Consumers Energy
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40 CFR 63, Subpart UUUUU Mercury MATS LEE Test Report

EUBOILER01 and EUBOILER02

CMS Enterprises
TES Filer City Station
700 Mee Street
Filer City, Michigan 49634
SRN: N1685
FRS: 110056958225

December 21, 2018

Test Dates: October 4 through November 12, 2018

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No. 4101982
Version No.: 0

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EXECUTIVE SUMMARY

Consumers Energy Regulatory Compliance Testing Section (RCTS) personnel conducted total vapor phase mercury (Hg) testing at the exhaust of electric utility steam generating units (EGU) EUBOILER01 (Unit 1) and EUBOILER02 (Unit 2) operating at the Tondu Energy Systems (TES) Filer City Station in Filer City, Michigan. The facility is a cogeneration power plant with a rated output of 60-megawatts (MW) net and 50,000 pounds of process steam per hour subject to 40 Code of Federal Regulations (CFR) 63, Subpart UUUUU-National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units, aka the Mercury and Air Toxics Standard (MATS) regulation.

This test program was conducted in October and November of 2018 to satisfy the annual performance testing requirements in accordance with §63.10005(h) to evaluate if the EGU's qualify as low emitting EGUs (LEE) for mercury. To qualify for LEE status, annual continuous sampling of each unit must occur over a 30 boiler operating day period and the average result must either:

1. be less than 10 percent of the applicable Hg emissions limit in Table 2 of the MATS rule, or
2. demonstrate the potential Hg mass emissions are less than or equal to 29.0 pounds per year and the emission rate is compliant with the applicable emissions limit in Table 2 of the MATS rule.

The applicable emission limit for EUBOILER01 and EUBOILER02, which are existing EGUs that are coal-fired not low rank virgin coal and subject to the emission limits within Table 2 of the MATS rule is 1.2 pounds of mercury per trillion British thermal unit (lb Hg/TBtu) or $1.3x10^{-2}$ pounds of mercury per gigawatt hour (lb/GWh).

The testing was performed in accordance with the test protocol submitted to the Michigan Department of Environmental Quality (MDEQ) on September 1, 2017 and subsequently approved by Mr. Jeremy Howe, MDEQ Environmental Quality Analyst, in his letter dated September 29, 2017. No deviations from the protocol occurred. The results of the testing are presented below:

- Unit 1: 0.3 lb/TBtu and 1.1 lb/yr mass emissions based upon the average of thirty boiler operating days.
- Unit 2: 0.3 lb/TBtu and 0.9 lb/yr mass emissions based upon the average of thirty boiler operating days.

The results indicate EUBOILER01 and EUBOILER02 comply with the MATS Hg lb/TBtu and lb/yr limits and meet LEE qualification criteria. Because the sources qualify as LEE's for mercury, continuous compliance through mercury continuous emissions monitoring or sorbent trap systems is not required; however, mercury performance testing must be performed yearly to evaluate LEE status.

Detailed results are presented in Appendix Tables 1 and 2. Sample calculations, field data sheets, and laboratory data are presented in Appendices A, B, and C. Boiler operating data and supporting documentation are provided in Appendices D and E.

1.0 INTRODUCTION

This report summarizes the results of total vapor phase mercury (Hg) testing conducted at the stack exhausts associated with electric utility steam generating units (EGU) EUBOILER01 (Unit 1) and EUBOILER02 (Unit 2) operating at the Tondu Energy Systems (TES) Filer City Station in Filer City, Michigan.

This document was prepared using the Michigan Department of Environmental Quality (MDEQ) *Format for Submittal of Source Emission Test Plans and Reports* published in March of 2018. Please exercise due care if portions of this report are reproduced, as critical substantiating documentation and/or other information may be omitted or taken out of context.

1.1 IDENTIFICATION, LOCATION, AND DATES OF TESTS

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted Hg testing at the exhaust stacks of EUBOILER01 and EUBOILER2 operating at the TES Filer City Station in Filer City, Michigan beginning October 4, 2018 through November 12, 2018.

A test protocol was submitted to the Michigan Department of Environmental Quality (MDEQ) in September 2017 and subsequently approved by Mr. Jeremy Howe, Environmental Quality Analyst, in his letter dated September 29, 2017. The approval letter reflects standing blanket approval of subsequent 40 CFR 63, Subpart UUUUU Hg LEE tests conducted at TES Filer City as long as no modifications from the original protocol are needed. On September 17, 2018 TES Filer City notified the MDEQ of its intent to begin the Hg testing the week of October 4, 2018.

1.2 PURPOSE OF TESTING

The facility is a cogeneration power plant with a rated output of 60-megawatts (MW) net and 50,000 pounds of process steam per hour subject to 40 Code of Federal Regulations (CFR) 63, Subpart UUUUU – *National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units*, aka the Mercury Air Toxics Standard (MATS) regulations. This test program was conducted to satisfy the annual performance testing requirements in accordance with §63.10005(h) to determine whether the EGU's qualify as Low Emitting Electric Generating (LEE) units for mercury. The Hg LEE evaluation requires annual continuous sampling of each unit over a 30 boiler operating day period and the average results must be either:

1. less than 10 percent of the applicable Hg emissions limit in Table 2 of the MATS rule (see Table 1-1 below), or
2. demonstrate the potential Hg mass emissions are less than or equal to 29.0 pounds per year and the emission rate is compliant with the applicable emissions limit in Table 2 of the MATS rule.

Table 1-1
40 CFR 63, Subpart UUUU – Table 2 Emission Limit

Parameter	Emission Limit	Units	Applicable Requirement
Mercury	1.2 or 1.3	lb/TBtu lb/GWh	Table 2(1)(c) to Subpart UUUUU of Part 63—Emission Limits for Existing EGU's
lb/TBtu pound of per trillion British thermal unit heat input lb/GWh pound of per gigawatt hour gross output			

1.3 Brief Description of Source

TES Filer City Station is a cogeneration power plant consisting of two predominantly solid-fuel fired boilers. EUBOILER01 and EUBOILER02 are spreader stoker boilers that produce steam which is used to generate electricity and sold to an adjacent property, when needed.

1.4 Contact Information

Table 1-2 presents the names, addresses, and telephone numbers for contacts involved in this test program.

Table 1-2
Contact Information

Program Role	Contact	Address
EPA Regional Contact	Compliance Tracker, AE-18J 312-353-2000	Air Enforcement and Compliance Assurance U.S. Environmental Protection Agency – Region 5 77 W. Jackson Boulevard Chicago, Illinois 60604
State Regulatory Administrator	Ms. Karen Kajiya-Mills Technical Programs Unit Manager 517-335-4874 kajiya-millsk@michigan.gov	Michigan Department of Environmental Quality Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Field Inspector	Mr. Jeremy Howe Environmental Quality Analyst 231-878-6687 howej1@michigan.gov	Michigan Department of Environmental Quality Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601
State Regulatory Inspector	Ms. Caryn Owens Environmental Quality Analyst 231-878-6688 owensc1@michigan.gov	Michigan Department of Environmental Quality Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601
Responsible Official	Mr. Henry Hoffman General Manager 231-723-6573 x 102 henry.hoffman@cmsenergy.com	CMS Generation Filer City Operating, LLC Filer City Station 700 Mee Street Filer City, Michigan 49634
Corporate Air Quality Contact	Mr. Jason Prentice Senior Engineer 517-788-1467 jason.prentice@cmsenergy.com	Consumers Energy Company Environmental Services Department 1945 West Parnall Road; P22-334 Jackson, Michigan 49201
Test Facility	Mr. Austin Swiatlowski Plant Operator 231-723-6573 x 108 austin.swiatlowski@cmsenergy.com	CMS Generation Filer City Operating, LLC Filer City Station 700 Mee Street Filer City, Michigan 49634

Table 1-2
Contact Information

Program Role	Contact	Address
Test Team Representative	Mr. Gregg Koteskey, QSTI Sr. Engineering Technical Analyst 616-738-3712 gregg.koteskey@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street Filer City, Michigan 49460
Laboratory	Ms. Alexandra Sipershteyn Product Manager 440-264-2500 x 305 alexandra.sipershteyn@ohiolumex.com	Ohio Lumex Co., Inc. 30350 Bruce Industrial Pkwy Cleveland, Ohio 44139

2.0 SUMMARY OF RESULTS

2.1 OPERATING DATA

In accordance with 40 CFR 63.10007(a)(2), the boilers were operated at maximum normal operating load conditions during the 30 boiler operating day test program; maximum normal operating load condition will generally be between 90 and 110 percent of design capacity but should be representative of site specific normal operations during each test run. The boilers fired blends of coal, tire derived fuel, wood, and/or natural gas during testing. The average steam generating rates during the 30 boiler operating day tests were approximately 296,700 lbs/hr for Unit 1 and 294,500 lbs/hr for Unit 2. These steam generating rates are approximately 92.7 and 92.0% of the full load ratings of 320,000 lbs/hr for each unit.

Refer to Attachment D for detailed operating data, including fuel blend firing rate and composite fuel factor data, which was recorded in Eastern Standard Time (EST). Note the time convention for the reference method (RM) testing was Eastern Standard Time (EST), consistent with the continuous emissions monitoring system (CEMS)/other process data time stamps.

2.2 APPLICABLE PERMIT INFORMATION

The TES Filer City Station is currently operating pursuant to the terms and conditions of State of Michigan Registration Number (SRN) N1685 air permit MI-ROP-N1685-2015b. The air permit incorporates state and federal regulations. The USEPA has assigned a Facility Registry Service (FRS) identification number of 110056958225. EUBOILER01 and EUBOILER02 are the emission unit sources listed within the permit and collectively comprise the FGBOILERS flexible group. Incorporated within the permit are the applicable requirements of 40 CFR 63, Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units.

2.3 RESULTS

The results of the testing indicate EUBOILER01 and EUBOILER02 comply with the MATS Hg 1.2 lb/TBtu limit, as well as the LEE qualification criteria. Table 2-1 presents a summary of the Hg test results.

Table 2-1
Summary of Test Results

Source	Test Run	Hg Concentration (µg/dscm)	Hg Emission Rate (lb/TBtu)		Emission Rate (lb/yr)	
		Result	Result	LEE Criteria	Result	LEE Criteria
Unit 1	1	0.46531	0.41	-	1.4	-
	2	0.25835	0.23	-	0.8	-
	3	0.69741	0.63	-	2.1	-
	4	0.08998	0.08	-	0.3	-
	Average	**0.37776**	**0.34**	**0.12**	**1.1**	**29.0**
Unit 2	1	0.40904	0.39	-	1.3	-
	2	0.18680	0.18	-	0.6	-
	3	0.37846	0.37	-	1.2	-
	4	0.20061	0.19	-	0.6	-
	Average	**0.29373**	**0.28**	**0.12**	**0.9**	**29.0**

Detailed results are presented in Appendix Tables 1 and 2. A discussion of the results is presented in Section 5.0. Sample calculations, field data sheets and laboratory results are presented in Appendices A, B, and C. Boiler operating data and supporting information are provided in Appendices D and E.

3.0 SOURCE DESCRIPTION

TES Filer City Station is a cogeneration facility consisting of two predominantly solid-fuel fired boilers. The electricity output is sold pursuant to a long-term power purchase agreement with Consumers Energy Company. Process steam is sold to an adjacent industrial customer.

3.1 PROCESS

TES Filer City Station operates as a cogeneration electric power plant with a rated output of approximately 60-megawatts net (MW_n) and is also capable of generating 50,000 pounds of process steam per hour. The electricity and process steam are sold under contract to public and/or private companies. The facility commenced commercial operations beginning in 1990.

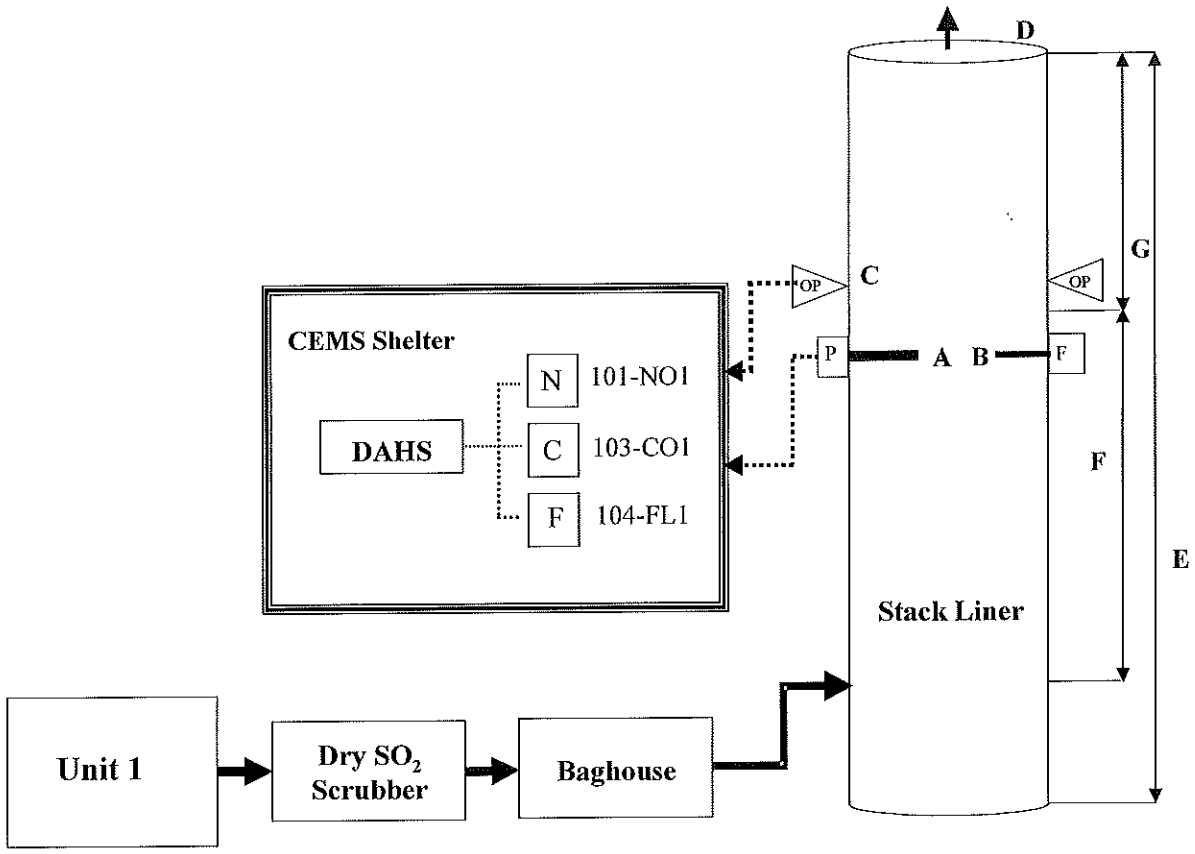
3.2 PROCESS FLOW

EUBOILER01 and EUBOILER02 are spreader stoker grate boilers used to generate steam. Each unit has a nominal heat input rating of approximately 384 mmBtu/hour and is currently allowed to combust coal, wood and wood waste, industrial construction/demolition wood waste, tire derived fuel and natural gas. The fuel is fired in the furnace where the combustion heats water within boiler tubes producing steam. At full load, each unit is capable of producing approximately 320,000 pounds per hour of steam. This steam is used to turn a common steam turbine that is connected to an electricity producing generator. The electricity is routed through the transmission and distribution system to customers.

The exhaust gas from each boiler is vented to a spray dryer absorber (SDA) flue gas desulfurization (FGD) system for sulfur dioxide (SO_2) and acid gas (i.e., HCl) control and a

baghouse to control particulate matter. The abated exhaust gases are discharged through separate circular flues housed within a single exhaust stack. The separate flues discharge approximately 250 feet above grade. Refer to Figure 3-1 for a Process Flow Diagram of Unit 1 which is representative of Unit 2.

Figure 3-1. Unit 1 Data Flow Diagram



3.3 Materials Processed

At the time of testing, Units 1 and 2 were capable of firing mixtures of coal (bituminous and subbituminous), wood and wood waste, construction/demolition (C/D) material, tire-derived-fuel (TDF) and natural gas. During the tests, coal, TDF, wood, and natural gas were fired. Refer to Appendix D for facility operating data recorded during the test program.

In March of 2016, two low NO_x natural gas-fired burners were installed each boiler. Natural gas is utilized as a clean startup fuel, as well as at other times for flame stabilization and other purposes.

TES executed an Administrative Consent Order with the EPA which resulted in all petroleum coke having been removed from the site by March 31, 2016, and TES does not anticipate firing petroleum coke in the near future.

3.4 Rated Capacity

EUBOILER01 and EUBOILER02 each have a nominally rated heat input capacity of 384 mmBtu/hr and a steam generation capacity of 320,000 lbs/hr; they can generate a combined net electrical output of approximately 60 MW_n and 50,000 pounds of process steam per hour. The boilers normally operate in a continuous manner near their rated capacity in order to meet the contractual electrical and steam requirements of TES Filer City Station customers.

3.5 Process Instrumentation

The process was continuously monitored by boiler operators, environmental technicians, and data acquisition systems during testing. The following operating parameters were recorded during the test program and are included in Appendix D:

- Carbon dioxide concentration (CO_2, %)
- Fuel blend (coal, natural gas, TDF, and wood) firing rates (lb/hr) (scfh for natural gas)
- Exhaust volumetric flowrate (standard cubic foot per hour [scfh])
- Mixed fuel factor, Fc (scf/mmBtu)
- Total heat input (mmBtu/hr)
- Steam load flow (1,000s lb/hr) [In lieu of electrical load, which is only determined on a combined basis.]
- Steam pressure (psia)
- Opacity (%)

Due to the various instrumentation monitoring systems, the reference method test times were correlated to facility instrumentation time stamps. The reference method data acquisition system clock was adjusted to match the facility time stamp, which uses Eastern Standard Time.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

RCTS personnel tested for total vapor phase mercury using the USEPA test methods presented in Table 4-1. Descriptions of the sampling and analytical procedures are presented in the following sections.

Table 4-1
Test Methods

Parameter	Method	USEPA Title
Sample/traverse point locations	1	Sample and Velocity Traverses for Stationary Sources
Moisture	ALT-091	Alternative Procedures for Determination of Moisture Content
Emission rates	19	Sulfur Dioxide Removal and Particulate, Sulfur Dioxide and Nitrogen Oxides from Electric Utility Steam Generators
Total vapor phase mercury	30B	Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps

4.1 Description of Sampling Train and Field Procedures

The test matrix presented in Table 4-2 summarizes the sampling and analytical methods performed for the specified parameters during this test program.

Table 4-2
Test Matrix

Source	Run	Sample Type	Start Date/ Time (EST)	Stop Date/ Time (EST)	Test Duration (hours)	EPA Test Method	Comment
Unit 1	1	Hg, moisture	10/4/18 10:17:59	10/11/18 10:07:08	167.8	30B Alt-091	Valid run
	2	Hg, moisture	10/11/18 10:58:59	10/19/18 9:32:02	190.6	30B Alt-091	Valid run
	Unit 1 and 2 periodic outage October 21 through October 27, 2018						
	3	Hg, moisture	10/29/18 11:02:59	11/5/18 11:48:31	168.8	30B Alt-091	Valid Run
	4	Hg, moisture	11/5/18 11:39:59	11/12/18 11:16:38	167.6	30B Alt-091	Valid run
Unit 2	1	Hg, moisture	10/4/18 10:52:59	10/11/18 11:05:25	168.2	30B Alt-091	Valid run
	2	Hg, moisture	10/11/18 11:38:00	10/19/18 9:54:04	190.3	30B Alt-091	Valid run
	Unit 1 and 2 periodic outage October 21 through October 27, 2018						
	3	Hg, moisture	10/29/18 11:36:59	11/5/18 12:49:07	169.2	30B Alt-091	Valid run
	4	Hg, moisture	11/5/18 12:42:01	11/12/18 11:53:06	167.2	30B Alt-091	Valid Run

4.1.1 Sample Location and Traverse Points (USEPA Method 1)

The selection of the measurement site was evaluated using the procedure in USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*. Each exhaust gas flue stack is 76-inches in diameter with two 6-inch internal diameter sample ports that extend 20-inches from the flue interior wall. The ports are situated:

- Approximately 90 feet or 14 duct diameters downstream of a duct bend disturbance where the combustion gases exit the baghouse and enter the vertical stack, and
- Approximately 150 feet or 24 duct diameters upstream of the exhaust to atmosphere

The sampling locations are at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame and meet the requirements of USEPA Method 1. As allowed in MATS Table 5, Item 4.a for mercury LEE testing, the sample probe tips for a dual sample train probe, with a single opening for each train was located at a point within 10 percent of the duct area centered about the duct centroid.

A dimensioned sketch of the sample location showing the sampling ports in relation to upstream and downstream disturbances in gas flow is presented as Figure 4-1. The Unit 1 duct cross section and sampling point detail is presented as Figure 4-2; Unit 2 is identical to Unit 1 with the exception the two test ports are located at the northeast and northwest compass positions.

Figure 4-1. Unit 1 and Unit 2 Sample Location

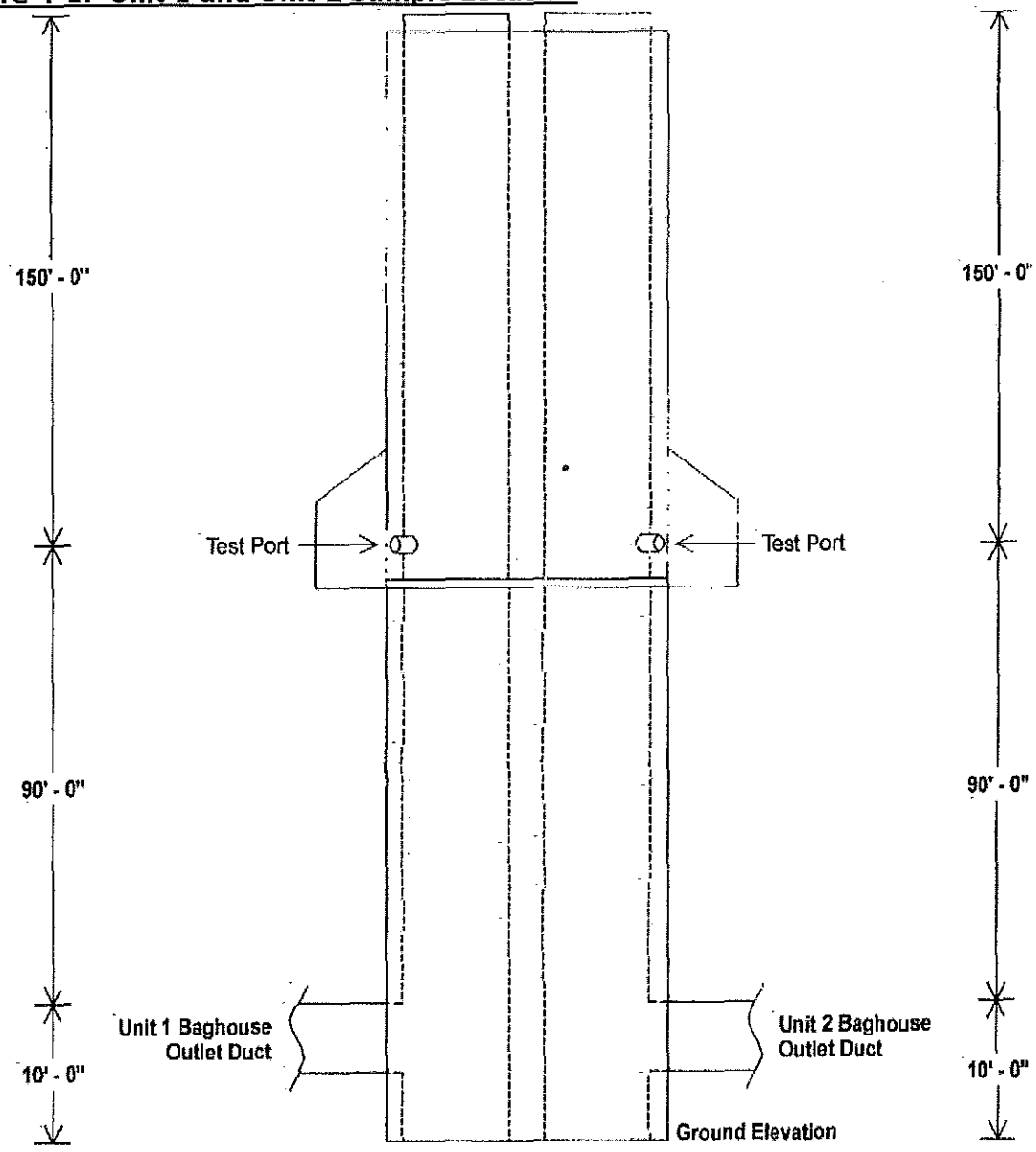
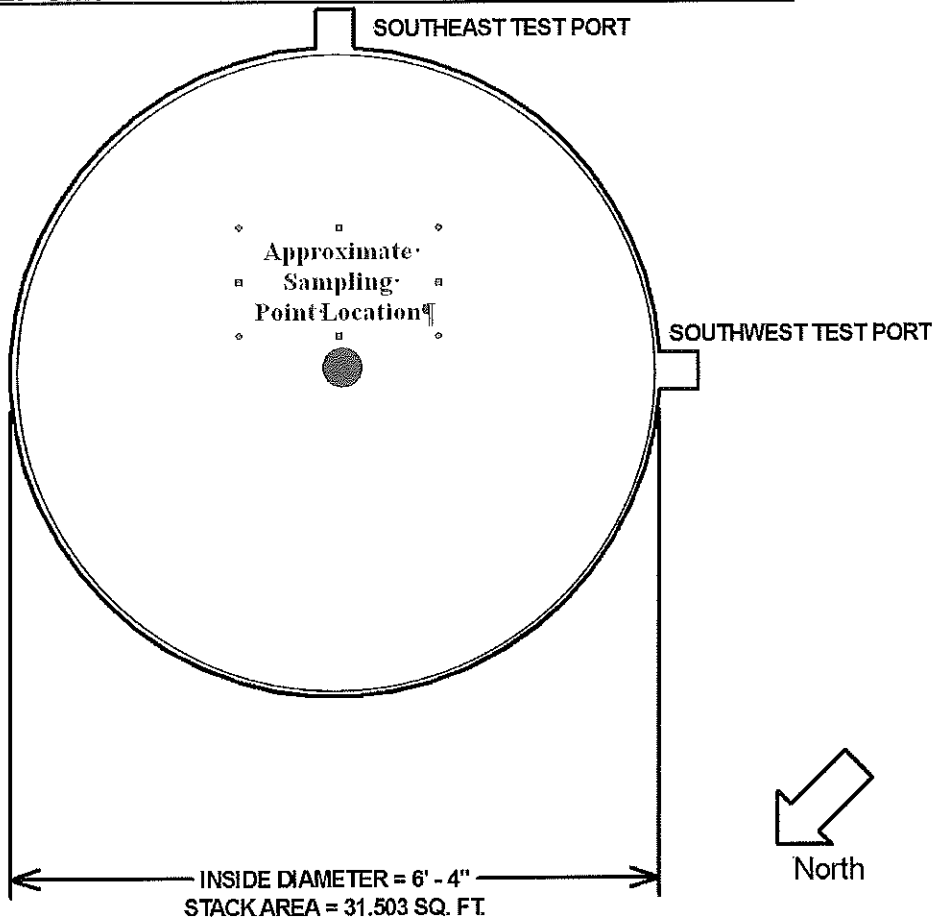


Figure 4-2. Unit 1 Duct Cross-Section and Sampling Point Detail



4.1.2 Moisture Content (USEPA Method ALT-091)

The exhaust gas moisture content was measured using USEPA Approved Alternative Method ALT-091, in conjunction with the reference method (RM) 30B sample apparatus. Exhaust gas was drawn through the RM 30B sample apparatus, which includes water knockout and desiccant vessels to remove stack gas moisture. The water knockout and desiccant vessels were weighed within 0.5 grams before and after each test run to measure the mass of water vapor collected. Using the mass of water collected and the volume of gas sampled, the stack gas moisture content was calculated using the applicable calculations in Section 12 of USEPA RM 4.

USEPA Approved Alternative Method ALT-091 requires the moisture content to also be determined using the average stack gas temperature in conjunction with saturation vapor tables, specifying the lower of the two values shall be considered the moisture content for the LEE demonstration. The stack gas temperature run averages ranged from 172.2 degrees Fahrenheit (°F) to 183 °F during the test period (Unit 1 183.0, 180.8, 180.4, 178.3; Unit 2 173.5, 172.6, 172.2, 174.7). The water vapor content at these temperatures equate to approximately 45% moisture by volume at saturation, much higher than the average measured using the mass of water collected in RM 30B sample apparatus (Unit 1 averaged 15.4% moisture by volume, Unit 2 averaged 14.4%). Therefore, the moisture content measured using the applicable calculations in Section 12 of RM 4 and the mass of water collected in the RM 30B sample apparatus were used in emissions calculations.

4.1.3 Emission Rates (USEPA Method 19)

USEPA Method 19, *Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates*, was used to calculate Hg emission rates in units of lb/mmBtu. Carbon dioxide concentrations obtained from the facility's 40 CFR 75 certified diluent gas monitoring system and site-specific pro-rated F factor (ratios of combustion gas volumes to heat inputs) were used to calculate emission rates using equation 19-6 from the method. Figure 4-3 presents the equation used to calculate lb/mmBtu emission rate:

Figure 4-3. USEPA Method 19 Equation 19-6

$$E = C_d F_c \frac{100}{\%CO_{2d}}$$

Where:

E	=	Pollutant emission rate (lb/mmBtu)
C_d	=	Pollutant concentration, dry basis (lb/dscf)
F_c	=	Volumes of combustion components per unit of heat content (scf/mMBtu)
$\%CO_{2d}$	=	Concentration of carbon dioxide on a dry basis (%, dry)

4.1.4 Mercury (USEPA Method 30B)

Mercury was measured utilizing USEPA Reference Method 30B, *Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps.* Known volumes of flue gas were continuously extracted from the stack through paired, in-stack, sorbent media traps at a constant flow rate. Each sorbent trap contained two sections, the first section quantitatively captured Hg and the second section was used to evaluate vapor phase Hg breakthrough. One of the traps contained sorbent media pre-spiked with mercury that was used to evaluate sample quality assurance. A heated sample line connected to the end of the heated probe transferred the sampled gas through a chilled moisture removal system consisting of a water knockout impinger and silica gel desiccant before entering a dry gas sampling console where sample volume and other parameters were recorded. The sorbent traps in the sampling system were periodically exchanged with new ones over the 30-boiler operating day test period. Refer to Figure 4-4 for a drawing of the USEPA Method 30B Hg Sample Apparatus.

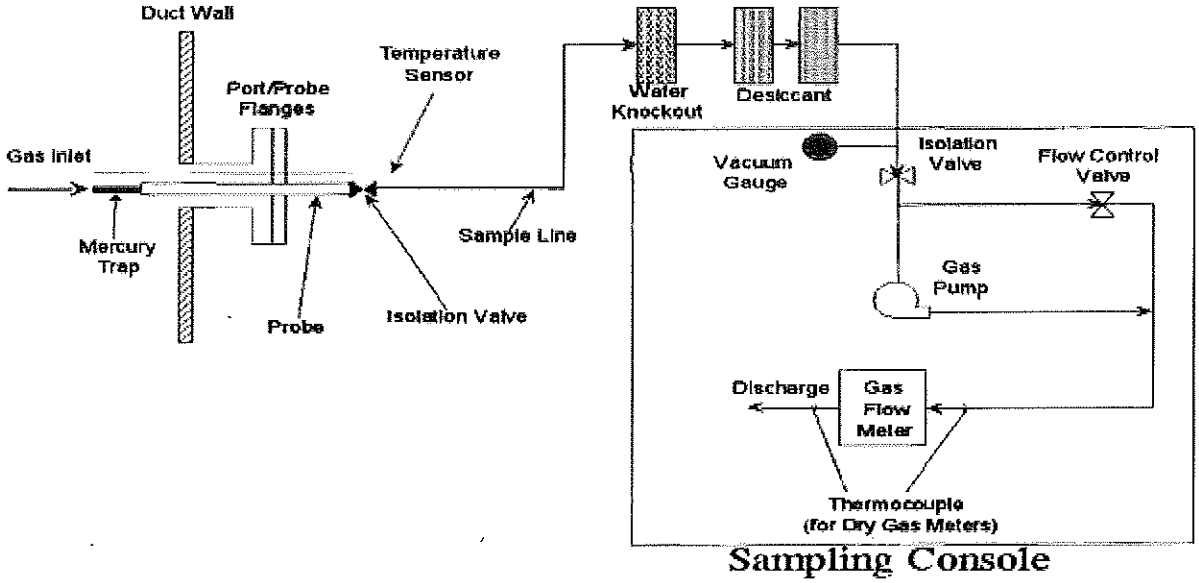
Each Hg sampling train was leak-checked before each test run as well as immediately after. Care was exercised to minimize effects of stray or ambient Hg at the sampling site, such as ensuring the sample ports are cleaned thoroughly, maintaining enough distance from duct walls and/or other sources of Hg so that bias was not introduced artificially. Time, dry gas meter temperature, sample rate, barometric pressure, source temperature and total sample volume were documented for each run.

At the conclusion of the test run and after the post-test leak check, the sorbent traps were recovered from the sampling system and shipped to Ohio Lumex, Co., Inc., for analysis. The contents of each section of the traps were carefully extracted onto a quartz glass ladle and placed into an oven where the captured mercury was thermally desorbed from the

sample matrix (i.e., charcoal) at approximately 680° Celsius. Vapor phase mercury was then measured using a calibrated atomic absorption spectrometry analyzer.

A minimum of three field recovery test runs were performed where one of the paired sorbent tubes was spiked with a known mass of mercury and used to sample flue gas during the test run. The field recovery test assesses the recovery of the elemental mercury spike to determine measurement bias and verify data acceptability. The results of the field recovery test met the acceptable performance criteria and are presented in the Appendix Tables.

Figure 4-4. USEPA Method 30B Hg Sample Apparatus



5.0 TEST RESULTS AND DISCUSSION

This test program was conducted in October and November of 2018 to satisfy the annual performance testing requirements in accordance with §63.10005(h) and §63.10006(f)(ii)(B) to evaluate if the EGU's qualify LEE's for mercury.

5.1 TABULATION OF RESULTS

Table 2-1 in Section 2 of this report summarizes the results and Appendix Tables 1 and 2 contain detailed tabulation of results, process operating conditions, and exhaust gas conditions.

5.2 SIGNIFICANCE OF RESULTS

The results indicate EUBOILER01 and EUBOILER02 comply with the MATS Hg 1.2 lb/TBtu emission limit and meet LEE qualification criteria. Because the sources qualify as LEE's for mercury, continuous compliance through mercury continuous emissions monitoring or sorbent trap systems is not required; however, mercury performance testing must be performed yearly to evaluate LEE status.

5.3 Variations from Sampling or Operating Conditions

No sampling or operating condition variations were encountered during the test program.

5.4 Process or Control Equipment Upset Conditions

The boiler and associated control equipment were operating under routine conditions and no upsets were encountered during testing. A periodic outage occurred the week of October 22, where the boilers and associated equipment were cleaned and inspected. Testing was suspended during the shutdown, outage, and startup period and resumed after normal operating load was achieved.

5.5 Air Pollution Control Device Maintenance

No significant pollution control device maintenance occurred during the three months prior to the test. Optimization of the air pollution control equipment is a continuous process to ensure compliance with regulatory emission limits.

5.6 Re-Test Discussion

Based on the results of this test program, a re-test is not required. The next required test will be a Hg LEE 30-boiler operating day test scheduled for the fourth quarter of 2019.

5.7 Results of Audit Samples

5.7.1 Performance Audit Sample

A performance audit (PA) sample (if available) for each test method employed is required, unless waived by the administrator for regulatory compliance purposes as described in 40 CFR 63.7(c)(2)(iii). A PA sample consists of blind audit sample(s), as supplied by an accredited audit sample provider (AASP), which are analyzed with the performance test samples in order to provide a measure of test data bias. Currently a PA sample is not available for mercury measured by USEPA Method 30B.

5.7.2 Reference Method Audits

The USEPA reference methods performed state reliable results are obtained by persons equipped with a thorough knowledge of the techniques associated with each method. Factors with the potential to cause measurement errors are minimized by implementing quality control (QC) and assurance (QA) programs into the applicable components of field-testing. QA/QC components were included in this test program. Table 5-2 summarizes the primary USEPA Method 30B quality assurance and quality control activities completed. Laboratory mercury analyzer calibration data and information on the associated mercury standards are included in Appendix C. Refer to Appendix E for supporting documentation.

Table 5-1
Summary of USEPA Method 30B QA/QC Procedures

QA/QC Test or Specification	Acceptance Criteria	Frequency	Consequences if not met
Gas flow meter calibration (At 3 settings or points)	Calibration factor (Yi) at each flow rate must be within ± 2% of the avg. value (y).	Prior to initial use and when post-test check is not within ± 5% of Y.	Recalibrate at 3 points until acceptance criteria are met.
Gas flow meter post-test calibration check	Calibration factor (Yi) at each flow rate must be within ± 5% of the Y value form most recent 3-pt. calibration.	After each field test. For mass flow meters must be done onsite, using stack gas.	Recalibrate gas flow meter at 3 pts. to determine a new value for Y. For mass flow meters, must be done onsite. Apply the new Y value to the field test data.
Temperature sensor calibration	Absolute temperature measures by the sensor within ± 1.5% of the reference sensor.	Prior to initial use and before each test thereafter.	Recalibrate: sensor may not be used until specification is met.
Barometer calibration	Absolute pressure measured by the instrument within ± 10 mmHg of reading with a mercury barometer.	Prior to initial use and before each test thereafter.	Recalibrate: instrument may not be used until specification is met.
Pre-test leak check	≤ 4% of target sampling rate	Prior to sampling	Sampling shall not commence until the leak check is passed.
Post-test leak check	Following daily calibration, 4% of average sampling rate	After sampling	Sample invalidated.
Multipoint analyzer calibration	Each analyzer reading within ±10% of true value and $r^2 \geq 0.99$	On the day of analysis, before analyzing any samples	Recalibrate until successful.
Analysis of independent calibration standard	Within ±10% of true value	Following daily calibration, prior to analyzing field samples	Recalibrate and repeat independent standard analysis until successful.
Analysis of continuing calibration verification standard (CCVS)	Within ±10% of true value	Following daily calibration, after analyzing ≤10 field samples, and at end of each set of analyses	Recalibrate and repeat independent standard analysis, reanalyze samples until successful, if possible; for destructive techniques, samples invalidated
Test run total sample volume	Within ± 20% of the total volume sampled during the field recovery test.	Each individual sample	Sample invalidated.
Sorbent trap section 2 breakthrough	≤ 10% of section 1 Hg mass for Hg concentrations > 1 µg/dscm; ≤ 20% of section 1 Hg mass for Hg concentrations ≤ 1 µg/dscm	Every sample	Sample invalidated.

Table 5-1
Summary of USEPA Method 30B QA/QC Procedures

QA/QC Test or Specification	Acceptance Criteria	Frequency	Consequences if not met
Paired sorbent trap agreement	≤ 10% Relative Deviation mass for Hg concentrations > 1 µg/dscm; ≤ 20% or ≤ 0.2 µg/dscm absolute difference for Hg concentrations ≤ 1 µg/dscm.	Every run	Run invalidated.
Field recovery	Average recovery between 85% and 115% for Hg.	Average from a minimum three spiked sorbent traps.	Field sample runs not validated without successful field recovery test.

5.8 Calibration Sheets

Calibration sheets and equipment quality control and assurance data are presented in Appendix E.

5.9 Sample Calculations

Sample calculations and formulas used to compute emissions data are presented in Appendix A.

5.10 Field Data Sheets

Field data sheets are presented in Appendix B.

5.11 Laboratory Quality Assurance / Quality Control Procedures

The method specific quality assurance and quality control procedures in each method employed during this test program were followed, without deviation. Refer to Appendix C for the laboratory data sheets.

5.11.1 QA/QC Blanks

The analysis of QA/QC blanks is not required for USEPA Method 30B. The analysis of blanks may be useful to verify the absence of, or an acceptable level of, Hg contamination in the sorbent media. Elevated blank levels can be concerning when quantifying low Hg levels and their potential contribution to meeting the sorbent trap section 2 breakthrough requirements; however, correcting sorbent trap results for blank levels is prohibited.

Review of sorbent tube section 2 data indicate 0 to 5 nanograms of mercury were detected resulting in breakthrough levels <0.2%. The data suggests mercury was not present within the sorbent media at quantities that would affect the results and conclusions of this test program. Laboratory data are contained in Appendix C.

Appendix Table

Table 1 - TES Filer City Unit 1 Mercury Emission Results - 2018 Hg LEE Demonstration

Run Start Date	Test ID	Date Analyzed	Trap ID	Side	Trap Analysis Results: Section A	Section B	Total Mass (A+B)	Breakthrough	Spike Added	Spike Recovery	Actual Time Sampled	Volume Sampled	Hg Concentration	Side A and B, RPD	Moisture by volume	Hg Concentration	CO_2 Concentration	Fuel Factor	Hg Emission Rate	
					(ng)	(ng)	(ng)	(%)	(ng)	(%)		(dscm)	(ug/dscm)	(%)	(%)	(ug/scm, wet)	(%, wet)	(Fc)	(lb/Tbtu)	(lb/yr)
10/4/2018	Unit 1_Run 1	10/23/2018	OL498803	A	3604.0	2.5	**3606.5**	0.07	1500	85.4	6d 23h 49m	4.762009	0.44236		16.0	0.37158			0.38926	1.30942
10/4/2018	Unit 1_Run 1	10/23/2018	OL508802	B	2309.0	0.0	**2309.0**	0.00			6d 23h 49m	4.729057	0.48826	4.9	15.4	0.41307			0.43273	1.45563
			Run 1 Average										**0.46531**		**15.7**	**0.39232**	**10.0**	**1678.9**	**0.41100**	**1.38253**
10/11/2018	Unit 1_Run 2	10/23/2018	OL498833	A	2848.0	4.6	**2852.6**	0.16	1500	96.1	7d 22h 33m	5.348393	0.25290		15.3	0.21420			0.22745	0.76511
10/11/2018	Unit 1_Run 2	10/23/2018	OL508809	B	1389.0	0.6	**1389.6**	0.04			7d 22h 33m	5.267520	0.26381	2.1	14.7	0.22503			0.23894	0.80376
			Run 2 Average										**0.25835**		**15.0**	**0.21962**	**9.9**	**1683.9**	**0.23320**	**0.78444**
10/29/2018	Unit 1_Run 3	11/9/2018	OL498928	A	4810.0	1.9	**4811.9**	0.04	1500	98.8	7d 0h 45 m	4.761926	0.69550		15.2	0.58978			0.62323	2.09643
10/29/2018	Unit 1_Run 3	11/9/2018	OL508829	B	3244.0	0.0	**3244.0**	0.00			7d 0h 45 m	4.638777	0.69932	0.3	14.6	0.59722			0.63109	2.12288
			Run 3 Average										**0.69741**		**14.9**	**0.59350**	**10.0**	**1697.1**	**0.62716**	**2.10966**
11/5/2018	Unit 1_Run 4	11/13/2018	OL498838	A	1935.0	0.9	**1935.9**	0.05	1500	101.7	6d 23h 36m	4.700744	0.09273		15.0	0.07882			0.08319	0.27985
11/5/2018	Unit 1_Run 4	11/13/2018	OL508835	B	396.6	1.3	**397.9**	0.33			6d 23h 36m	4.561199	0.08724	3.1	14.3	0.07476			0.07891	0.26543
			Run 4 Average										**0.08998**		**14.7**	**0.07679**	**10.2**	**1717.0**	**0.08105**	**0.27264**
	Unit 1 LEE Demonstration Average							**Field Recovery Test %**		**95.5**			**0.37776**		**15.1**	**0.32056**	**10.0**	**1694.2**	**0.33810**	**1.13732**

NOTES:

1) Run times listed are synchronized to CEMS time.
2) Break Through Criteria for Compliance Testing: ≤ 10% of Section 1 for Hg concentrations > 1.0 µg/dscm; ≤ 20% of Section 1 for Hg concentrations ≤ 1.0 µg/dscm; ≤ 50% of Section 1 Hg mass if concentration is ≤ 30% of the Hg equivalent to the applicable emission standard.
3) Field Recovery Test Criteria: Average recovery based upon three runs between 85% and 115%.
4) Paired Sorbent Trap Agreement Criteria: ≤ 10% Relative Deviation (RD) mass for Hg conc. > 1.0 µg/dscm; ≤ 20% RD or ≤ 0.2 µg/dscm absolute difference for Hg conc. ≤ 1.0 µg/dscm.

Table 2 - TES Filer City Unit 2 Mercury Emission Results - 2018 Hg LEE Demonstration

Run Start Date	Test ID	Date Analyzed	Trap ID	Side	Trap Analysis Results: Section A (ng)	Section B (ng)	Total Mass (A+B) (ng)	Breakthrough (%)	Spike Added (ng)	Spike Recovery (%)	Actual Time Sampled	Volume Sampled (dscm)	Hg Concentration (ug/dscm)	Side A and B, RPD (%)	Moisture by volume (%)	Hg Concentration (ug/scm, wet)	CO_2 Concentration (%, wet)	Fuel Factor (Fc)	Hg Emission Rate (lb/Tbtu)	Hg Emission Rate (lb/yr)
10/4/2018	Unit 2_Run 1	10/23/2018	OL498826	A	3314.0	1.5	**3315.5**	0.05	1500	86.4	7d 0h 12m	4.688313	0.38724		15.1	0.32877			0.36421	1.22515
10/4/2018	Unit 2_Run 1	10/23/2018	OL508862	B	2078.0	0.9	**2078.9**	0.04			7d 0h 12m	4.825299	0.43083	5.3	14.9	0.36664			0.40617	1.36629
			Run 1 Average										**0.40904**		**15.0**	**0.34770**	**9.5**	**1680.6**	**0.38519**	**1.29572**
10/11/2018	Unit 2_Run 2	10/23/2018	OL498779	A	2434.0	0.0	**2434.0**	0.00	1500	95.2	7d 22h 16m	5.194018	0.17982		14.5	0.15375			0.17120	0.57588
10/11/2018	Unit 2_Run 2	10/23/2018	OL508856	B	1037.0	0.0	**1037.0**	0.00			7d 22h 16m	5.351671	0.19377	3.7	14.3	0.16606			0.18491	0.62200
			Run 2 Average										**0.18680**		**14.4**	**0.15990**	**9.4**	**1675.5**	**0.17805**	**0.59894**
10/29/2018	Unit 2_Run 3	11/9/2018	OL498828	A	3204.0	1.0	**3205.0**	0.03	1500	93.9	7d 1h 12m	4.625716	0.36859		14.3	0.31588			0.35535	1.19534
10/29/2018	Unit 2_Run 3	11/9/2018	OL508872	B	1850.0	0.0	**1850.0**	0.00			7d 1h 12m	4.763961	0.38833	2.6	14.2	0.33319			0.37482	1.26083
			Run 3 Average										**0.37846**		**14.3**	**0.32454**	**9.4**	**1697.7**	**0.36508**	**1.22809**
11/5/2018	Unit 2_Run 4	11/13/2018	OL498817	A	2484.0	0.6	**2484.6**	0.02	1500	110.1	6d 23h 11m	4.528893	0.21740		14.3	0.18632			0.20578	0.69221
11/5/2018	Unit 2_Run 4	11/13/2018	OL508857	B	857.4	0.6	**858.0**	0.07			6d 23h 11m	4.667738	0.18381	8.4	14.1	0.15790			0.17439	0.58663
			Run 4 Average										**0.20061**		**14.2**	**0.17211**	**9.6**	**1692.4**	**0.19009**	**0.63942**
			Unit 2 LEE Demonstration Average					Field Recovery Test %		**96.4**			**0.29373**		**14.5**	**0.25106**	**9.5**	**1686.6**	**0.27960**	**0.94054**

NOTES:

1) Run times listed are synchronized to CEMS time.
2) Break Through Criteria for Compliance Testing: ≤ 10% of Section 1 for Hg concentrations > 1.0 µg/dscm; ≤ 20% of Section 1 for Hg concentrations ≤ 1.0 µg/dscm; ≤ 50% of Section 1 Hg mass if concentration is ≤ 30% of the Hg equivalent to the applicable emission standard.
3) Field Recovery Test Criteria: Average recovery based upon three runs between 85% and 115%.
4) Paired Sorbent Trap Agreement Criteria: ≤ 10% Relative Deviation (RD) mass for Hg conc. > 1.0 µg/dscm; ≤ 20% RD or ≤ 0.2 µg/dscm absolute difference for Hg conc. ≤ 1.0 µg/dscm.

Appendix A
Sample Calculations