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April 27, 2000

Mr. William Grimley
Emission Measurement Center (MD-19)
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Re: Mercury Test Report for Nelson Dewey Generating Station

Dear Mr. Grimley:

Enclosed is the report on the Speciated Mercury Emissions Testing conducted at the Nelson Dewey Generating Station. The testing was conducted on February 8 and 9 by Mostardi Platt. The enclosed report describes the methods used for sampling and analysis, as well as includes a discussion of the test results and the QA/QC activities followed to ensure data quality. The report also includes data from operations, calibrations, and lab analyses.

If you have questions regarding the enclosed report, please contact me at (608) 252-0592.

Sincerely,

Linda Lynch

Linda Lynch, CHMM

Cc: Sharon Klinger - Alliant Energy
Jerry Lokenvitz (no enclosure) - Alliant Energy
Alan Arnold (no enclosure) - Alliant Energy
Marty Burkholder - Department of Natural Resources
Barb Pavliscak - Department of Natural Resources

Mostardi-Platt Associates, Inc.
A Full-Service
Environmental Consulting
Company

945 Oaklawn Avenue
Elmhurst, Illinois 60126-1012
Phone 630-993-9000
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Mostardi Platt

SPECIATED MERCURY EMISSIONS TESTING

Performed For

ALLIANT ENERGY

At The

Nelson Dewey Plant

Unit 1

Precipitator Inlet and Outlet

Cassville, Wisconsin

February 8 and 9, 2000

MOSTARDI PLATT PROJECT 000604

DATE SUBMITTED: APRIL 21, 2000

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

CERTIFICATION SHEET

Having supervised and worked on the test program described in this report, and having written this report, I hereby certify the data, information, and results in this report to be accurate and true according to the methods and procedures used.

Data collected under the supervision of others is included in this report and has been gathered in accordance with the procedures outlined in the Quality Assurance Project Plan.

MOSTARDI-PLATT ASSOCIATES, INC.

James R. Platt
Vice President, Emissions Services

Reviewed by:

Frank H. Jarke
Manager, Analytical and Quality Assurance

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1.0 INTRODUCTION

1.1 Summary of Test Program
The United States Environmental Protection Agency (USEPA), is using its authority under section 114 of the Clean Air Act, as amended, to require that selected coal-fired utility steam generating units provide mercury emissions information to the USEPA.

The USEPA selected the Nelson Dewey Plant of Alliant Energy in Cassville, Wisconsin to be one of seventy-eight coal-fired utility steam generating units to conduct mercury emissions measurements. Testing was performed by MOSTARDI-PLATT ASSOCIATES, INC. on Unit 1 on February 8 and 9, 2000. Simultaneous measurements were conducted at the Precipitator Inlet and Outlet. Mercury emissions were speciated into elemental, oxidized and particle-bound mercury using the Ontario-Hydro test method. Fuel samples were also collected concurrently with Ontario-Hydro samples in order to determine fuel mercury content.

1.2 Key Personnel
The key personnel who coordinated the test program and their telephone numbers are:

- Mostardi Platt Vice President, James Platt 630-993-9000
- Linda Lynch, Alliant Energy 608-252-0592
- Sharon Klinger-Kingsley, Alliant Energy 608-725-2235

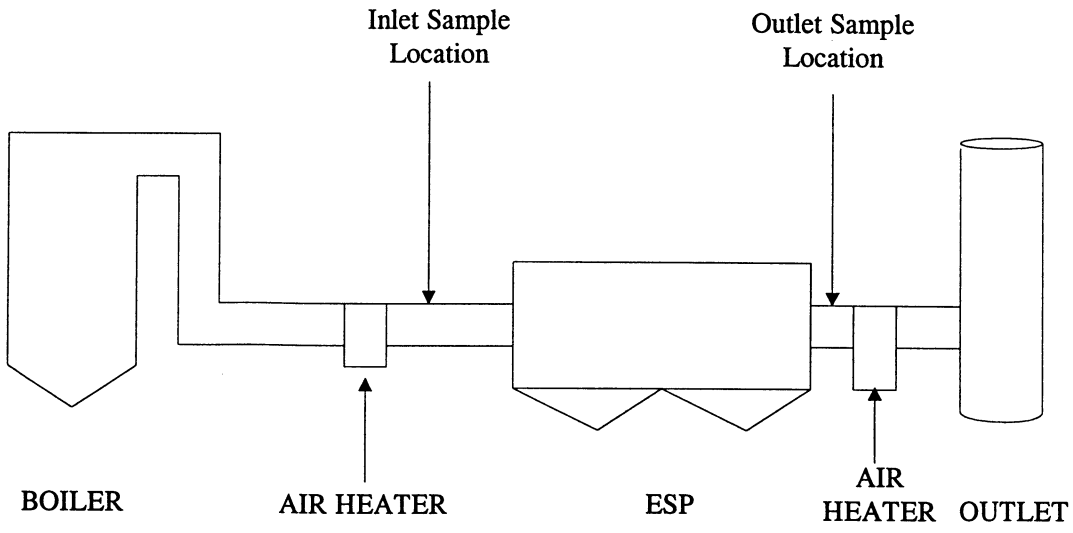
2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 Process Description

Nelson Dewey Unit 1 is a cyclone-fired, forced draft boiler with a name plate rating of 100 MW. Figure 2-1 shows a schematic of the boiler and pollution control equipment, including sample points.

Unit 1 is a coal/petroleum coke firing steam boiler. The steam is converted into mechanical energy by flowing through a turbine (generator) which produces electrical power. The unit was operating at or near full load during the tests. Fuel type, boiler operation and control device operation were all maintained at normal operating conditions.

Figure 2-1 Facility Process Flow Diagram



The following is a list of operating components for this unit:

- Babcock & Wilcox, cyclone fired, forced draft boiler
- 100 MW gross capacity (Name plate rating)
- Fuel: (Approximate Blend)
  - Spring Creek Mine—80% subbituminous coal, 0.34% sulfur
  - Pine Bend Mine—20% petroleum coke, 5.73% sulfur
- No SO_2 control

- No NO_X control
- Research Cottrell Electrostatic Precipitator with an estimated average collection efficiency of 95%

2.2 Control Equipment Description

Particulate emissions from the boiler are controlled by a Research Cottrell Electrostatic Precipitator with an estimated collection efficiency of 95%. Air heaters exist before and after the precipitator.

The flue gas at the inlet was approximately 495 °F. At the outlet, the gas temperature was approximately 500 °F and contained approximately eleven percent (11%) moisture.

2.3 Flue Gas Sampling Locations

2.3.1 Inlet Location

Inlet samples were collected at the precipitator inlet. A schematic and cross section of the inlet location are shown in Figure 2-2. This location meets the requirements of USEPA Method 1. Two (2) inlet ducts exist; only one (1) was sampled.

The existing test ports were modified in order to complete the test program. The ports were 54 inches in length initially and were cut down to 6 inches in length to accommodate the test equipment.

2.3.2 Outlet Location

Outlet samples were collected at the precipitator outlet sample ports. A schematic and cross section of the outlet location is shown in Figure 2-3. This location meets the requirements of USEPA Method 1. Two (2) outlet ducts exist. Both were sampled for mercury concentrations and total gas flow.

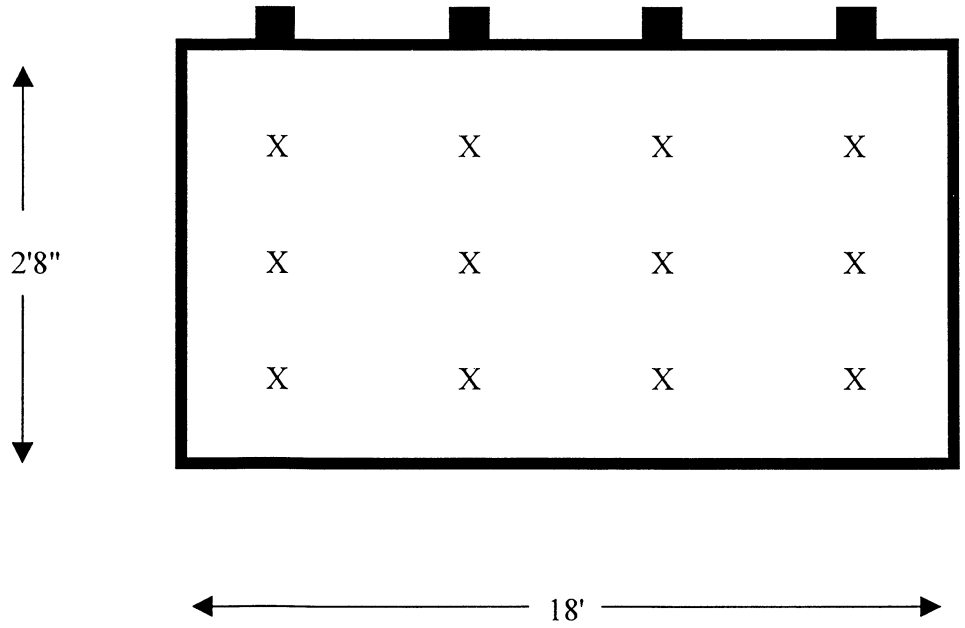
The flue gas at the outlet was above the method specification of a minimum filtration temperature of 120°C. Therefore, in stack filtration per Method 17 was used.

2.4 Fuel Sampling Location

Fuel samples were collected at the fuel feeders to each individual cyclone. One sample was collected from each feeder during each test run, and the feeder samples collected during a test run were composited prior to analysis. The Mostardi Platt test crew supervisor assisted plant personnel with the collection of fuel samples.

Figure 2-2 Schematic of the Precipitator Inlet Sampling Location

Equal Area Traverse For Rectangular Ducts (Inlet)

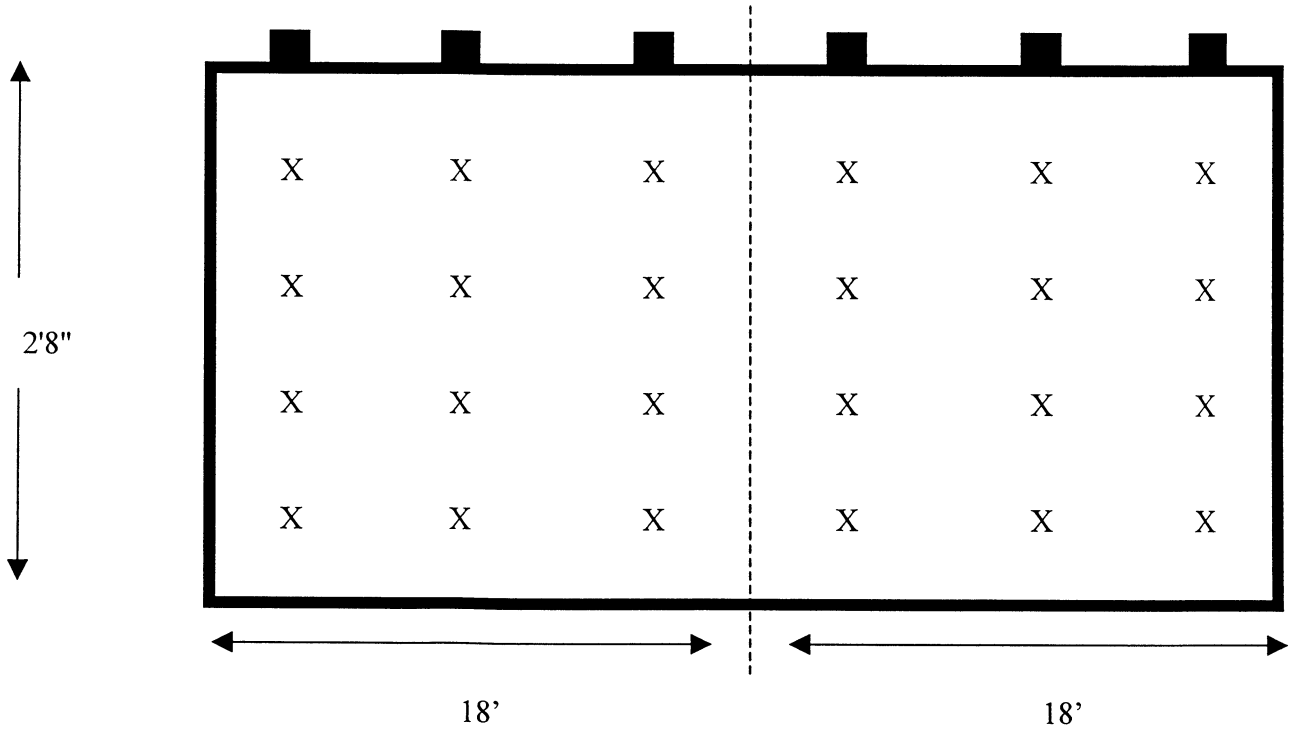


Job:	Alliant Energy Nelson Dewey Plant		
Date:	February 8 and 9, 2000	Area:	96.00 ft^2 (Total)
Unit No:	1	No. Test Ports:	4
Length:	2.6667 Feet	Tests Points per Port:	3
Width:	18 Feet	Distance Between Ports:	4.5'
Duct No:	Inlet (1 of 2)*	Distance Between Points:	0.67'

* Two (2) inlet ducts exist – Only one (1) duct was sampled for gas flow and mercury concentration. One duct was sampled twice during each test to represent the total for the inlet.

Figure 2-3 Schematic of the Precipitator Outlet Sampling Location

Equal Area Traverse For Rectangular Ducts (Outlet)



Job:	Alliant Energy Nelson Dewey Plant		
Date:	February 8 and 9, 2000	Area:	96.00 ft^2
Unit No:	1	No. Test Ports:	4
Length:	2'8"	Tests Points per Port:	5
Width:	18'	Distance Between Ports:	4.5'
Duct No:	Outlet*	Distance Between Points:	53'

*Two (2) outlet ducts exist. Both ducts were traversed for gas flow and mercury concentration.

3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

3.1 Objectives and Test Matrix

The purpose of the test program was to quantify mercury emissions from this unit. This information will assist the USEPA Administrator in determining whether it is appropriate and necessary to regulate emissions of Hazardous Air Pollutants (HAPs) from electric utility steam generating units. The specific objectives, in order of priority were:

- Measure speciated mercury emissions at the outlet.
- Measure speciated mercury concentrations at the inlet of the last air pollution control device.
- Measure mercury and chlorine content from the fuel being used during the testing.
- Measure the oxygen and carbon dioxide concentrations at the inlet and the outlet.
- Measure the volumetric gas flow at the inlet and the outlet.
- Measure the moisture content of the flue gas at the inlet and the outlet.
- Provide the above information to the USEPA for use in establishing mercury emission factors for this type of unit.

The test matrix is presented in Table 3-1. The table shows the testing performed at each location, methodologies employed and responsible organization.

Table 3-1
TEST MATRIX FOR THE NELSON DEWEY PLANT

Sampling Location	No. of Runs	Parameters	Sampling Method	Sample Run Time (min)	Analytical Method	Analytical Laboratory
Outlet	3	Speciated Hg	Ontario Hydro	120	EPA SW846 7470	Philip Services
Outlet	3	Moisture	EPA 4	120	Gravimetric	Mostardi Platt
Outlet	3	Flow	EPA 1 & 2	120	Pitot Traverse	Mostardi Platt
Outlet	3	O_2/CO_2	EPA 3	120	Orsat	Mostardi Platt
Inlet	3	Speciated Hg	Ontario Hydro	120	EPA SW846 7470	Philip Services
Inlet	3	Moisture	EPA 4	120	Gravimetric	Mostardi Platt
Inlet	3	Flow	EPA 1 & 2	120	Pitot Traverse	Mostardi Platt
Inlet	3	O_2/CO_2	EPA 3	120	Orsat	Mostardi Platt
Fuel Feeders	3	Hg, Cl in Fuel	Grab	1 Sample Per Feeder Per Run	ASTM D3684 (Hg) ASTM D4208 (Cl)	CTE

3.2 Field Test Changes and Problems

The Site Specific Test Plan stated that only one side of the precipitator would be traversed for mercury concentration and the outlet on the other side would be traversed for total flow determination. A change was made to traverse both outlet ducts for mercury concentration and gas flow.

The QAPP indicated that the speciated mercury would be analyzed by TEI , Inc. The speciated mercury samples from this test program were sent to Philip Services for analysis.

There were no other field test changes or problems encountered during this test program.

3.3 Presentation of Results

3.3.1 Mercury Mass Flow Rates

The mass flow rates of mercury determined at each sample location are presented in Table 3-2.

Table 3-2
SUMMARY OF RESULTS

Sample Location	Elemental Mercury (lb/hr)	Oxidized Mercury (lb/hr)	Particle-Bound Mercury (lb/hr)	Total Mercury (lb/hr)
Fuel				
Run 1				0.00522
Run 2				0.00502
Run 3				0.00501
Average				0.00508
Precipitator Inlet				
Run 1	0.00252	0.00039	0.00000	0.00291
Run 2	0.00169	0.00018	0.00000	0.00188
Run 3	0.00169	0.00009	0.00000	0.00178
Average	0.00197	0.00022	0.00000	0.00219
Precipitator Outlet				
Run 1	0.00251	0.00019	0.00000	0.00270
Run 2	0.00180	0.00012	0.00000	0.00192
Run 3	0.00190	0.00020	0.00000	0.00210
Average	0.00207	0.00017	0.00000	0.00224

3.3.2 Comparison of Volumetric Flow Rate

Volumetric flow rate is a critical factor in calculating mass flow rates. Ideally, the volumetric flow rate (corrected to standard pressure and temperature) measured at the inlet to the control device should be the same as that measured at the stack, which should be the same as that measured by the CEMS. A comparison of the flow rates at the two test locations can be seen in table 3-3. A comparison to the stack CEMS could not be made because this is a common stack location for two units.

Table 3-3
COMPARISON OF VOLUMETRIC FLOW RATE DATA

	Inlet			Outlet		
Run No.	**KACFM[1]**	**KSCFM[2]**	**KDSCFM[3]**	**KACFM**	**KSCFM**	**KDSCFM**
Run 1	451.1	255.7	228.3	433.7	242.2	215.3
Run 2	440.6	248.9	223.1	430.2	240.3	214.4
Run 3	455.2	256.3	229.1	442.5	245.4	218.6
Average	449.0	253.6	227.1	435.5	242.6	216.1

[1] Thousands of Actual Cubic Feet per Minute
[2] Thousands of Standard Cubic Feet per Minute (68° F and 29.92 inches Hg)
[3] Thousands of Dry Standard Cubic Feet per Minute

The measured volumetric flow rate (KSCFM) at the inlet was approximately 5% higher than that measured at the outlet.

3.3.3 Individual Run Results

A detailed summary of results for each sample run at the precipitator inlet and outlet test locations are presented in Tables 3-4 and 3-5, respectively.

3.3.4 Process Operating Data

The process operating data collected during the tests is included in Appendix A. A summary of the coal usage and mass emission rate of mercury available from coal are presented in Table 3-6.

Table 3-4
PRECIPITATOR INLET INDIVIDUAL RUN RESULTS

Test Run Number:	**1**	**2**	**3**	**Average**
Source Condition		Normal		
Fuel Factor, dscf/10^6 Btu	9822	9837	9834	
Date	2/8/2000	2/8/2000	2/9/2000	
Start Time	10:00	14:00	9:00	
End Time	12:15	16:14	11:11	
Elemental Mercury:				
HNO_3-H_2O_2, ug detected	ND <0.25	ND <0.25	ND <0.25	ND <0.25
H_2SO_4-$KMnO_4$, ug detected	5.400	3.400	3.500	4.100
Reported, ug	5.400	3.400	3.500	4.100
ug/dscm	2.95	2.03	1.97	2.31
lb/hr	0.00252	0.00169	0.00169	0.00197
lb/10^{12} Btu	2.29	1.57	1.47	1.78
Oxidized Mercury:				
KCl, ug detected	0.830	0.370	0.190	0.463
Reported, ug	0.830	0.370	0.190	0.463
ug/dscm	0.45	0.22	0.11	0.26
lb/hr	0.00039	0.00018	0.00009	0.00022
lb/10^{12} Btu	0.35	0.17	0.08	0.20
Particle-bound Mercury:				
Filter, ug detected	--	--	--	--
HNO_3, ug detected	ND <0.010	ND <0.010	ND <0.010	ND <0.010
Reported, ug	0.000	0.000	0.000	0.000
ug/dscm	0.00	0.00	0.00	0.00
lb/hr	0.00000	0.00000	0.00000	0.00000
lb/10^{12} Btu	0.00	0.00	0.00	0.00
Total Inlet Speciated Mercury:				
ug/dscm	3.40	2.25	2.07	2.57
lb/hr	0.00291	0.00188	0.00178	0.00219
lb/10^{12} Btu	2.64	1.74	1.55	1.98
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	451,087	440,637	455,172	448,965
@ Standard Conditions, dscfm	228,253	223,131	229,915	227,100
Average Gas Temperature, °F	490.1	493.7	500.4	494.7
Average Gas Velocity, ft/sec	78.31	76.50	79.02	77.94
Flue Gas Moisture, percent by volume	10.75	10.34	10.29	10.46
Average Flue Pressure, in. Hg	30.52	30.52	30.64	
Barometric Pressure, in. Hg	29.75	29.75	29.87	
Average %CO_2 by volume, dry basis	14.4	14.5	15.0	14.6
Average %O_2 by volume, dry basis	4.4	4.3	3.8	4.2
% Excess Air	25.83	25.09	21.55	24.15
Dry Molecular Wt. of Gas, lb/lb-mole	30.480	30.492	30.552	
Gas Sample Volume, dscf	64.694	59.250	62.872	
Isokinetic Variance	99.6	101.4	104.5	

Table 3-5
PRECIPITATOR OUTLET INDIVIDUAL RUN RESULTS

Test Run Number:	1	2	3	Average
Source Condition		Normal		
Fuel Factor, dscf/10^6 Btu	9822	9837	9834	
Date	2/8/2000	2/8/2000	2/9/2000	
Start Time	10:18	14:00	9:00	
End Time	12:49	16:14	11:15	
Elemental Mercury:				
HNO_3-H_2O_2, ug detected	ND <0.25	ND <0.25	ND <0.25	ND <0.25
H_2SO_4-$KMnO_4$, ug detected	4.700	3.700	3.900	4.100
Reported, ug	4.700	3.700	3.900	4.100
ug/dscm	3.11	2.24	2.33	2.56
lb/hr	0.00251	0.00180	0.00190	0.00207
lb/10^{12} Btu	2.39	1.72	1.74	1.95
Oxidized Mercury:				
KCl, ug detected	0.360	0.240	0.410	0.337
Reported, ug	0.360	0.240	0.410	0.337
ug/dscm	0.24	0.15	0.24	0.21
lb/hr	0.00019	0.00012	0.00020	0.00017
lb/10^{12} Btu	0.18	0.11	0.18	0.16
Particle-bound Mercury:				
Filter, ug detected	ND <0.14	ND <0.060	ND <0.060	ND <0.09
HNO_3, ug detected	--	--	--	--
Reported, ug	0.000	0.000	0.000	0.000
ug/dscm	0.00	0.00	0.00	0.00
lb/hr	0.00000	0.00000	0.00000	0.00000
lb/10^{12} Btu	0.00	0.00	0.00	0.00
Total Outlet Speciated Mercury:				
ug/dscm	3.35	2.39	2.57	2.77
lb/hr	0.00270	0.00192	0.00210	0.00224
lb/10^{12} Btu	2.57	1.83	1.93	2.11
Average Gas Volumetric Flow Rate:				
@ Flue Conditions, acfm	433,732	430,188	442,492	435,471
@ Standard Conditions, dscfm	215,278	214,386	218,603	216,089
Average Gas Temperature, °F	496.6	496.2	507.0	499.9
Average Gas Velocity, ft/sec	75.30	74.68	76.82	75.60
Flue Gas Moisture, percent by volume	11.10	10.78	10.91	10.93
Average Flue Pressure, in. Hg	30.26	30.26	30.38	
Barometric Pressure, in. Hg	29.75	29.75	29.87	
Average %CO_2 by volume, dry basis	14.3	14.5	14.8	14.5
Average %O_2 by volume, dry basis	4.2	4.2	3.8	4.1
% Excess Air	24.26	24.33	21.48	23.36
Dry Molecular Wt. of Gas, lb/lb-mole	30.456	30.488	30.520	
Gas Sample Volume, dscf	53.388	58.280	59.236	
Isokinetic Variance	103.9	102.8	102.5	

Table 3-6
COAL USAGE RESULTS

Test Run Number:	1	2	3	Average
Date	2/8/2000	2/8/2000	2/9/2000	
Coal Properties:				
Carbon, % dry	75.40	75.25	74.77	75.14
Hydrogen, % dry	4.69	4.97	5.03	4.90
Nitrogen, % dry	1.04	1.05	1.01	1.03
Sulfur, % dry	1.48	1.37	1.35	1.40
Ash, % dry	5.04	4.83	4.93	4.93
Oxygen, % dry (by difference)	12.35	12.53	12.91	12.60
Volatile, % dry	38.04	30.18	29.78	32.67
Moisture, %	22.40	21.52	23.56	22.49
Heat Content, Btu/lb dry basis	13006	13052	12984	13014
F_d Factor O_2 basis, dscf/10^6 Btu	9822	9837	9834	9831
F_c Factor CO_2 basis, scf/10^6 Btu	1861	1851	1849	1853
Chloride, ug/g dry	141.0	151.0	95.0	129.0
Mercury, ug/g dry	0.06	0.06	0.06	0.06
Coal Consumption:				
Time Reading Taken	10:00-12:50	14:00-16:15	09:00-11:14	
Feeder A, lbs	102884	77636	82494	
Feeder B, lbs	111330	83972	78794	
Feeder C, lbs	103310	78135	82746	
Total Raw Coal Input, lbs	317524	239743	244034	267100
Total Coal Input, lbs/hr dry	86964	83622	83525	84704
Total Mercury Available in Coal:				
Mercury, lbs/hr	0.00522	0.00502	0.00501	0.00508
Mercury, lbs/10^{12} Btu	4.61	4.60	4.62	4.61

Laboratory Analysis can be found in Appendix F.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Test Methods

4.1.1 Speciated mercury emissions

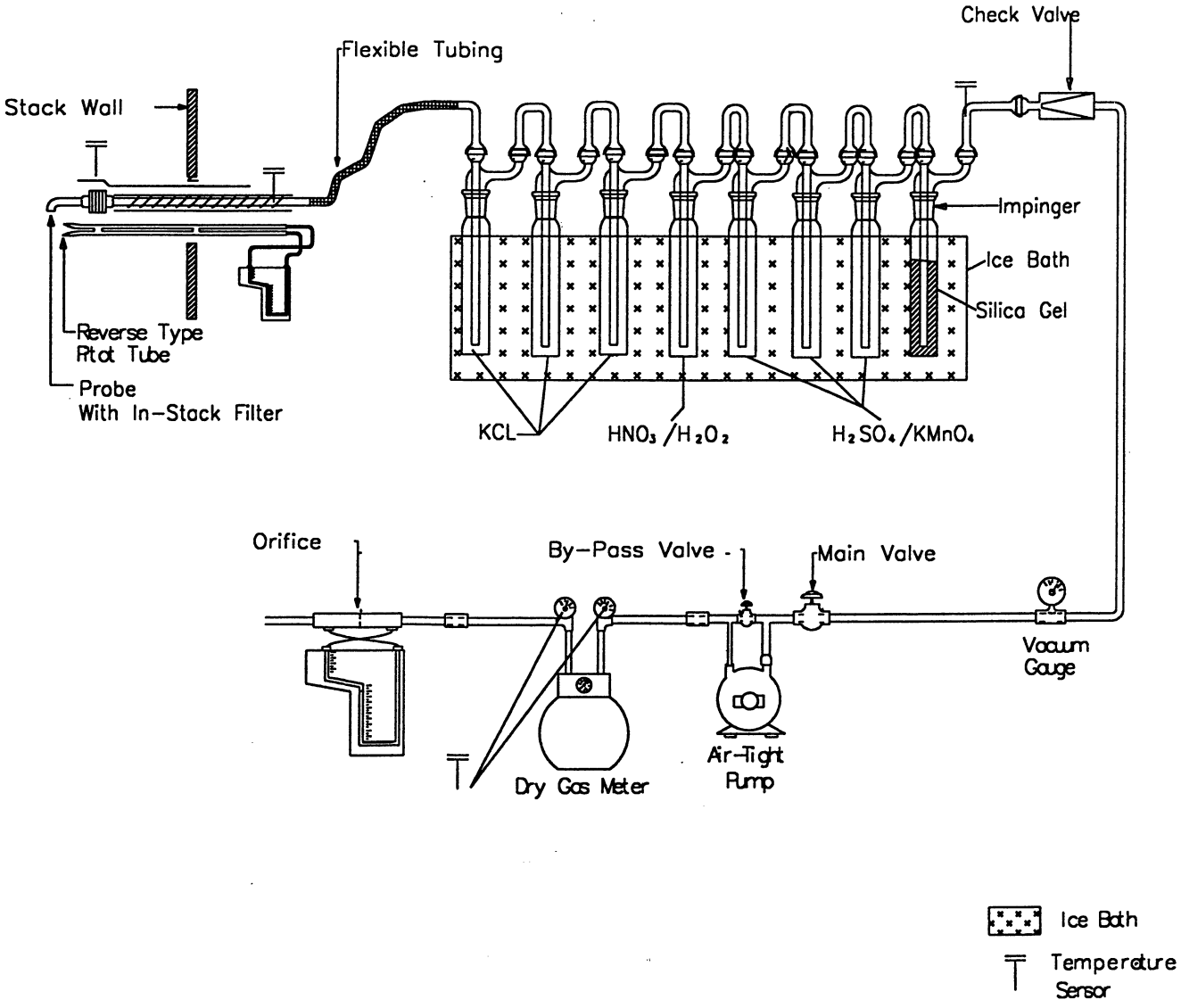
Speciated mercury emissions were determined via the draft "Standard Test Method for Elemental, Oxidized, Particle-Bound, and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario-Hydro Method)", dated July 7, 1999.

The in-stack filtration (Method 17) configuration was utilized at the inlet and outlet test locations. Figures 4-1 is schematic of the Ontario-Hydro sampling train.

Figure 4-2 illustrates the sample recovery procedure. The analytical scheme was per Section 13.3 of the Ontario-Hydro Method.

Speciated Mercury Sampling Train Equipped with In-Stack Filter

Ontario Hydro Method



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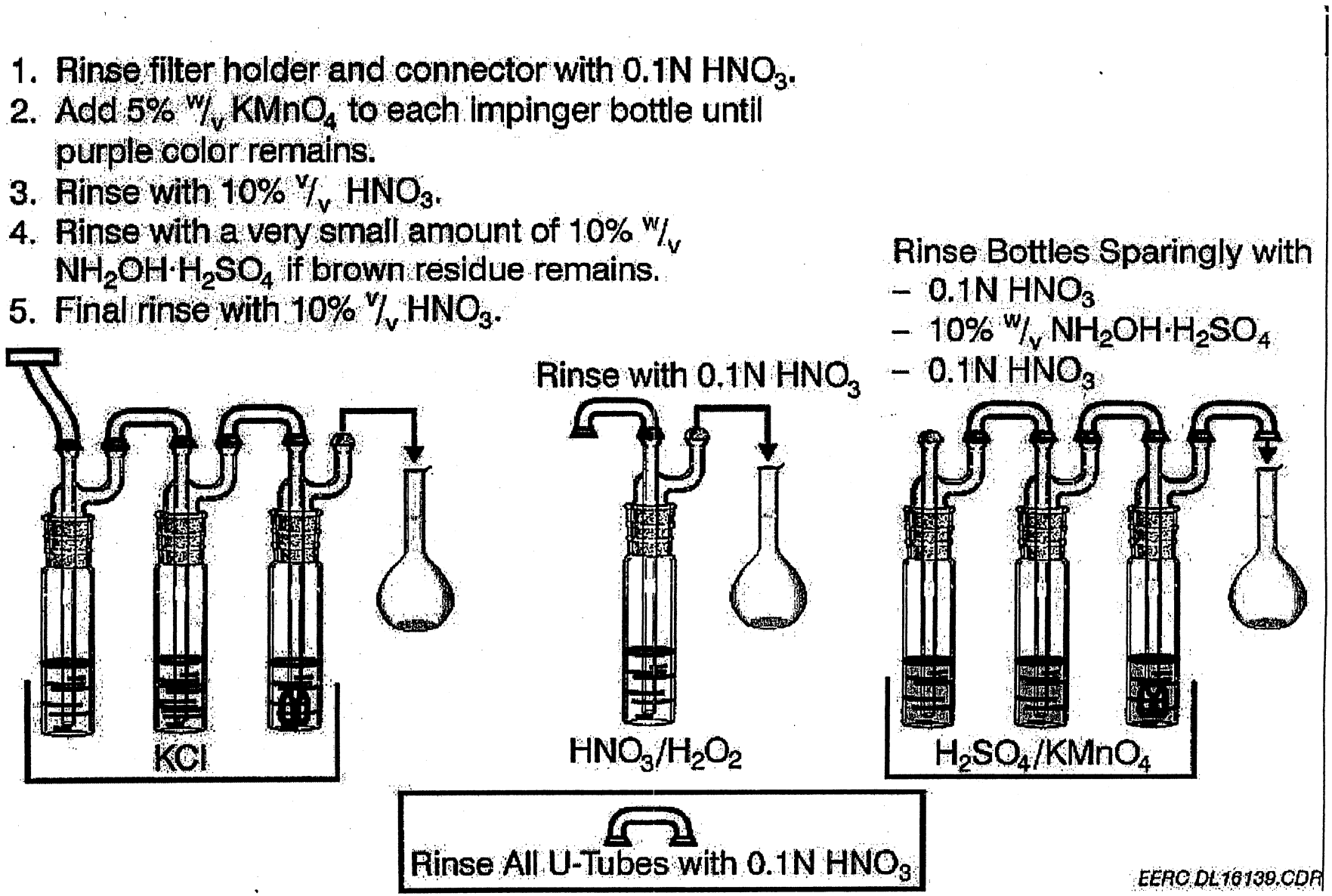

Figure 4-2 Sample Recovery Scheme for Ontario-Hydro Method Samples

4.1.2 Fuel samples

Fuel samples were collected by composite sampling. Three samples were collected at equally spaced intervals during each speciated mercury sampling run. Each set of three samples was composited into a single sample for each sample run. Sample analysis was conducted according to the procedures of ASTM D3684 and ASTM D4208.

4.2 Procedures for Obtaining Process Data

Plant personnel were responsible for obtaining process-operating data. The process data, which can be found in Appendix A, was continuously monitored by the facility.

4.3 Sample Identification and Custody

The chain-of-custody for all samples obtained for analysis can be found in Appendix E.

5.0 INTERNAL QA/QC ACTIVITIES

All sampling, recovery and analytical procedures conform to those described in the site specific test plan. All resultant data was reviewed by the laboratory and Mostardi Platt per the requirements listed in the QAPP and were determined to be valid.

5.1 QA Audits

5.1.1 Reagent Blanks

As required by the method, blanks were collected for all reagents utilized. The results of reagent blank analysis are presented in Table 5-1. All detected reagent blank values were subtracted from each test run in the calculation of actual emissions.

Table 5-1
REAGENT BLANK ANALYSIS

Sample ID #	Sample Fraction	Contents	Mercury (µg)	Detection Limit (µg)
038	1 N KCl	1 N KCl	<0.030	0.030
039	HNO_3/H_2O_2	HNO_3/H_2O_2	<0.25	0.008
040, 041	$KMnO_4/H_2SO_4$	$KMnO_4/H_2SO_4$	<0.030	0.003

5.1.2 Blank Trains

As required by the method, blank trains were collected at both the inlet and stack sampling locations. These trains were collected on February 8, 2000. The results of blank train analysis are presented in Table 5-2. Blank trains analytical results are reported but not used in the determination of actual emissions.

Table 5-2
BLANK TRAIN ANALYSIS

Sample ID #	Sample Fraction	Contents	Mercury (µg)	Detection Limit (µg)
031	KCl impingers	Impingers/rinse	0.30	0.030
034	KCl impingers	Impingers/rinse	0.063	0.030
032	HNO_3-H_2O_2 impingers	Impingers/rinse	<0.25	0.010
035	HNO_3-H_2O_2 impingers	Impingers/rinse	<0.25	0.010
033	$KMnO_4/H_2SO_4$ impingers	Impingers/rinse	<0.10	0.030
036	$KMnO_4/H_2SO_4$ impingers	Impingers/rinse	<0.10	0.030

5.1.3 Field Dry Test Meter Audit

The field dry test meter audit described in Section 4.4.1 of Method 5 was completed prior to the test. The results of the audit are presented in Appendix C.