INTERMOUNTAIN POWER SERVICE CORPORATION

January 13, 2000

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ATTN: **Electric Utility Steam Generating Unit Mercury Test Program**

Enclosed please find 3 copies (2 bound, 1 loose) of the final report for Mercury Emissions and Speciation Testing at the Intermountain Power Project Generating Station, Unit 2SGA. These documents are intended to fulfill the requirements of the EPA's Utility Mercury Information Request.

The contact for questions is:

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Regards,

S. Gale Chapman
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RJC:BP:db

Enclosures: (3) IPSC Mercury Speciation Test Reports

cc: Mike Nosanov, LADWP
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Mercury Emissions and Speciation Testing at Intermountain Power Plant Unit 2SGA

Test Report

Prepared for

Intermountain Power Service Corporation
Intermountain Power Plant
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Delta, Utah 84624

Prepared By

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January 5, 2000

Glossary of Abbreviations

APCD	Air Pollution Control Devices
ASTM	American Society for Testing and Materials
CAAA	Clean Air Act Amendments
CEMS	Continuous Emission Monitoring System
EER	Energy and Environmental Research Corporation
EPA	Environmental Protection Agency
EPM	EPA Project Manager
FTL	Field Team leader
HAPs	Hazardous Air Pollutants
ICR	Information Collection Request
IPSC	Intermountain Power Service Corporation
OAQPS	Office of Air Quality Planning and Standards
PAS	Philip Analytical Services
PM	Project Manager
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
RDS	Relative Standard Deviation
SOP	Standard Operating Procedure
SSTP	Site-Specific Test Plan

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1.0 INTRODUCTION

1.1 Summary of Test Project

GE-Energy and Environmental Research Corporation (GE-EER) was contracted by Intermountain Power Plant in Delta, Utah to conduct Speciated Mercury Testing at Unit 2SGA. This testing was conducted to satisfy Part III of the United States Environmental Protection Agency's (EPA) Electric Utility Steam Generating Unit Mercury Emissions Information Collection Request (ICR). Section 112(n)(1)(A) of the Clean Air Act Amendments (CAAA) requires the EPA to perform a study of the hazards to public health reasonably anticipated to occur as a result of hazardous air pollutants (HAPs) emissions by electric utility steam generating units. The EPA's Report to Congress of this study stated that mercury is the HAP emission of greatest potential concern from coal-fired utilities and that additional mercury emissions data are needed before a decision to regulate mercury emissions from electric utility boilers can be made. Therefore, EPA has initiated the ICR to collect information on the total amount of mercury emitted from electric utility steam generating units and on the speciation and controllability of such mercury. Part I of the ICR collected general information on coal-fired electric utility steam generating facilities in the US. Part II of the ICR requires facilities to report the amount of coal received for a calendar year and analyze selected shipments for mercury, chlorine, and other parameters. Part III of the ICR requires a select number of facilities to perform speciated mercury measurements at the inlet and outlet of the final air pollution control device. The ICR also requires measurement of coal mercury content during the tests. The Intermountain Power Plant was selected to perform these measurements. Speciated mercury in flue gases was measured using EPA Method PRE-003 Standard Test Method for Elemental, Oxidized, Particle-Bound, and Total mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario Hydro Method) (DRAFT, September 1, 1999).

Intermountain Power Service Corporation (IPSC) operates the Intermountain Power Plant. Unit 2SGA at this facility is an opposed wall-fired, dry bottom, utility boiler fired with a blend of bituminous and sub-bituminous coal. It is equipped with fabric filters and a wet scrubber for emissions control. The emissions testing was performed by the GE-Energy and Environmental Research Corporation (EER) of Irvine, California. The objective of this project

was to collect and analyze valid representative samples of boiler exhaust gases upstream and downstream of the scrubber for mercury species (particle-bound, elemental, and oxidized). In addition, coal samples were collected during the exhaust gas sampling and subsequently analyzed for mercury and other parameters.

1.2 Test Project Organization

Figure 1-1 presents the Test Project organization, major lines of authority and communication, and names and phone numbers of responsible individuals. The project team was organized along lines of authority which distributes responsibility for completing test activities among key individuals in the team structure. Each of the individual test team members was ultimately responsible to the EER Project Manager. The EER Field Team Leader had overall responsibility for the preparation and operation of all sampling equipment. On-site he interfaced with plant personnel, directed and performed the set up, operation, and recovery of the sampling trains. Internal quality assurance and quality control (QA/QC) activities were provided by the QA/QC Advisor and QA/QC Manager. The QA/QC Advisor and QA/QC Manager reviewed test and quality assurance plans and provided guidance for any method modifications or deviations that were necessary. EER's QA Organization provides authority of the QA/QC Manager independent of the Project Organization.

Address information for project participants is:

Plant Owner/Operator:	Intermountain Power Agency 480 East 6400 South Murray, UT 84107
Operating Agent:	Los Angeles Department of Water & Power 111 North Hope Street Los Angeles, CA 90012-2694
Plant Operations & Contact:	Intermountain Power Service Corp 850 West Brush Wellman Road Delta, UT 84624-9546

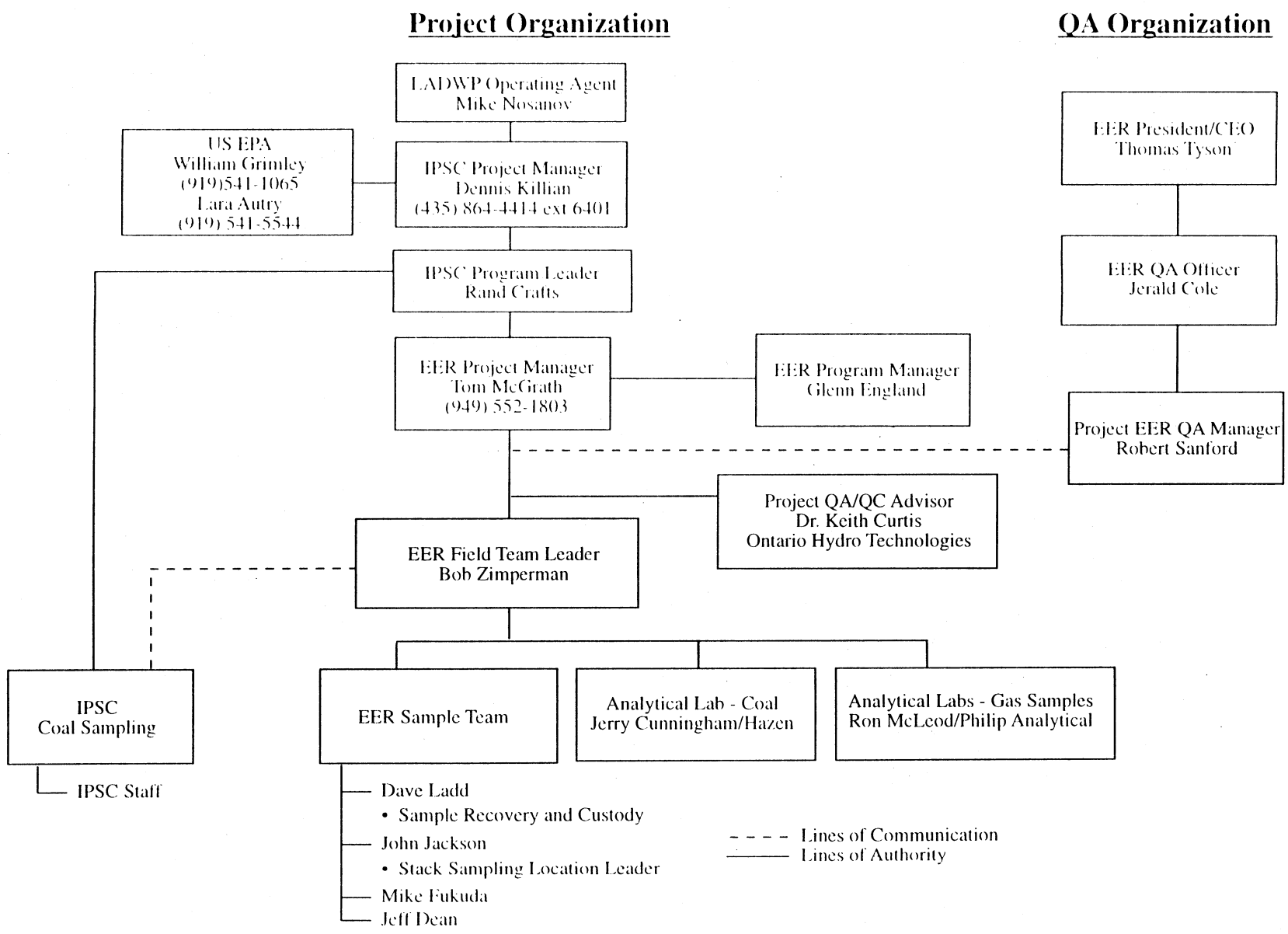


Figure 1-1. Project and QA Organization.

Testing Contractor:	GE - Energy and Environmental Research Corp (EER) 18 Mason Irvine, California 92618
Analytical Laboratories:	Philip Analytical Services (PAS) 5555 North Service Burlington, Ontario Canada L7L5H7
	Hazen Research, Inc. 4601 Indiana Street Golden, CA 80403
Regulatory Agency:	United States Environmental Protection Agency (EPA) Emissions Measurements Center Office of Air Quality Planning and Standards Research Triangle Park, NC 27711

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTIONS

2.1 Process Description

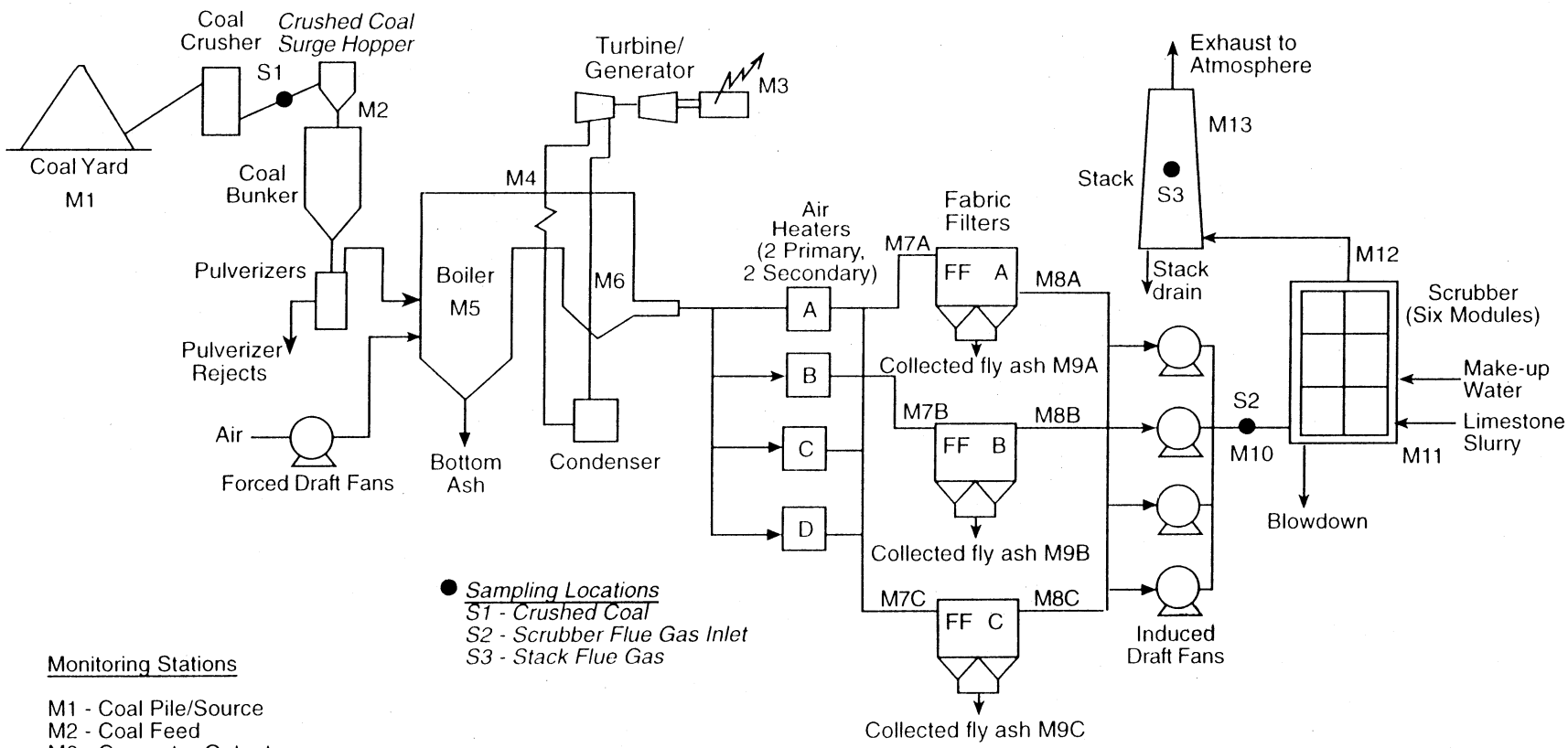
There are two identical steam generating units at the Intermountain Power Plant. Boiler 2SGA is a pulverized coal fired natural circulation boiler manufactured by Babcock and Wilcox (Figure 2-1). The boiler's rated capacity is 875 MW with nameplate capacities of 820 MWhe for the turbine and 6,600,000 pounds of steam per hour at a pressure of 2,975 pounds per square inch and a temperature of 1,005 degrees Fahrenheit. The burner has 48 low NOx burners installed in an opposed wall configuration. Pulverized coal is carried by pipes to the burners by pressurized primary air. Table 2-1 lists key boiler operating parameters that were monitored during testing, and the target value and target range of operation for each parameter. Gases exiting the boiler pass through the air pollution control equipment described below.

2.2 Control Equipment Description

The air pollution control system includes particulate and acid gas removal equipment. Three parallel fabric filters installed at the boiler outlet remove particulate from the boiler exhaust gas. Downstream of the fabric filters, the exhaust gas is combined into a common outlet duct, split into four streams feeding four induced draft fans, and recombined into a common scrubber inlet duct. A wet scrubber system with six scrubber modules for acid gas removal is installed downstream of the ID fans. Four of the six modules are used at any given time. Two are redundant. Downstream of the wet scrubber, the flue gas is exhausted to the atmosphere through a circular stack. The design specifications for the fabric filters and wet scrubber are shown in Table 2-2. This table also lists the target range of operating conditions for testing.

<u>Coal Handling System and Sampling Description</u>

The unit fires bituminous and subbituminous coal. Table 2-3 lists the typical target range of coal compositions. Coal is delivered to the units via two 1000 ton per hour (tph) conveyor belts (18A & 18B). Coal is dropped via chute to a 180 ton capacity surge hopper from which



Monitoring Stations

M1 - Coal Pile/Source
M2 - Coal Feed
M3 - Generator Output
M4 - Steam Generation
M5 - Burners Firing
M6 - O2 at Convective Pass
M7 - Fabric Filter Inlets
M8 - Fabric Filter Outlets
M9 - Captured Fly Ash
M10 - Scrubber Inlet
M11- Slurry Feed Line
M12 - Scrubber Outlet
M13 - Stack

Figure 2-1. Intermountain Power Plant Boiler 2SGA process overview.

TABLE 2-1. BOILER OPERATING PARAMETERS

Parameter	Units	Monitoring Station	Testing Target Value	Normal/Testing Target Range
Load (Electrical)	Mwe	M3	875	788 - 875
Load (Thermal)	MBtu/hr	*	8,900	8,300 - 9,300
Oxygen	%	M6	3.2	2.6 - 3.6
Steam Generation	1000 lb/hr	M4	6,300	5,500 - 6,400
LOI-Ash	%	M9	< 0.75	0.25 - 1.0

*Calculated

TABLE 2-2. AIR POLLUTION CONTROL EQUIPMENT DESIGN SPECIFICATIONS AND OPERATION RANGE

Parameter	Units	Design Specification	Target Testing Value	Normal Range of Operation
Fabric Filter				
Manufacturer	na.	General Electric Environmental Services, Inc.	na.	na.
Type/Basic Design	na.	Reverse Air	na.	na.
Bag Material	na.	Fiberglass	Fiberglass	Fiberglass
Air-to-Cloth Ratio	acfm/ft2	2.0 to 1	2.3 to 1	2.0 to 2.6 to 1
Pressure Drop	in. w.c.	6.8 to 8.0	6 to 7	6 to 9
Inlet Temperature	°F	285	260 to 280	255 to 305
Outlet temperature	F	285	245 to 265	240 to 290
Wet Scrubber				
Manufacturer / Designer	na.	General Electric Environmental Services	na.	na.
Type/Basic Design	na.	Wet spray, limestone	na.	na.
Slurry Type	na.	Limestone	Limestone	Limestone
Slurry pH	pH	5.5 to 6.0	5.6	5.5 to 5.7
Slurry Concentration (Solids)	%	10 to 15	18	12 to 20
Liquid-to-Gas Ratio	gal/acf	60 gal/1000 acf	60 gal/1000 acf	45 gal/1000 acf - 75 gas/1000 acf
Pressure Drop	in. w.c.	4.1	2.5 to 3.0	2 to 4
Inlet Temperature	°F	285	230 to 250	230 to 250
Outlet Temperature	°F	145	114	110 to 120

na. = not applicable

TABLE 2-3. COAL COMPOSITION

Parameter	Units	Normal/Testing Target Range
Carbon	Dry %	70.4 - 72.6
Hydrogen	Dry %	5.0 - 5.4
Nitrogen	Dry %	1.3 - 1.6
Oxygen	Dry %	9.5 - 12.0
Ash	Dry %	8.0 - 14.0
Sulfur	Dry %	0.4 - 0.9
Heating Value (dry)	Btu/lb	12,500 - 13,500
Moisture	%	6.0 - 14.0
Mercury	ppm	0.02 - 0.10

Mine	Country, State
Canyon Fuel Co./ARCH Coal Sales - SKYLINE	Carbon, Utah
Canyon Fuel Co./ARCH Coal Sales - SUFCO	Sevier, Utah
Andalex Resources	Carbon, Utah
Andalex Resources - GENWAL	Emery, Utah
Cyprus Amax Coal Sales - PLATEAU	Carbon, Utah
Cyprus Amax Coal Sales - WILLOW CREEK	Carbon, Utah
Commonwealth Coal Sales - WHITE OAK	Carbon, Utah
Commonwealth Coal Sales - HORIZON	Carbon, Utah
Oxbow Mining	Gunnison, Colorado

coal can be directed to either unit. Coal sent to Unit Two is delivered by two hopper feeders to two 600 tph belts. These belts in turn transfer coal to en masse chain conveyors for delivery to eight 750 ton coal bunkers. Each bunker is dedicated to one calibrated mass-flow feeder and one pulverizer. Bunkers are filled in rotation, 10 minutes at a time. Each pulverizer delivers coal to wall mounted burners in the boiler. Residence time for coal in this system for normal operation is ten to twelve hours from sampling point to burn. This residence time depends on bunker levels. The system is designed and operated such that coal characteristics remain unchanged until pulverized. Coal quality can vary based on mine source.

2.3 Flue Gas and Process Sampling Locations

Emissions sampling were conducted at the scrubber inlet and at the stack. Figure 2-2 shows the locations of the sampling ports.

2.3.1 Scrubber Inlet (S2)

Twenty-five 6-inch inside diameter sampling ports were located on the top of a horizontal duct downstream of the fabric filters and induced draft fans and upstream of the scrubber modules. As shown in Figure 2-3, the sample location did not meet EPA Method 1 criteria for upstream and downstream undisturbed flow dimensions because the 25 sample ports were located in a transition section. In accordance with testing guidance published on the Electric Utility Steam Generating Unit Mercury Emissions Information Collection Effort website frequently asked questions (FAQ), sampling at this location could still be performed because it was the most accessible inlet location and "sampling may be performed at the most accessible inlet location without conducting the three-dimensional flow testing that may be needed at several inlet locations to find a suitable location. This was because (a) mercury is primarily in the gaseous phase and is not impacted by uncertainties in the gas flow and the isokinetic sampling rate, and (b) stratification of mercury species is not expected."

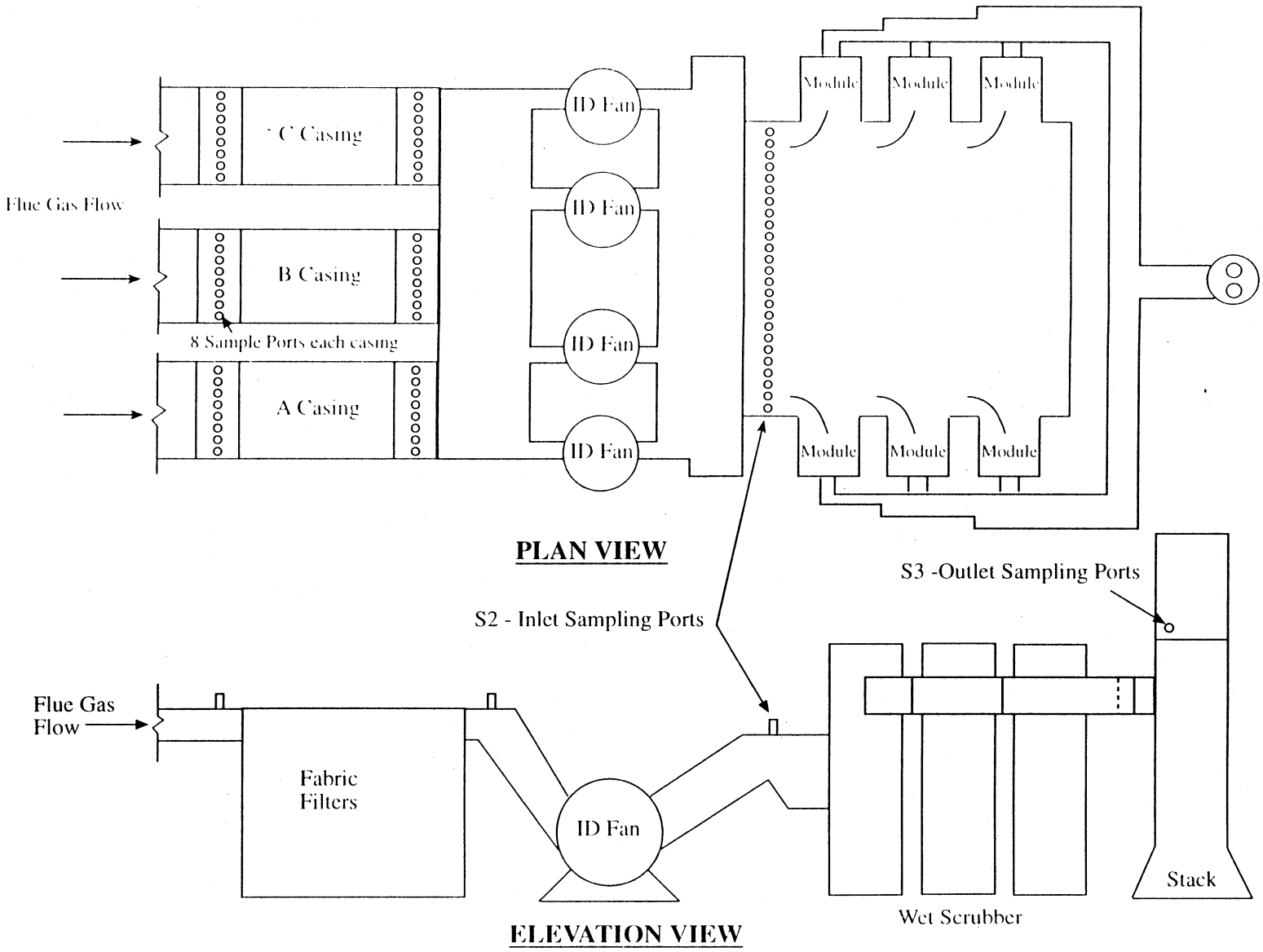
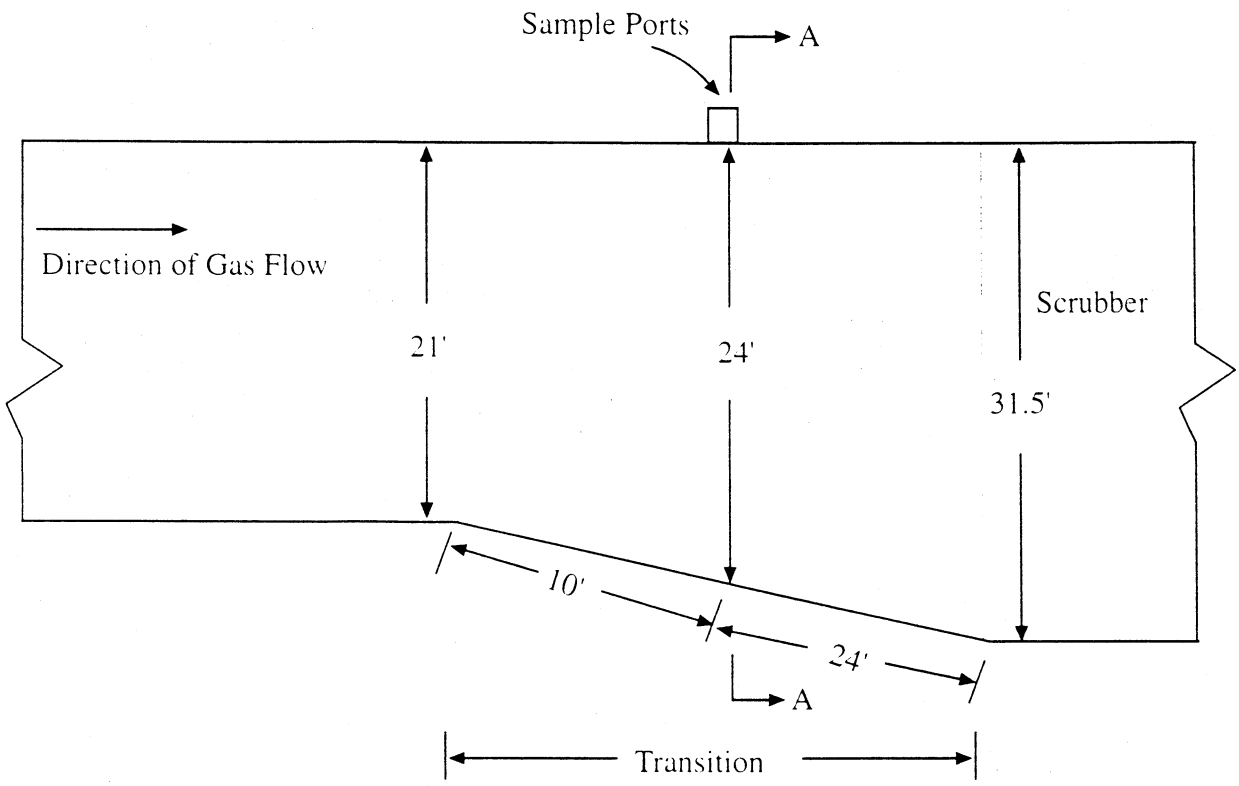


Figure 2-2. APCD process schematic.



Elevation View

Figure 2-3. Schematic of horizontal scrubber inlet duct.

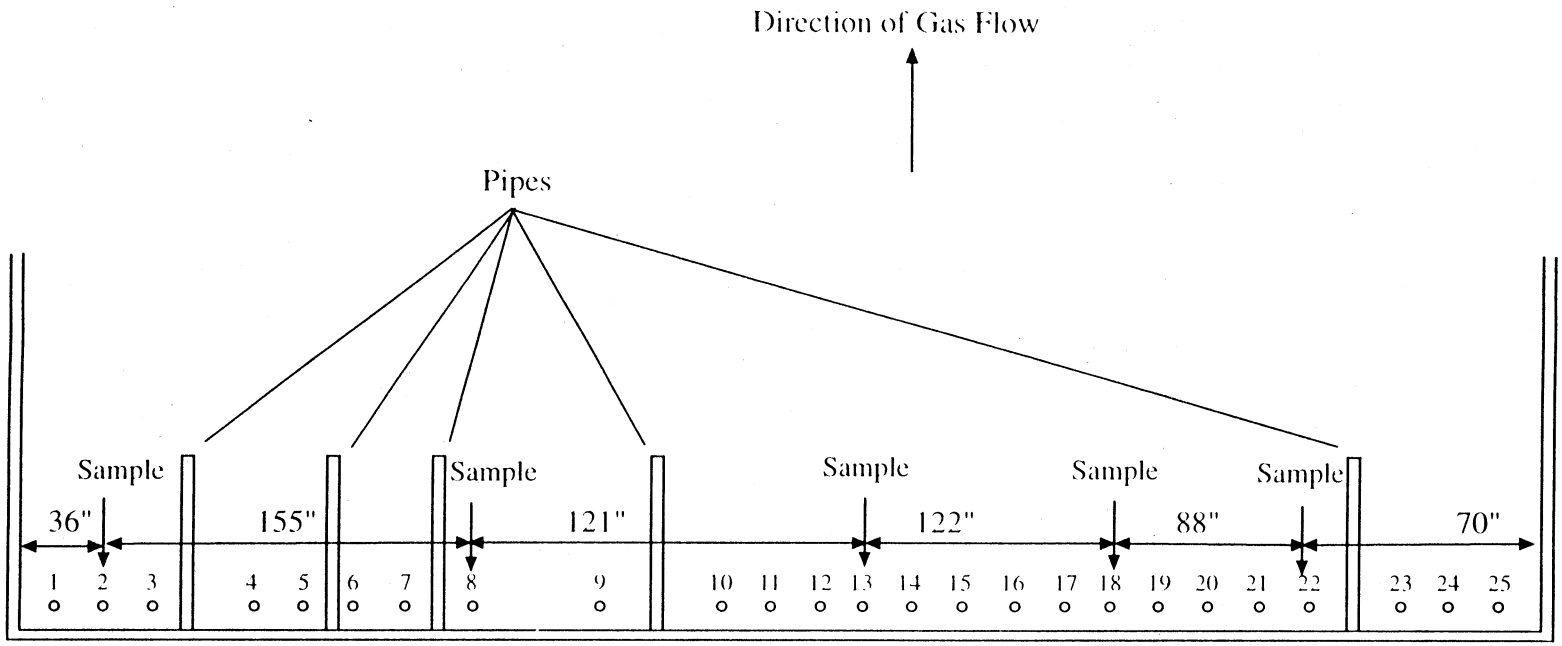
Figure 2-4 shows the 25 ports. The ports are not equally distributed across the duct. The five ports that were used for sampling were those which were closest to the centers of five equal areas, and were not obstructed for sampling. The five ports that were used for sampling numbers 2, 8, 13, 18, and 22. Port 12 could not be used because the plant 40 CFR Part 75 CEMS probe was located there. The site specific test plan (SSTP) listed ports 3 and 23 for sampling. However, the flanges for ports 3 and 23 were partially obstructed and the closest accessible ports, 2 and 22, were used.

Since the undisturbed distances upstream and downstream of the sample ports did not meet the minimum EPA Method 1 criteria of 2 and 0.5 diameters, respectively, the maximum number of sample traverse points for Method 1 (25 = 5 x 5 matrix) were used as shown in Figure 2-5.

The depth of the duct at the sampling location was 24 feet. As permitted by EPA in the ICR FAQ, the center of the fifth (deepest) sampling zone was 16 feet from the upper wall. Therefore, the sampling points used for the Ontario Hydro Method sampling trains did not encompass the entire duct. Previous testing at the scrubber inlet location had measured cyclonic flow angles of 0 to 35 degrees and reverse flow at the bottom of the duct due to the steepness of the transition section. Prior to sampling, a preliminary velocity traverse of the entire duct was performed to characterize the velocity profile. This traverse included the 5 by 5 traverse matrix for the Ontario Hydro Method sampling train and traverse point 6 as shown in Figure 2-5. A seventh traverse point, at the bottom of the duct, could not be accessed because the pulley sytem for vertically traversing the probe was not of sufficient height. Therefore, the presence of reverse flow at the bottom of the duct could not be verified. If reverse flow exists in the bottom of the duct, which was not traversed during the sample train runs, the volumetric gas flows measured by these trains may be biased high.

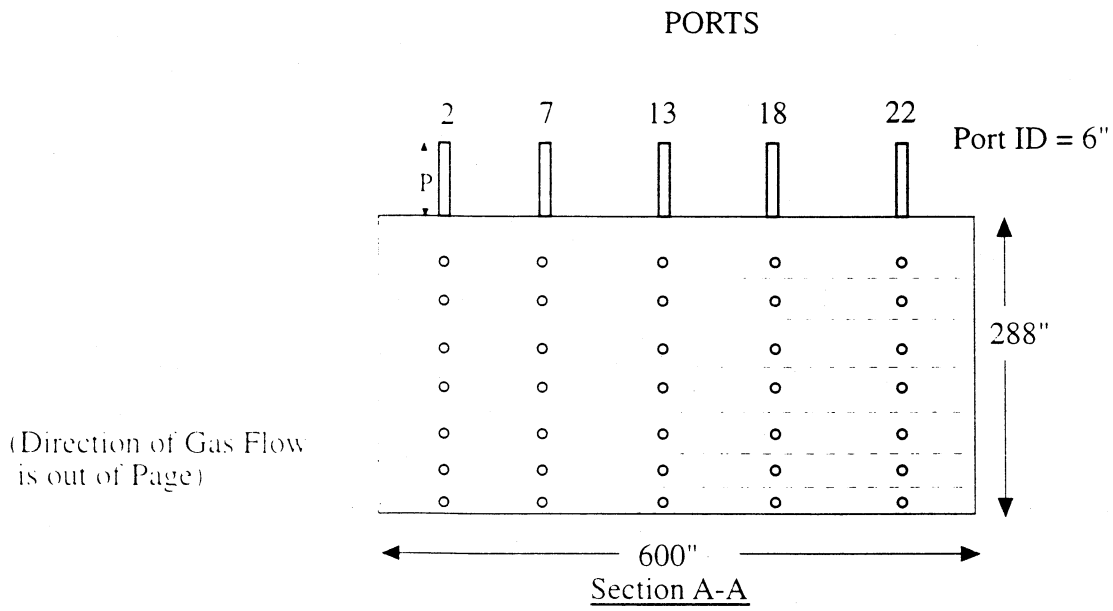
2.3.2 Stack (S3)

The scrubber outlet sampling location was in the exhaust stack. This exhaust stack was one of two liners inside a concrete stack. This liner was identified as Stack liner 2. The other



Plan View

Figure 2-4. Scrubber inlet sample port configuration.



Traverse Point	Distance from Inner Wall (inches)	+	Port Length from Inner Wall (Includes Wall thickness) (inches)	=	Distance from End of Outside Port (inches)
1	21.3		P=24"		45.3
2	64.0				88.0
3	106.7				130.7
4	149.3				173.3
5	192.0				216.0
6*	232.0				256.0
7**	269.4				293.4

* Traverse points only for preliminary velocity measurements, not used for Ontario Hydro Method sampling trains traverses.

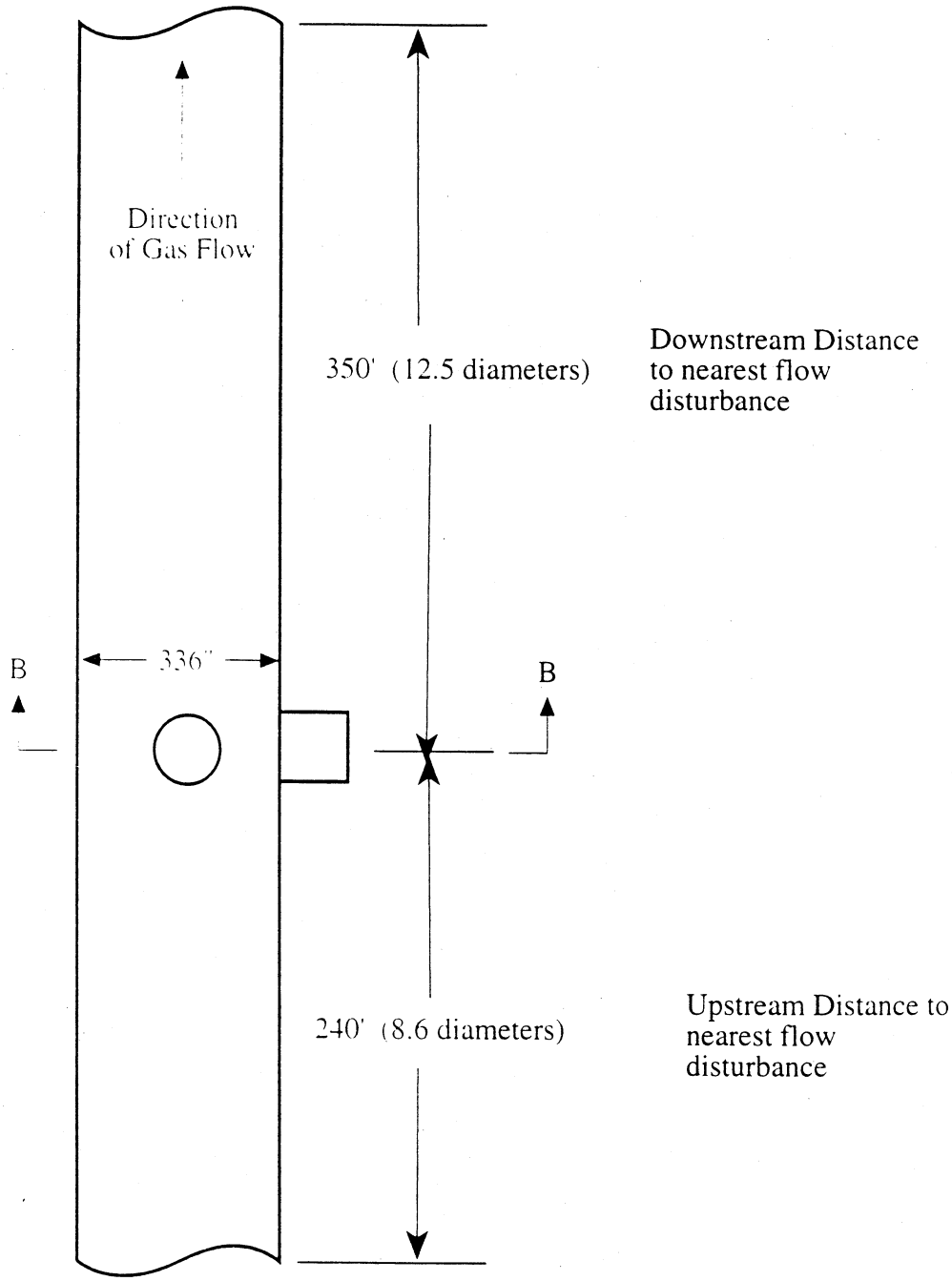
** Seventh traverse point could not be accessed due to limitations of the pulley system for probe traverse.

Figure 2-5. Traverse point sampling locations for the scrubber inlet.

did not interfere with the placement of the probe in the ports at Stack liner 2. Figure 2-6 shows the outlet sampling location with upstream and downstream dimensions. The sample ports were 6 inches inside diameter. There were 4 sampling ports. The sampling points are shown in Figure 2-7.

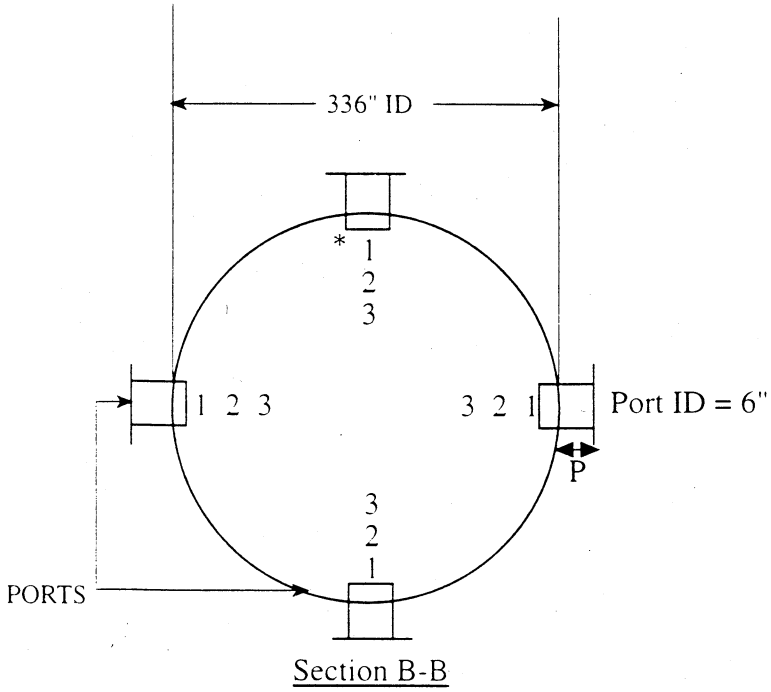
2.3.3 Coal Sampling Location (S1)

Time integrated composited coal samples were collected upstream of the coal bunkers from the coal falling from the 1000 tph conveyer belts (18A and 18B) feeding the surge hopper and bunkers. Figure 2-8 shows a schematic of the sampling system and the configuration of the sampling location.



Elevation View

Figure 2-6. Stack liner 2 sample location.



Traverse Point	% of Diameter from near wall	Distance from Inner Wall (inches)	+	Port Length (include wall thickness) (inches)	=	Distance from Outside of Port (inches)
1	4.4	14.8		P=9		23.8
2	14.6	49.1				58.1
3	29.6	99.5				108.5

* Ports extended 4 inches into duct

Figure 2-7. Traverse point sampling locations for stack liner 2.

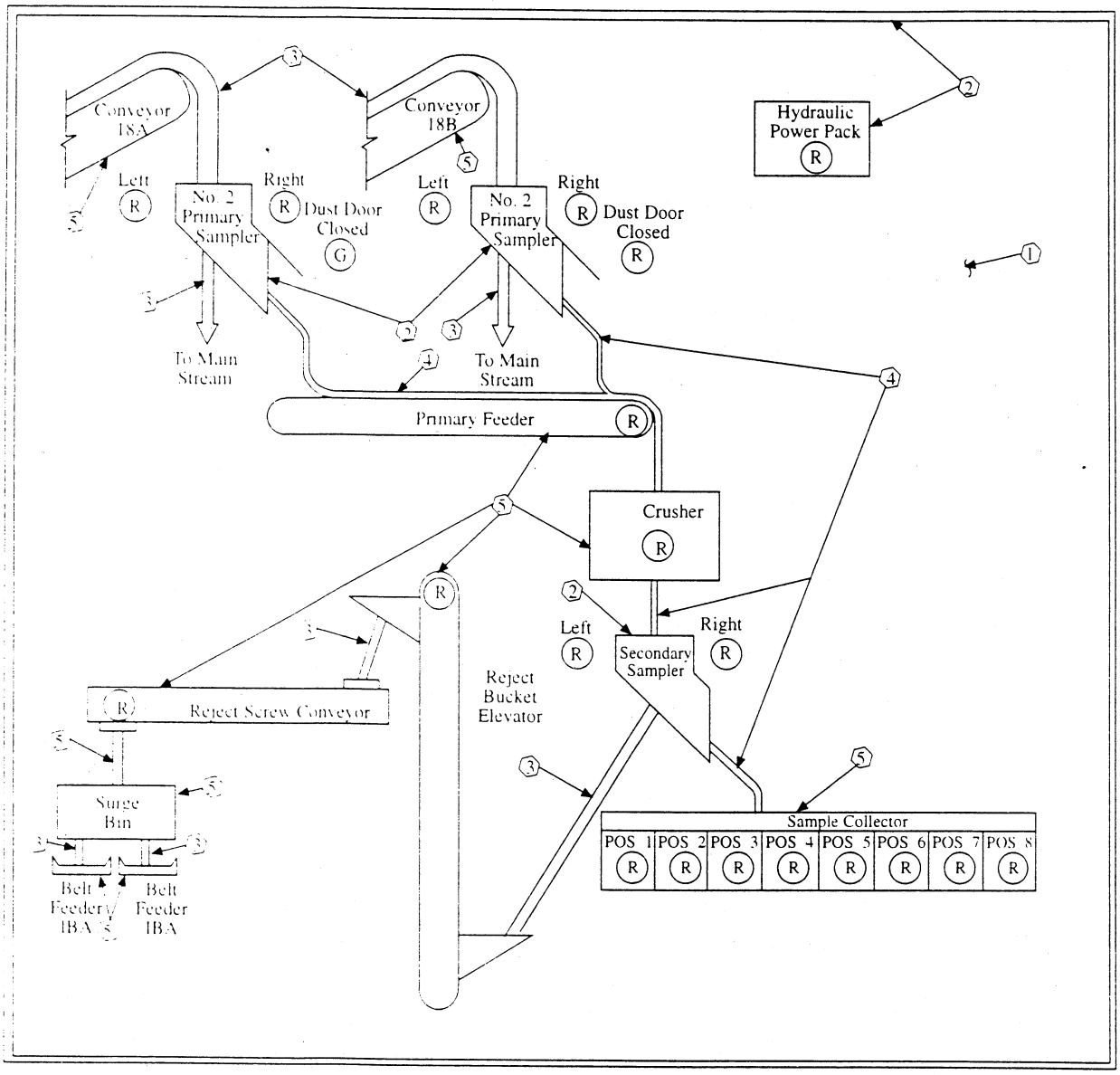


Figure 2-8. Ramsey coal sampler at IPP Unit 2SGA.

3.0 SUMMARY AND DISCUSSION OF RESULTS

3.1 Objectives and Test Matrix

Objectives

The overall goal of this test project was to determine mercury emissions from the 2SGA boiler and the speciation and controllability of such mercury by a wet scrubber. To this end, the specific objectives of this test project were to:

- Simultaneously measure speciated mercury emissions at the entrance to the wet scrubber and at the stack for boiler 2SGA using the Ontario Hydro Method.

- Collect integrated "as fired" coal samples upstream of the fuel bunkers during each of the three test runs and analyze the samples for mercury, sulfur, heating value, ash, and chlorine.

- Log pertinent process operating parameters that document boiler and air pollution control equipment operation during each test run.

Test Matrix

Table 3-1 shows the sampling and analytical test matrix for the test project. Four Ontario Hydro Method sampling train runs were performed at the inlet to the wet scrubber concurrently with four Ontario Hydro Method sampling train runs at the boiler stack. Run 1 was invalidated due to the melting of the probe liner at the inlet. Only runs 2, 3, and 4 are presented in this report. Since the scrubber inlet samples were collected from five sample ports and the stack samples were collected from four sample ports, it was not feasible to sample simultaneously at both locations for the entire duration of each test run. The sampling was conducted such that the start of sampling at the first and last ports at each location coincided. Integrated coal samples were also simultaneously collected during each of these runs. Parameters such as fabric filter cleaning

TABLE 3-1. INTERMOUNTAIN POWER PLANT Hg SPECIATION TEST MATRIX

Sampling Location	No. of Runs	Sample Type / Parameter	Sampling Method	Sampling Organization	Sample Run Time (min)	Analytical Method/ Principle	Analytical Laboratory
Scrubber Inlet (S2) and Stack (S3) (concurrent)	3	Integrated Gas/ Speciated Mercury	Ontario Hydro (EPA PRE-003)	EER	125/120 (a)	Ontario Hydro/ CVAAS	Philip Analytical Services
	3	Integrated Gas/ O2, CO2 and Molecular Weight	EPA M3 (bag)	EER	b	EPA M3/ Fyrite	EER
	3	Velocity	EPA M2	EER	b	EPA M2/ S-Type Pitot, Manometer, and TC	EER
	1	Pre-Test Velocity	EPA M2	EER	NA	EPA M2/S-Type Pitot, Manometer, and TC	EER
	3	Integrated Gas/ Moisture	EPA M4	EER	b	EPA M4/ Gravimetric	EER
Upstream of the coal bunker (S1)	3	Integrated Coal / Mercury	ASTM D2234	IPSC	b	ASTM 3684-94/Bomb-CVAA	Hazen
	3	Integrated Coal / Sulfur	ASTM D2234	IPSC	b	ASTM D4239-97/Combustion - IR Absorption	Hazen
	3	Integrated Coal / Chlorine	ASTM D2234	IPSC	b	ASTM D2361-95/Bomb - Titration	Hazen
	3	Integrated Coal / Ash	ASTM D2234	IPSC	b	ASTM D3174-97/Oven - Gravimetry	Hazen
	3	Integrated Coal/HHV	ASTM D2234	IPSC	b	ASTM D1989-97/Isoperibol Calorimeter	Hazen
	3	Integrated Coal / Moisture	ASTM D2234	IPSC	b	ASTM D3173-87(96)/Oven - Gravimetry	Hazen

a. 125 minutes at scrubber inlet, 120 minutes at stack.
b. Conducted during each Ontario Hydro Method isokinetic train.
NA - not applicable

cycles were manually recorded. At the end of each test day, a hard copy and an electronic copy of the process data for the test run time periods were collected from IPSC by EER. All measured values are presented in Tables 3-2, 3-3, and 3-4.

3.2 Field Test Methods Modifications and Problems and Corrective Actions

3.2.1 Mercury Sampling

Sampling consisted of four simultaneous runs at the inlet and stack. One on October 12 (Run 1), two on October 13 (Runs 2 and 3) and the last one on October 14 (Run 4). The following problems were encountered and subsequent corrective actions were performed during the testing:

- Run 1 was eliminated because the scrubber inlet sampling train probe liner melted due to a faulty temperature controller, thus the results from this test were not used and a fourth test run was performed;

- The stack was saturated with water, thus the saturation moisture value for the measured stack temperature was used for data reduction;

- Flue gas samples collected at the scrubber inlet for EPA Method 3 determination of stack gas composition (O_2 and CO_2) and molecular weight were unreliable due to a leaky sample line. Thus, the flue gas compositions measured at the scrubber outlet/stack location were used to determine the scrubber inlet flue gas composition. The flue gas is under positive pressure from the scrubber inlet to the chimney liners, which are air tight. Thus, there is no air in-leakage between these locations and scrubber outlet samples will have the same O_2 and CO_2 composition as the scrubber inlet; and

- The scrubber outlet CO_2 levels measured by EPA Method 3 were lower than the CO_2 levels measured by the stack CEMS. The theoretical CO_2 concentrations based on the coal composition and O_2 concentrations were then calculated and determined to closely agree with

Table 3-2. Summary of Inlet and Stack Data

PARAMETER	UNITS	MEASUREMENTS								METHOD
		Wet Scrubber Inlet				Wet Scrubber Outlet/Stack				
		Run 2	Run 3	Run 4	Average	Run 2	Run 3	Run 4	Average	
Test Date	M/D/Y	10/13/99	10/13/99	10/14/99		10/13/99	10/13/99	10/14/99		
Run Times	Start	11:47	17:15	10:05		11:47	17:15	10:05		
	End	15:20	20:57	13:30		15:15	20:57	13:30		
Stack Gas Temperature	deg F	305	305	300	**303**	120	120	119	**120**	EPA 2
Stack Gas Velocity	ft/sec	45.0	50.4	49.1	**48.2**	66.4	66.9	67.6	**67.0**	EPA 2
	m/s	13.7	15.4	15.0	**14.7**	20.2	20.4	20.6	**20.4**	EPA 2
Stack Gas Flowrate	dscfm	1,950,000 (5)	1,960,000 (5)	1,990,000 (5)	**1,970,000**	1,950,000	1,960,000	1,990,000	**1,970,000**	EPA 2
	acfm	-	-	-	-	2,450,000	2,470,000	2,500,000	**2,470,000**	EPA 2
	dscmm	55,200	55,600	56,200	**55,700**	55,200	55,600	56,200	**55,700**	EPA 2
Flue Gas Concentrations										
CO2	Dry %	14.6	14.7	14.2	**14.5**	14.6	14.7	14.2	**14.5**	EPA 3
O2	Dry %	4.5	4.4	5.1	**4.7**	4.5	4.4	5.1	**4.7**	EPA 3
Particle Bound Mercury	µg/dscm	<1.9E-2	<1.7E-2	<1.8E-2	**<1.8E-2**	1.2E-2	6.5E-3	9.2E-3	**9.1E-3**	OHM
Oxidized Mercury	µg/dscm	9.3E-1	1.0E+0	1.2E+0	**1.1E+0**	< 4.1E-2	6.9E-2 (3)	6.9E-2 (3)	**6.0E-2**	OHM
Elemental Mercury	µg/dscm	1.8E-1 (3) (4)	2.2E-1 (4)	1.9E-1 (3) (4)	**2.0E-01**	2.3E-1 (2) (4)	4.2E-1 (2) (4)	3.6E-1 (2) (4)	**3.4E-1**	OHM
Total Mercury	µg/dscm	1.1E+0	1.3E+0	1.4E+0	**1.3E+0**	2.8E-1	4.9E-1	4.4E-1	**4.0E-1**	OHM
Flue Gas Emissions										
Particle Bound Mercury	lb/hr	< 1.4E-4	< 1.2E-4	< 1.3E-4	**< 1.3E-4**	8.5E-5	4.8E-5	6.9E-5	**6.7E-5**	OHM
Oxidized Mercury	lb/hr	6.8E-3	7.7E-3	8.9E-3	**7.8E-3**	< 3.0E-4	5.1E-4 (3)	5.1E-4 (3)	**4.4E-4**	OHM
Elemental Mercury	lb/hr	1.3E-3 (3)	1.6E-3	1.4E-3 (3)	**1.4E-3**	1.7E-3	3.1E-3	2.7E-3	**2.5E-3**	OHM
Total Mercury	lb/hr	8.2E-3	9.4E-3	1.1E-2	**9.4E-3**	2.1E-3	3.6E-3	3.2E-3	**3.0E-3**	OHM
Other Flue Gas Parameters										
Moisture	%	7.2	6.7	6.6	**6.8**	11.5	11.5	11.5	**11.5**	EPA 4 (1)
Dry Molecular Weight	gm/gm-mole	30.5	30.5	30.5	**30.5**	30.5	30.5	30.5	**30.5**	EPA 3
Wet Molecular Weight	gm/gm-mole	29.6	29.7	29.7	**29.7**	29.1	29.1	29.0	**29.1**	EPA 3
Sampling Isokinetic Rate	%	97.8	96.9	93.3	**96.0**	100	100	100	**100**	OHM

(1) Flue gas at sampling location was saturated for moisture, reported value is saturation concentration at stack gas temperature.
< measured values were ND
(2) Field blank exceeds 30% of measured value.
(3) Mercury in reagent blank exceeded 10% of measured value.
(4) Based on the sum of a sample fraction with detectable levels of mercury and a sample fraction with non-detectable levels of mercury.
(5) Scrubber Inlet flue gas flowrates based on measurements at the Scrubber Outlet.

TABLE 3-3. COAL COMPOSITION

Parameter	Units	Measured Value			Average	Normal/Testing Target Range
		Run 2	Run 3	Run 4		
Carbon	Dry %	72.44	72.44	72.53	72.47	70.4 - 72.6
Hydrogen	Dry %	5.29	5.29	5.06	5.21	5.0 - 5.4
Nitrogen	Dry %	1.4	1.4	1.35	1.38	1.3 - 1.6
Oxygen	Dry %	11.05	11.05	11.27	11.12	9.5 - 12.0
Chlorine	Dry %	0.03	0.02	0.01	0.02	Not Specified
Ash	Dry %	9.16	9.36	9.36	9.29	8.0 - 14.0
Sulfur	Dry %	0.68	0.67	0.63	0.66	0.4 - 0.9
Higher Heating Value (dry)	Btu/lb	12,986	13,022	12,949	12,986	12,500 - 13,500
Moisture	%	7.52	7.77	7.31	7.53	6.0 - 14.0
Mercury	mg/kg	0.02	0.02	0.03	0.02	0.02 - 0.10

TABLE 3-4. PROCESS OPERATING DATA COLLECTED DURING TEST RUNS

Parameter	Units	Target Testing Value	Normal Range of Operation	Actual Value			Average	Frequency
Boiler Operating Data				Run 2 13-Oct	Run 3 13-Oct	Run 4 14-Oct		
Coal Source	na.	-	-	-	-	-		na.
Coal Feed Rate	lb/hr	-	-	670,000	668,000	676,000	671,000	hourly average
Thermal Load	MMbtu/hr	8,900	8,300 - 9,300	8,700	8,700	8,750	8,720	hourly average
Electrical Load	MW	875	788 to 875	875	875	874	875	continuous
Steam Generation Rate	1000 lb/hr	6,300	5,500 to 6,400	6,226	6,148	6,188	6,187	continuous
Number of Burners Firing (Pulverizers in Service)	na.	-		7	7	7	7	daily
Excess O2	%	3.2	2.6 to 3.6	2.59	2.75	2.75	2.70	continuous
LOI-Ash	%	< 0.75	0.25 to 1.0	0.44	0.44	0.44	0.44	
Fabric Filter Operating Data								
Pressure Drop	in. w.c.	6 to 7	6 to 9	8.25	7.77	8.18	8.07	continuous
Inlet Temperature	°F	260 to 280	255 to 305	303	302	302	302	continuous
Outlet Temperature	°F	245 to 265	240 to 290	299	300	296	298	continuous
Gas Flowrate	cfm	-	-	189,000	190,000	191,000	190,000	continuous
Cleaning Cycles (1)	-	-	-	-	-	-	-	continuous
Air to Cloth Ratio (1)	acfm/ft²	2.3 to 1	2.3 to 2.6	2.3	2.3	2.3	2.3	
Wet Scubber Operating Data								
Slurry Type	-	Limestone	Limestone	Limestone	Limestone	Limestone		continuous
Scrubbing Slurry Density	wt % solids	18	12 to 20	16.7	16.5	16.9	16.7	
Scrubbing Slurry pH	pH	5.6	5.5 to 5.7	5.67	5.69	5.68	5.68	continuous
Slurry Make up Flowrate	gpm	-	-	15.5	14.9	13.8	14.7	continuous
Inlet Temperature	°F	230 to 250	230 to 250	275	278	276	276	continuous
Outlet Temperature	°F	114	110 to 120	111	111	108	110	continuous
Pressure Drop	in. w.c.	2.5 to 3.0	2 to 4	1.88	1.99	1.99	1.95	continuous
Slurry Recirculation Flowrate	gpm	-	-	164,408	163,278	163,661	163,782	
Stack CEMS Data								
Stack CO2 (wet)	%	13.4		13.16	13.04	13.04	13.08	continuous
Stack NOx (wet)	ppm	240		253	256	237	249	continuous
Stack SO2 (wet)	ppm	25		20.9	19.7	19.6	20.1	continuous
Stack Opacity	%	-		3.2	3.0	3.3	3.2	continuous

(1) Maximum Net air-to-cloth is 2.3 acfm/sq.ft. Max Net air-to-cloth represents full load operation with compartment cleaning and maintenance occurring simultaneously. Filter cleaning occurs continuously without impacting removal. Each unit has three casings with 16 compartments per casing. Max Net air-to-cloth allows one compartment to be out for cleaning and one for maintenance and still allow full load operation. There is always a compartment out of service for cleaning. A cleaning cycle completely isolates the compartment from the flue gas path, and lasts about 8 minutes, whereupon the next compartment is brought out of service. Cycle will repeat after all 16 compartments are cleaned. All three casing operate simultaneously. Therefore, cleaning is continuous.

the CO_2 levels measured by the stack CEMS. In addition, the theoretical moisture concentrations based on the coal composition and O_2 concentrations compared very well with the EPA Method 4 moisture levels measured at the scrubber inlet, providing confidence in the O_2 levels and calculated concentrations. Thus, the calculated CO_2 levels were believed to be more accurate than the EPA Method 3 CO_2 concentrations and the calculated CO_2 concentrations were used to determine stack gas molecular weight; and

- The flue gas flowrates measured at the scrubber inlet were higher than the flowrates measured at the scrubber outlet/stack location. The stack configuration is much better for flowrate/velocity measurements than the inlet location as the stack location meets EPA Method 1 criteria and the scrubber inlet does not. In addition, historical data showed reverse flow at the bottom of the scrubber inlet duct. Velocities at the bottom of the scrubber inlet duct were not measured during the isokinetic sampling because the maximum probe length required for this testing was less than the duct height. Thus, it is likely the scrubber inlet flowrate measurements were biased high because the reverse flow was not accounted for. There was no evidence of flue gas leakage between the two sampling locations, thus the scrubber inlet flue gas flowrate was set equal to the outlet flue gas flowrate.

3.2.2 Coal Sampling

The coal samples were collected by IPSC personnel and analyzed by Hazen laboratories. No problems or method changes were noted.

3.2.3 Process Sampling

Process data were collected from IPSC personnel. No problems were noted.

3.3 Summary of Results

3.3.1 Mercury Sampling

Table 3-2 presents a summary of the mercury emissions data at the scrubber inlet and outlet. It should be noted that the analytical detection limits for particle bound mercury in the stack samples were lower than the detection limits in the scrubber inlet samples. Thus, detected particle found mercury levels at the stack are lower than non-detected mercury levels at the scrubber inlet. Data reduction procedures for this data included:

- If an analysis determined a non-detect level, the reported value is the full detection limit with a less than sign (<).

- Mercury was detected in the 10% hydroxylamine solution reagent blank. The hydroxylamine solution was added to the KCl and H2SO4-KMnO4 impinger solutions during sample recovery. The analytical results for KCl and H2SO4-KMnO4 samples were corrected as follows:

  - If the weight of the mercury in the reagent blank was greater than 10% of the weight in the field sample, then 10% of the field sample value was subtracted from the field sample and the data was flagged

  - If the weight of the mercury in the reagent blank was less than 10% of weight in field sample, then the weight of the mercury in the reagent blank was subtracted from the field sample

  - If the field sample had non-detect levels of mercury, then the weight of the mercury in the reagent blank was not subtracted and the non-detect levels were reported.

3.3.2 Coal Sampling

Table 3-3 presents a summary of the coal characteristics. The coal composition was within the target testing range.

3.3.3 Process Sampling

Table 3-4 presents a comparison the process data target values and the actual measured values. All parameters were within the normal range of operation with the exceptions that the fabric filter outlet and scrubber inlet temperatures were slightly high, and scrubber pressure drop and outlet temperature were slightly low. The flue gas flowrates measured at the fabric filter are over an order of magnitude lower than those measured during the testing and are not reliable.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Emission Test Methods

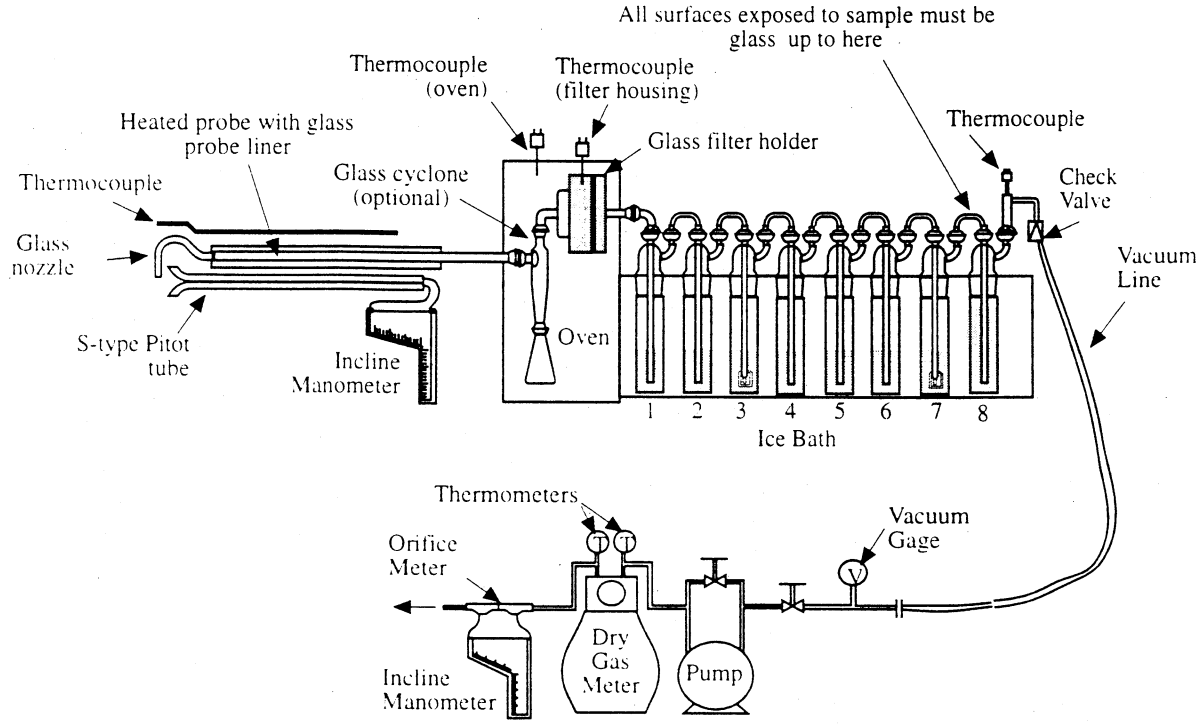
4.1.1 Sampling Procedures

Mercury species in flue gases were measured using EPA Method PRE-003 Standard Test Method for Elemental, Oxidized, Particle-Bound, and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario Hydro Method)(DRAFT – September 1, 1999). Copies of the Ontario Hydro Method are provided in the SSTP. Refer to the SSTP for details regarding the preparation, operation, and recovery of the sampling trains. An overview of special sampling procedures at the stack and scrubber inlet sampling locations follows below.

Stack– Speciated Mercury Sampling

The sampling train configuration, shown in Figure 4-1, was used at the stack sample location. Clarifications regarding and deviations from the published method consisted of the following:

- The filter exit gas temperature was monitored using a thermocouple attached to the filter housing exit outer surface;
- The probe gas temperature was checked by monitoring the probe liner outer surface temperature at the outlet of the probe;
- A Teflon probe liner was used rather than glass. Use of a glass liner was not feasible on the 28 foot diameter stack due to the high probability of breakage.



Impingers
1. Modified Greenburg-Smith: 100 ml 1 N KCl
2. Modified Greenburg-Smith: 100 ml 1 N KCl
3. Greenburg-Smith: 100 ml 1 N KCl
4. Modified Greenburg-Smith: 100 ml 5% HNO_3/10% H_2O_2
5. Modified Greenburg-Smith: 100 ml 4% $KMnO_4$/10% H_2SO_4
6. Modified Greenburg-Smith: 100 ml 4% $KMnO_4$/10% H_2SO_4
7. Greenburg-Smith: 100 ml 4% $KMnO_4$/10% H_2SO_4
8. Modified Greenburg-Smith: 200-300g Silica Gel

EER S. O. P. Test Methods Ontario Hydro Method (EPA-PRE-003)
Ontario Hydro Mercury Speciation Method
Drawing revised 5/6/99
Method publication date 4/8/99

Figure 4-1. Ontario Hydro method mercury speciation train (method 5 configuration).

Scrubber Inlet - Speciated Mercury Sampling

A sampling train with a Method 17 style, in-stack Teflon-coated filter holder was used to sample vertically in the 24-foot deep horizontal transition. Clarifications regarding and deviations from the published method consisted of the following:

- The location of the ports (in the transition of the duct) did not conform to EPA Method 1 criteria for upstream and downstream flow obstructions and, as discussed in Section 2.3.1, historical data indicated swirling flow was present. However, according to Frequently Asked Questions (FAQ) No. 8 on the Electric Utility Steam Generating Unit Mercury Emissions Information Collection Effort Website flue gas stratification and cyclonic flow were not expected to have an impact on the representativeness of the Ontario Hydro Method sample collection. Therefore, swirl checks were not performed and the sampling was conducted by orientating the probe nozzle parallel to the duct. Flue gas velocity and volumetric flow measurements conducted with the Ontario Hydro method sampling train may be biased as discussed in Sections 2.3.1 and 3.2.1.

- Using an in-stack filter eliminated the need to monitor filter exit gas temperature.

- A 20 foot heated Teflon sample line, with two 10 foot heated zones, was used between the filter and the impinger train. The sample line was maintained at >120°C. The flexible probe and heated sample line gas temperatures were checked by monitoring the sample tube outer surface temperature at two locations in the heated sample line, one in each 10 foot heated zone.

4.1.2 Ontario Hydro Analytical Procedures

The Ontario Hydro sample fractions were analyzed by Cold Vapor Atomic Absorption Spectroscopy (CVAAS). The CVAAS method is based on the absorption of radiation at 253.7 nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a

closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrometer. Absorbency was measured as a function of mercury concentration. A soda-lime trap and a magnesium chloride perchlorate trap were used to condition the gas before it entered the absorption cell.

4.1.3 Molecular Weight Determination (EPA Method 3)

EPA Method 3 was used to determine the stack gas O_2 and CO_2 concentrations and dry molecular weight. An integrated stack gas sample was collected in a Tedlar bag which was connected to the exhaust of each sample train meter box for the entire length of each test run. The Tedlar bag sample was analyzed for O_2 and CO_2 with a Fyrite analyzer. The dry molecular weight of the stack gas was calculated using the measured O_2 and CO_2 levels and assuming the remainder of the stack gas composition was nitrogen. Low levels (ppm range) of CO, SO_2, NOx, hydrocarbons, and other compounds were not significant factors in the molecular weight determination. The Fyrite analyzer determines the percentage of O_2 and CO_2 by volume by absorption of each in separate analyzer bulbs filled with absorbing solutions for the respective species. The volume of each gas was determined by the decrease in volume caused by the absorption in each bulb under constant temperature and pressure. The absorbing solutions used were:

- O_2 - Chromous Chloride ($CrCl_2$) dyed blue
- CO_2 - Potassium Hydroxide (KOH) dyed red

Each analysis was performed in triplicate. This data is presented in Appendix B.

4.1.4 Coal Sampling and Analytical Procedures

The IPP coal delivery process has a system for sampling as-fired coal producing an integrated 24-hour sample. Coal is delivered to a platform by railcar from several different mines. The coal is not segregated into separate areas for the separate mines. A Ramsey coal sampler (Figure 2-8) takes sampling cuts at the discharge chutes of belts 18A & B. Six-inch cross-cut

samplers are present in each chute and make full stream cuts across a 52.5-inch stream path. A full width cut takes 3.5 seconds and cuts are made every 240 seconds, collecting 222 pounds of 2-inch x 0-inch coal per swath, per belt. The sample is sent to a hammer crusher and sized to 3/8-inch x 0-inch (about 8 mesh). Coal discharged from the crusher is sampled by a secondary 1.5- inch cutter taking a nine-inch swath every 105 seconds, and collecting a 0.20 pound lot. Sample rejects are returned to the surge hopper. Sample lots are dropped to enclosed sample containers and collected over a 24-hour period. Final samples can run between 30 to 50 pounds, depending on coal delivery to the units, and are sealed in airtight bags. This sampling unit meets the requirements of ASTM D2234 and has been biased tested to those specifications.

The timing of sampling cuts and sample collection was modified during the emissions testing to ensure that a time integrated composited coal sample was collected representative of the flue gas sampling period. Specifically, programming changes were made to take more frequent sample cuts from the coal flow to maintain a sample weight of approximately 10 pounds for samples collected every three hours instead of every twenty-four hours. This sample was riffled and split four ways providing GE-EER with a split of about 1,000 grams. Sampling was initiated prior to stack testing so that residence time for coal in the bunkers as a function of coal flow rate was accounted for. In preparation for stack testing, each coal silo level was lowered and evened out at about 200 tons. This provided about a four hour residence time for coal at the target boiler operating load. Sampling began at four hours prior to the first run. This correlated combusted coal with sampled coal for each three hour run. American Society of Testing and Materials (ASTM) coal analysis methods used for this testing project are shown in Table 4-1. The coal was prepared using ASTM D2013-86 (94).

4.2 Process Data

Process data was collected using existing plant instrumentation which was monitored and recorded either automatically by the computer-based plant control system, or manually on data logs by IPSC staff.

TABLE 4-1. SUMMARY OF COAL ANALYSES PROCEDURES

Measurement	Mercury	Chlorine	Residual Moisture	Sulfur	Ash	HHV
Analytical Method	ASTM D3684-94	ASTM D2361(95)	ASTM D3173-87(96)	ASTM D4239-85	ASTM D3174-89	ASTM D1989-91
Analytical Principal	Bomb/ CVAA	Bomb/ Titration	Oven/ Gravimetry	Oven/ IR Absorption	Combustion/ Gravimetry	Isoperibol Calorimetry

4.3 Sample Identification and Custody

The execution of this program included the acquisition and compilation of field sampling and process operation data, and the physical collection, handling, storage, shipping, and analysis of various types of field samples. Both field data and physical samples required rigorous documentation and safeguarding to maintain data and sample integrity and to ensure against loss of valuable test results. Field data such as computer files, operator logs, and data sheets were filled out and checked for completeness, and then copied and stored or maintained in a systematic fashion. In addition, physical samples were promptly labeled and tracked. Physical samples were handled, stored, and/or shipped, according to the specific test methodologies. These steps were critical for samples since many of the samples were shipped or changed hands between operations prior to sample analysis.

The sample recovery team was responsible for proper data and sample logging and custody. Run sheets, data sheets, files, and sample tracking forms were completed by each of the respective team members responsible for data acquisition, equipment operation, sample recovery, and manual data logging. The sample recovery specialist was responsible for signing sample custody forms and shipping samples. These procedures are discussed in more detail below.

4.3.1 Sample Tracking and Custody Procedures

The team member(s) responsible for sample acquisition maintained an up-to-date Sample Tracking and Chain of Custody Form. At a minimum, the form itemized the following for each sample:

1. Sample identification number.
2. Location and time of sample collection.
3. Test conditions and all other factors defining the test conditions.
4. Sampling method and procedures and reference.
5. Method of processing or preserving of samples collected in the field.

This form is a special "cradle-to-grave" document which accompanies all samples, tared containers and filters, sample trains, and other specialized sample collection apparatus. The Sample Tracking and Chain of Custody Form must be signed whenever a transfer of the samples takes place, both by the person relinquishing the samples and the person receiving the samples. A copy of the form was:

- Retained by the recovery specialist as record of the shipped samples;
- Included with the samples; and
- Returned with the lab results from the analytical laboratory.

The chain of custody form, a critical component of EER's QC procedures, is essential in satisfying the legal "rules of evidence" in the event of legal challenge and satisfies the requirements specified in EPA/600/4-77/027a2.0.6 and EPA/600/4-77/077b3.0.3. An example of this form is shown in Figure 4-2.

The responsible team member also prepared the sample labels:

- Sample Label. An example of this label is shown as Figure 4-3. The sample label was completely filled out and attached to each sample promptly upon collection by the recovery specialist. This label has a pre-printed number for the sample, and it is the unique ID number for that sample. The time was filled out as time the sample was taken. The site was identified as IPP Boiler 2SGA. Samples were identified as follows:

  Test Run No. - Location - Sample Type - Container Number
  Example: R2 - SI - OHM - 3

This Ontario Hydro Method mercury sample train sample is from run number 2 at the scrubber inlet and is container number 3 (KCl contents and rinse).

- Test Run Numbers were: R1,R2, R3, FB (Field Blank), or RB (Reagent Blank).

Energy and
Environmental
Research Corporation

18 Mason, Irvine, CA 92718
tel: (949) 859-8851
fax: (949) 859-3194

Laboratory Report Due by
EER Contact
Tel ( )
Fax ( )

to:
Address

Bill to: PO No.
EER Corporation
18 Mason
Irvine, CA 92618

Sample Chain of Custody Record

Page ____ of ____

EER Project No.:	Sampling System Prepared by:
Project Name:	Test Operator(s):
Site Name:	Samples Recovered by:

Laboratory I.D. No.	EER Label No.	FIELD SAMPLE IDENTIFICATION AND SAMPLING INFORMATION				No. of Containers	Analyses Required						Additional Information (e.g. Volumes, TT, Holding Times Sample Preparation, Add'l Instructions, etc.)
		Test ID/Location	Physical Description	Date	Time								

Method of Shipment:	Remarks (RUSH!, units: mg/L, ppm, etc.):	Relinquished by: (Sign & Print)	Date/Time	Relinquished by: (Sign & Print)	Date/Time
Shipment I.D.: / Date Shipped:					
Samples Shipped to:					
	After Analysis: ☐ **Archive Samples** (Hold for ____ months, then dispose.)				
Attention:	☐ **Return Samples to:** EER Corporation 8001 Irvine Blvd., Irvine, CA 92618				

Figure 4-2. Example of EER's "Sample Tracking and Chain of Custody" form.

No. 205470

EER

Date _____

Time _____

Test No. 2-SI-OHM-3

Site _____ Location _____

Sample Description _____

For Method No. _____

Discard On _____ Name _____

18 Mason Irvine, CA 92618 (949) 859-8851

Figure 4-3. Example of an EER sample label.

- Locations were: SI (Scrubber Inlet), SO (Scrubber Outlet (stack)), CB (Coal Bunker or RB (Recovery Blank)

- Sample Types were: OHM (Ontario Hydro Method Sample Train), Coal, and M3 (EPA Method 3 Tedlar Bag)

- Container Numbers were only applicable to Ontario Hydro Method Sample. Train components, including reagent blanks:

1 - Sample Filter
2 - Front Half Rinses
3 - KCl Impinger Contents and Rinse and Back Half Rinse.
4 - HNO_3 - H_2O_2 Impinger Contents and Rinses
5 - H_2SO_4 - $KMnO_4$ Impinger Contents and Rinses
6 - Silica Gel Impinger Contents (Not analyzed) – Weighted and Recharged
7 - 0.1 N HNO_3 Blank
8 - 1 N KCl blank
9 - 5% v/v HNO_3 - 10% v/v H_2O_2 Blank
10 - H_2SO_4 - KMnO4 Blank
11 - 10% w/v Hydroxylamine Sulfate Blank
12 - Sample Filter Blank

Discard date was date of testing plus 3 years. Date format was mm/dd/yy. Time format was hh:mm using a 24-hour clock. Name was printed legibly with first initial and last name provided.

Blank samples were labeled with sample ID numbers and tracked just like a regular sample.

4.3.2 Sample Shipping

The same attentive care was applied in shipping samples as in the sample collection and recovery. Experience has shown that samples are damaged most often during shipping under two conditions:

1. Sample containers are packed too closely and bang together during transit.
2. Samples are packed too loosely and are free to move when the package is jostled.

Therefore, care was taken to ensure that all samples were tightly packed so that they did not bang against other containers. Glass sample bottles were used. Liquid samples were contained in these bottles. ($KMnO_4$ samples required head space to prevent a possible explosion from the reaction of the $KMnO_4$ and the acid.) Volume levels were marked on the outside of these containers. Lids were closed tightly and sealed with Teflon tape. The liquid mercury train samples and reagent blanks also required proper hazardous materials (or "dangerous goods") shipping procedures. Glass containers from the mercury samples were placed in ziplock bags and then put in metal containers and surrounded by vermiculite to assure the sample was immobile. The metal containers were place in specially designed packaging material and shipped by FedEx in 4G shipping boxes. The boxes were properly labeled and marked with "fragile", "oxidizer" (as applicable), "corrosive" (as applicable), and "this side up" stickers. The coal samples were sealed in plastic bags labeled and shipped in coolers. Petri dishes were tightly sealed with Teflon tape such that top and bottom plates did not separate and then sealed in zip bags. A set of dishes were then stacked with cardboard or bubble pack in between each. The entire stack of used filters were then completely enclosed with bubble wrap and taped tightly. The stack was compressed so there was no separation between petri dishes and cardboard inserts if the package was jostled. The entire assembly was placed upright (filters facing up) in a shipping container completely surrounded by Styrofoam packing peanuts. The EPA Method 17 style quartz filters from the scrubber inlet were packaged in precleaned wide mouth sample jars. The jars were secured with bubble wrap and placed in a cardboard box. The coal samples, the Petri dishes and quartz filters did not require hazardous material special shipping procedures. For all samples, the sample labels were double-checked for accuracy and completeness against custody sheets. Any labels that appeared to be

peeling were taped down. Each shipment was insured. A copy of the sample tracking and chain of custody forms were included with each shipment. Copies were retained by the responsible team member. Samples were shipped at the end of the test program.

4.3.3 Sample Storage

Samples were handled and shipped to ensure that train sample analyses were performed within specified time limits. Ontario Hydro Method mercury samples had to be analyzed within 45 days of recovery. All reagent chemicals, filters, and materials which became parts of samples were properly stored in compliance with safety regulations. Samples did not need to be maintained at less than 4°C. Glass jars were foil wrapped to prevent light exposure. Prepared solutions were labeled with identification lot number, the concentration of the solution, date of preparation (and the expiration date if appropriate, etc.) and name of technician who prepared the stock solution. Coal samples were stored in air tight container with a minimum of head space.

5.0 QA/QC ACTIVITIES

5.1 Speciated Mercury Measurements

QA activities and QC procedures for the Ontario Hydro Method speciated mercury measurements consisted of the following:

- Use of standard sample train data sheets which were completed to document sampling. No deviations from method requirements were noted.

- Completion of method QC checklists for sample trains' calibration, preparation, operation, recovery, data reduction, and laboratory. The checklists include frequency, control limits, and corrective action for each check. No deviations from method requirements were noted. The QC checklists are in Appendix E.

- On-site meterbox performance audits using a critical orifice prior to the first test run. The meterbox audit consisted of two runs of 5-7 minutes duration at a flowrate of 0.75 cfm. The calculated meter cal factors for this check varied from the calibrated values by 0.5% and 1.4% for meterbox CA4 and by 3.1% and 1.7% for meterbox CA2. These results indicated that both meterboxes were functioning properly. The meterbox audit forms are in Appendix E.

- A technical systems audit (TSA) of the sampling trains preparation, operation (at the scrubber inlet and stack), and recovery procedures. No significant problems or deviations from test method requirements or planned test activities were noted. The TSA report and field forms are in Appendix E.

- An audit of the analytical laboratory report. Table 5-1 lists results of laboratory QA/QC activities. Duplicate spike analyses met the method control limit. Elemental mercury was detected in the scrubber outlet/stack field blank. The data

TABLE 5-1. SUMMARY OF BLANKS AND LABORATORY SPIKES

	units	Hydroxylamine	Particle Bound Mercury (Inlet)	Particle Bound Mercury (Outlet)	Oxidized Mercury (KCl fraction)	Elemental Mercury (KMnO4 fraction)	Elemental Mercury (H2O2 fraction)	Method Control Limit	Within Control Limit?	Corrective Action
Field Blank Inlet	µg	-	<.040	-	< .10	<0.1	<.25	<30% Field Measurement	Yes	None
Field Blank Outlet	µg	-	-	< .040	< .10	0.34	<.25	<30% Field Measurement	No (2)	Flag Data
Reagent Blank OHM	µg	0.027 (1)	<.040	<.010	<0.1	<0.1	<.25	<10% Field Measurement		
Method Blank	µg	<.01	-	<.01	<.01	<0.1	<.01	<10% Field Measurement	Yes	None
Method Spike	µg	-	0.44	0.14	3	0.76	2.4	NA	NA	
Method Spike % Recovery	%	-	110	110	100	95	96	NS	NA	None
Method Spike Duplicate	µg	-	0.44	0.13	3	0.76	2.4	NS	NA	None
Method Spike Duplicate % Recovery	%	-	110	100	100	95	97	NS	NA	None
Duplicate Sample Analysis	Relative percent difference	-	0	10	0	0	0	≤10%	Yes	None
NIST 1633b Coal Ash	mg/kg	-	0.12 (3)	-	-	-	-	NS	NA	None

1. Based on 1ml of hydroxylamine used per sample * 0.027 ug Hg/ml hydroxylamine (=2.7 ug/100ml)
2. KMnO4 Elemental Hg in field blank outside control limit. Other field blank fractions within method control limit.
3. Certified value is 0.141 mg/kg

NA - not applicable
NS - not specified

TABLE 5-1. SUMMARY OF BLANKS AND LABORATORY SPIKES

	units	Hydroxylamine	Particle Bound Mercury (Inlet)	Particle Bound Mercury (Outlet)	Oxidized Mercury (KCl fraction)	Elemental Mercury (KMnO4 fraction)	Elemental Mercury (H2O2 fraction)	Method Control Limit	Within Control Limit?	Corrective Action
Blank Spike #1	µg	0.097	-	0.10	0.30	0.31	0.10	NA	NA	
Blank Spike #1 % Recoveries	%	97	-	100	100	100	100	NS	NA	None
Blank Spike #2	µg	0.10	-	0.10	0.31	0.31	0.10	NA	NA	
Blank Spike #2 % Recoveries	%	100	-	100	100	100	100	NS	NA	None
Blank Batch B	µg	-	-	-	-	<0.05	-	NS	NA	None
Blank Batch B Duplicate	µg	-	-	-	-	<0.05	-	NS	NA	None
Blank Batch B Method Spike	µg	-	-	-	-	0.51	-	NA	NA	None
Blank Batch B Method Spike % Recovery	%	-	-	-	-	100	-	NS	NA	None
Blank Batch B Matrix Duplicate	µg	-	-	-	-	0.5	-	NS	NA	None
Blank Batch B Matrix Spike Duplicate % Recovery	%	-	-	-	-	100	-	NS	NA	None
Blank Batch 1	µg	-	-	-	-	<0.05	-	<10% Field Measurement	Yes	None
Blank Batch 2	µg	-	-	-	-	<0.05	-	<10% Field Measurement	Yes	None
Blank Batch	µg	-	-	-	-	<0.05	-	<10% Field Measurement	Yes	None

NA - not applicable
NS - not specified

was flagged as discussed in Section 3. Mercury was detected in the hydroxylamine reagent blank. The data was corrected and flagged as discussed in Section 3.

5.2 Flue Gas O_2 and CO_2

QA activities and QC procedures for EPA Method 3 sampling and analyses to determine O_2 and CO_2 concentrations in the flue gas consisted of the following:

- Use of a standard sampling and analytical datasheet;

- Replicate analyses. Although the analyses met the QA requirements the data from the scrubber inlet were rejected due to suspected ambient air leakage into the samples. Stack/scrubber outlet Method 3 O_2 analyses met the method QA requirements but the CO_2 analyses were suspected to be biased as the Method 3 CO_2 values were much lower than CO_2 measured by the plant CEMS and calculated based on the coal composition and O_2 concentrations. Thus, as discussed in Section 3, CO_2 concentrations based on the coal composition were used to determine the flue gas composition.

5.3 Coal Composition

QA activities and QC checks for coal sampling consisted of the following:

- Verification that the auto-sampler was operating correctly; and

- Verification that the timing of the sampling cuts and sample collection had been modified to coincide with the emissions sampling.

These checks were documented during the TSA audit (Appendix E). QA activities and QC checks for coal analysis are shown in Table 5-2. All parameters were within method control limits with the exception of one chlorine analysis.

5.4 Process Data

An analysis of the process data showed run to run consistency and operation within normal ranges (Table 3-4).

TABLE 5-2. COAL ANALYSES QA/QC RESULTS.

	Mercury	Chlorine	Moisture	Sulfur	Ash	HHV
Reagent Blank	<.005 mg/kg	< .005%	-	-	-	-
Replicate Analysis	0.002 - 0.009 Hg %	0.05 & 0.15 Cl %	0.00 - 0.03 moisure %	0.003 - 0.017 S %	0.000 - 0.18 Ash %	RPD = 0.03 - 3.3%
Within Method Control Limit?	Yes	Yes & No (control limit is 0.06%)	Yes	Yes	Yes	NS
Calibration Check	-	-	-	% recovery 104%	-	-
Within Method Control Limit?	NA	NA	NA	NS	NA	NA
Standard Sample Analysis Value (mg/kg)/% recovery	.106/73%	-	-	-	-	-
Within Method Control Limit?	NS	NA	NA	NA	NA	NA

RPD - relative percent difference
NS- Not Specified
NA - Not Applicable

APPENDICES