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 the months of October and November 2020 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 Department of Environment, Great Lakes, and Energy (EGLE) on September 1, 2017 and subsequently approved by Mr. Jeremy Howe, MDEQ Environmental Quality Analyst, in his standing approval letter dated September 29, 2017. No deviations from the protocol occurred. The results of the testing are presented below:

- Unit 1: 0.48 lb/TBtu and 1.6 lb/yr mass emissions based upon the average of thirty boiler operating days.
- Unit 2: 1.04 lb/TBtu and 3.5 lb/yr mass emissions based upon the average of thirty boiler operating days.

The results indicate EUBOILER01 and EUBOILER02 comply with the MATS 1.2 lb Hg/TBtu emission limit and have potential emissions less than 29.0 lbs/yr and therefore 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 ongoing 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. Appendix F presents additional field data from voided runs.

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 Environment, Great Lakes, and Energy (EGLE) *Format for Submittal of Source Emission Test Plans and Reports* published in November of 2019. 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 continuous Hg testing at the exhaust stacks of EUBOILER01 and EUBOILER2 operating at the TES Filer City Station in Filer City, Michigan beginning October 7 and completing November 19, 2020 for Unit 1 and November 21, 2020 for Unit 2.

A test protocol was submitted to the EGLE 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 if no modifications from the original protocol are needed. On September 9, 2020 TES Filer City notified EGLE of its intent to begin the Hg testing the week of October 7, 2020.

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 UUUUU – 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 Environment, Great Lakes, and Energy 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 Environment, Great Lakes, and Energy 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 Environment, Great Lakes, and Energy Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601
Responsible Official	Mr. Todd Guenthardt Plant Manager 231-723-6573 x 102 todd.guenthardt@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

Table 1-2
Contact Information

Program Role	Contact	Address
Test Facility	Mr. Austin Swiatlowski IC&E Technician 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
Test Team Representative	Mr. Dillon King, QSTI Sr. Engineering Technical Analyst 989-895-5585 dillon.king@cmsenergy.com	Consumers Energy Company D.E. Karn Generating Complex 2742 N. Weadock Hwy, ESD Trailer #4 Essexville, Michigan 48732

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, wood, and/or natural gas during testing. The average steam generation rates during the 30 boiler operating day tests were approximately 296,200 lbs/hr for Unit 1 and 295,400 lbs/hr for Unit 2. These steam generation rates are approximately 95.3 and 95.0% of the full load ratings of 311,000 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 Daylight Savings Time (EDT) or Eastern Standard Time (EST), as applicable (note that Daylight Savings ended 11/01/2020). Note the time convention for the reference method (RM) testing was EDT for Runs 1 through 4 for both Units. The remaining test runs were in EST as the sampling equipment synced time with the test computers when connected. The data time convention was considered and adjusted as appropriate when merging data sets with differing time stamps (note that the continuous emissions monitoring system (CEMS) always stays on EST).

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 mass-based 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	2	1.16853	1.04	-	3.5	-
	3	0.47412	0.42	-	1.4	-
	5	0.22235	0.19	-	0.6	-
	6	0.30889	0.26	-	0.9	-
	Average†	**0.55259**	**0.48**	**0.12**	**1.6**	**29.0**
Unit 2	1	1.27649	1.19	-	4.0	-
	2	1.36346	1.28	-	4.3	-
	3	1.02509	0.96	-	3.2	-
	6	0.73408	0.70	-	2.3	-
	7	1.01123	0.94	-	3.2	-
	Average†	**1.11835**	**1.05**	**0.12**	**3.5**	**29.0**

†: Time weighted averages

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 data sheets are presented in Appendices A, B, and C. Boiler operating data and supporting information are provided in Appendices D and E. Appendix F presents additional field data from voided runs.

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

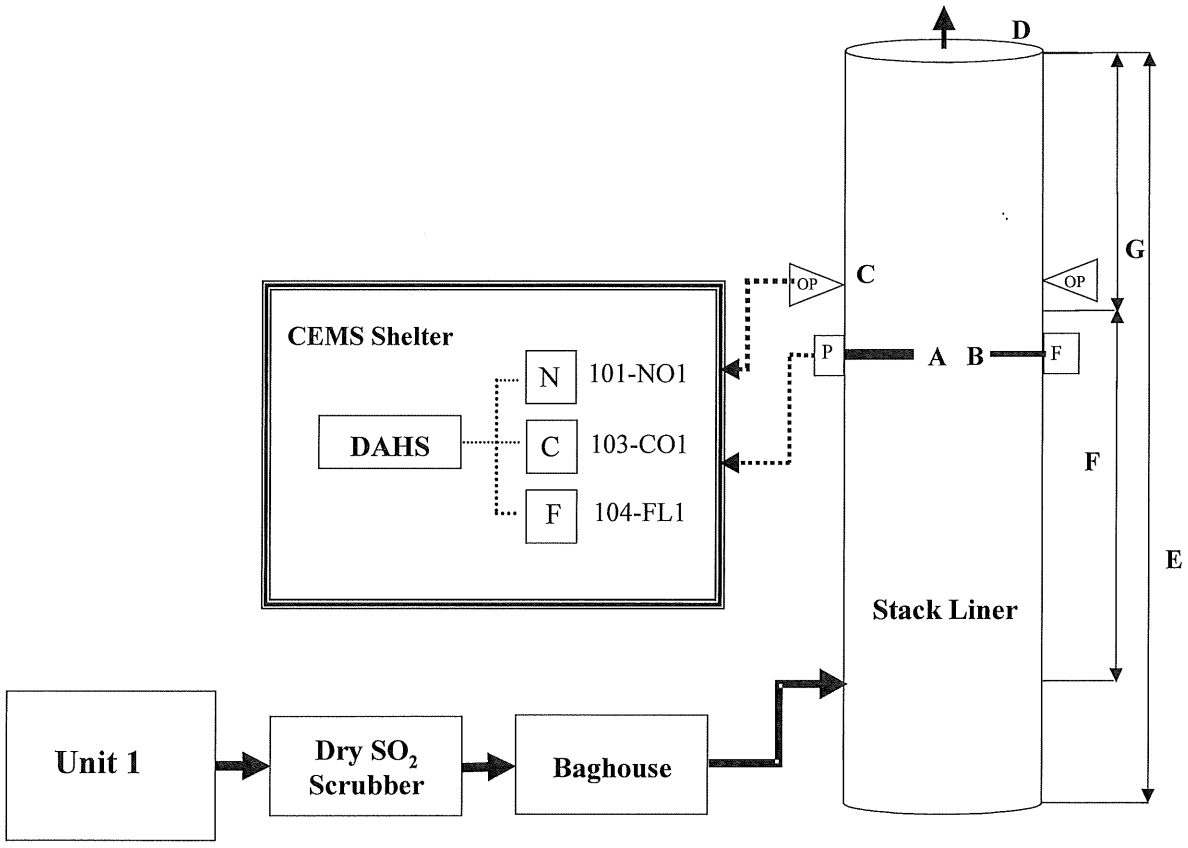
TES Filer City Station operates as a cogeneration electric power plant with a rated output of approximately 60-megawatts net (MW_n) and is also capable of generating 50,000 pounds of process steam per hour. The electricity and process steam are sold under contract to public and/or private companies. 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 311,000 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, wood, TDF 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. Initially, natural gas was utilized as a clean startup fuel, as well as at other times for flame stabilization and other purposes. Since mid-2018, natural gas has been a consistent part of the fuel mixture for each boiler.

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 311,000 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 CO_2/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)
- SO_2 reduction (%)
- 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 as needed to match the facility time stamp, which uses Eastern Standard Time. Starting with Run 5, the reference method DAS for both Unit 1 and Unit 2 used EST and no adjustment was necessary.

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 of Flue Gas Emissions during Low Emitting EGU (LEE) Testing for Mercury
Emission rates	19	Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxides Emission Rates

Table 4-1
Test Methods

Parameter	Method	USEPA Title
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	10/7/2020	10/13/2020	143.1	30B Alt-091	Void run
	2	Hg, moisture	10/13/2020	10/21/2010	189.9	30B Alt-091	Valid run
	3	Hg, moisture	10/21/2020	10/28/2020	163.8	30B Alt-091	Valid run
	4	Hg, moisture	10/28/2020	11/4/2020	166.8	30B Alt-091	Void run
	5	Hg, moisture	11/4/2020	11/12/2020	193.5	30B Alt-091	Valid run
	6	Hg, moisture	11/12/2020	11/19/2020	164.9	30B Alt-091	Valid run
Unit 2	1	Hg, moisture	10/7/2020	10/13/2020	142.8	30B Alt-091	Valid run
	2	Hg, moisture	10/14/2020	10/21/2020	166.0	30B Alt-091	Valid run
	3	Hg, moisture	10/21/2020	10/28/2020	163.4	30B Alt-091	Valid run
	4	Hg, moisture	10/28/2020	11/4/2020	167.4	30B Alt-091	Void run
	5	Hg, moisture	11/4/2020	11/10/2020	140.9	30B Alt-091	Void run
	6	Hg, moisture	11/10/2020	11/14/2020	98.0	30B Alt-091	Valid run
	7	Hg, moisture	11/17/2020	11/21/2020	96.9	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

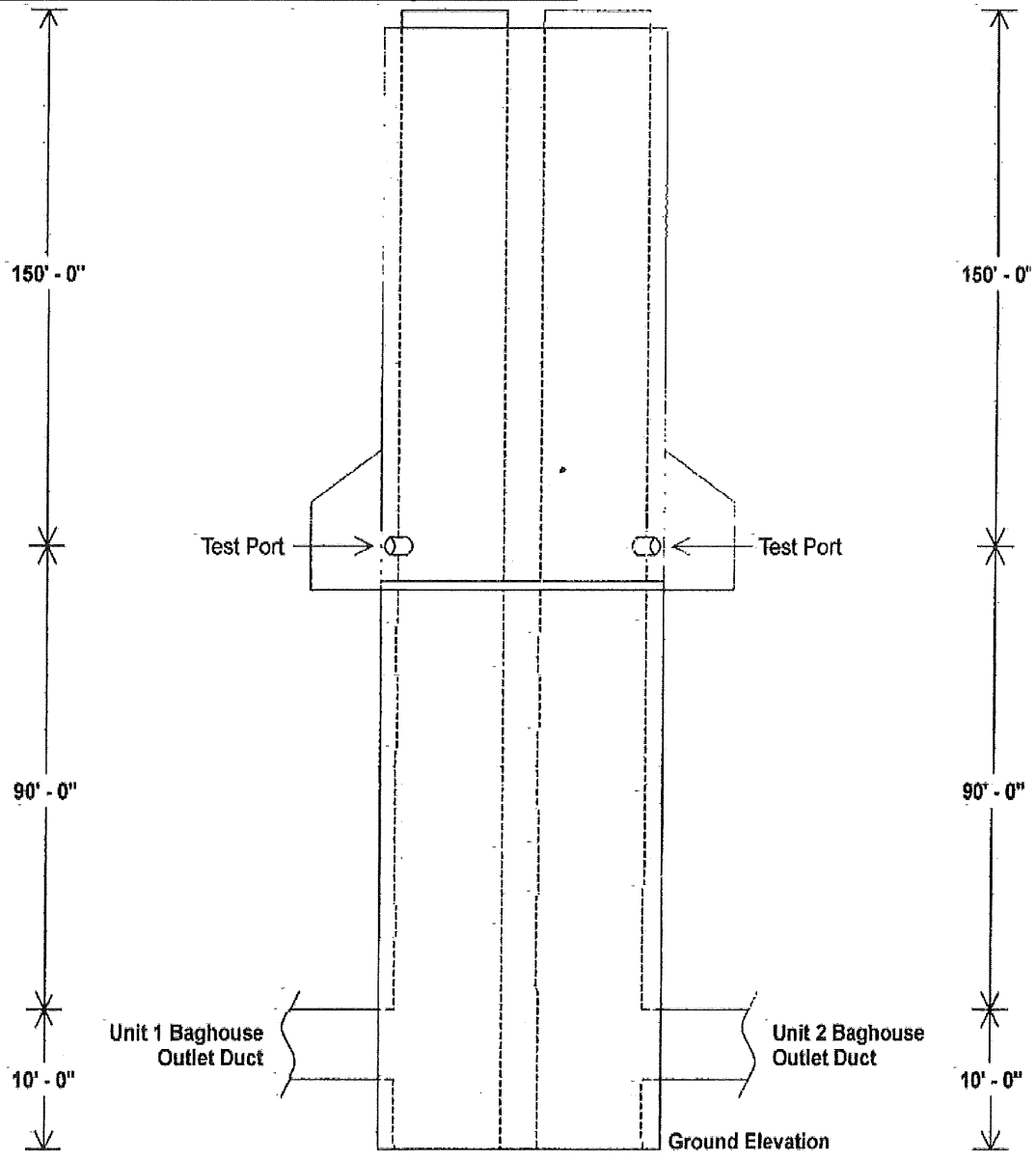
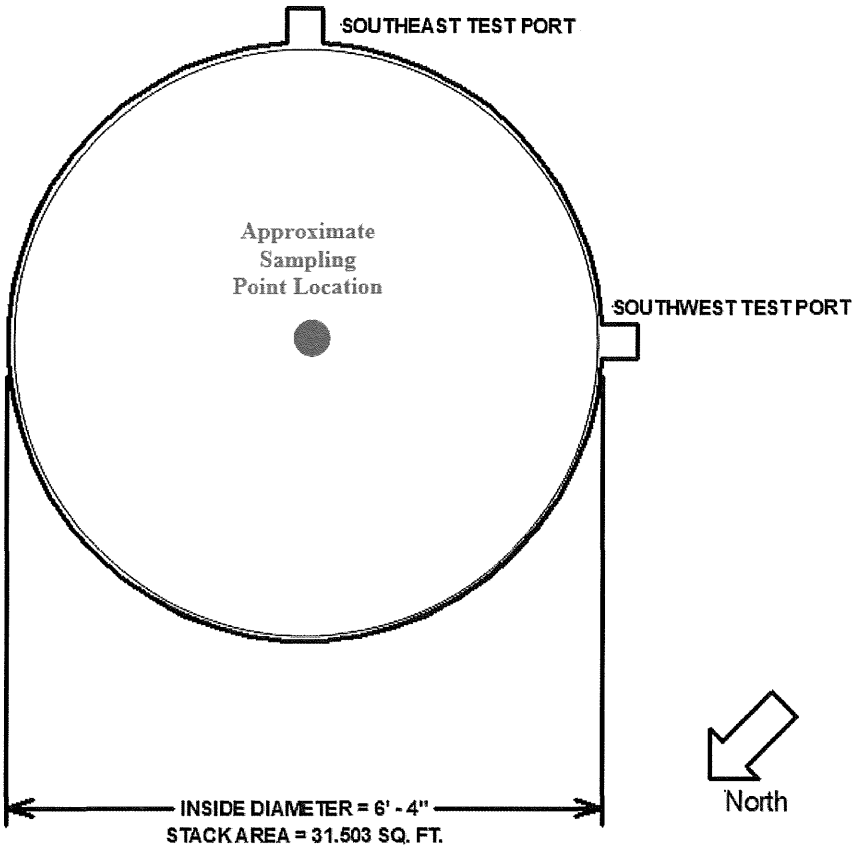


Figure 4-2. Unit 1 Stack Cross-Section and Sampling Point Detail



4.1.2 Moisture Content (USEPA Approved Alternative 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 Method 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. For the valid runs, the stack gas temperature run averages ranged from 180.4 degrees Fahrenheit (°F) to 205.5 °F during the test period (Unit 1: 180.4, 190.3, 193.2, 191.9; Unit 2: 190.8, 189.1, 189.4, 189.7,205.5). The water vapor content at these temperatures equate to approximately 50% 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 14.7% moisture by volume, Unit 2 averaged 15.7%). Therefore, the moisture content measured using the applicable calculations in Section 12 of USEPA Method 4 and the mass of water collected in the Method 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 systems 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 CO_2/mMBtu)
$\%CO_{2d}$	=	Concentration of carbon dioxide on a dry basis (%, dry)

Note that consistent with §63.10007(e)(2)(v), the Hg concentrations as µg/scm were first multiplied by 6.24×10^{-11} in order to convert the concentrations into the required lb/scf units. The Hg emission rates in units of lb/TBtu were then determined by multiplying the lb/mmBtu emission rates by 10^6.

4.1.4 Mercury (USEPA Method 30B)

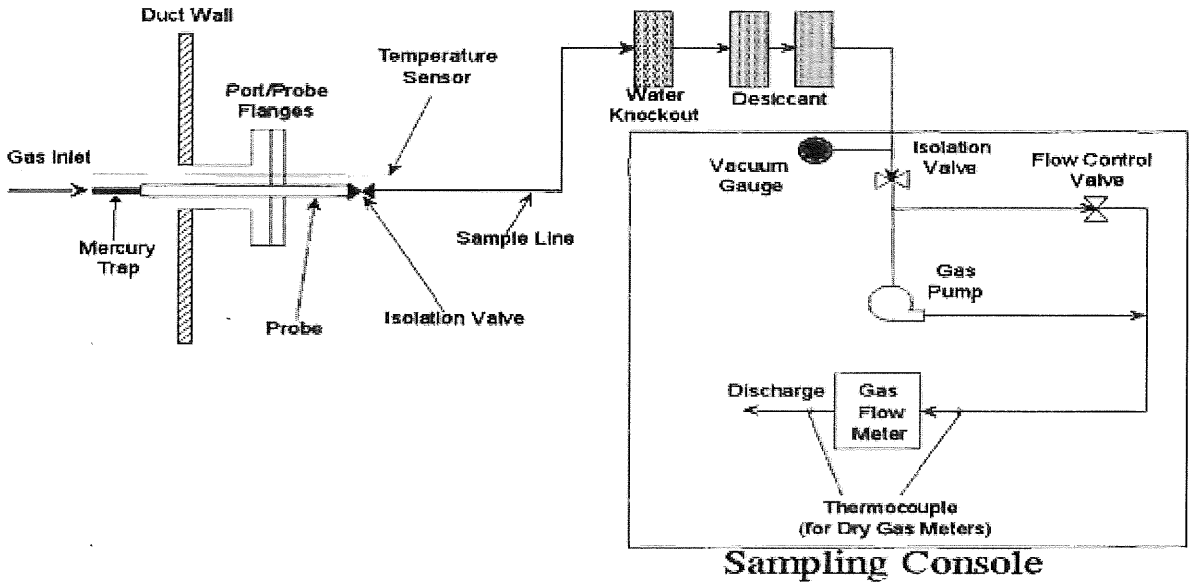
Mercury was measured utilizing USEPA Reference Method 30B, *Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps.* Volumes of flue gas were continuously extracted from the stack through paired, in-stack, sorbent media traps at a constant flow 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, with a total of 4-5 runs of nominally equal length. 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 transported to the RCTS field office in Essexville, MI, for analysis. Due to logistics, the Run 3 sorbent traps were analyzed onsite by Ohio Lumex personnel. 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 spectrometer 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 (85%-115%) and are presented in the Appendix Tables. For Unit 1, an average field recovery of 102.1% was calculated based on Runs 2, 3, 5 and 6, whereas an average recovery of 91.6% was calculated for Unit 2 based on Runs 1, 2, 6 and 7.

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



5.0 TEST RESULTS AND DISCUSSION

This test program was conducted in October and November 2020 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 as 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 ongoing LEE status.

5.3 Variations from Sampling or Operating Conditions

Due to variation in test run lengths, the average results for each Unit are time-weighted based on the duration of the test run versus the total duration of the 30-day LEE test. On November 19, 2020, RCTS realized if Run 7 on Unit 2 was stopped, the sample volumes would not meet the requirement of being within ±20% of the field recovery test runs. It was approved by Jeremy Howe of EGLE to continue the test run to meet the sample volume requirement and time-weigh the total test average as sampling would occur over 32 days in for Unit 2 Run 7 to meet the sample volume requirement (±20% of the field recovery test runs).

On October 13, 2020 it was discovered that the mass flow monitor was faulty for the Unit 1 Hg sampling console (console 3310). This caused the Run 1 sample volumes to widely vary between the A and B trains as the mass flow monitor signals a valve to allow the correct volume to pass through. This malfunction caused the valve to remain fully open as the system attempts to reach the correct flowrate. Though the spike recovery, and deviation between A and B Hg concentrations were within method requirements, the run didn't meet the method requirement for sample volumes falling within 20% of the sample volumes measured during the field recovery test. Another reason the run was invalidated is there was uncertainty regarding the moisture content measured as there was liquid water discovered in the silica trap on the B train. RCTS implemented a manual flow control valve to set a constant sampling rate and monitored it for the remaining runs.

The first attempt at Unit 2 Run 2 was invalidated due to Unit 2 going into an outage October 13, 2020 following the start of the run. Run 2 was then started on October 14, 2020 after swapping out the sorbent traps and obtaining pre-weights for the water knockouts and silica gel traps.

Unit 1 Run 2 had variation between the A and B train sample volumes, however, it was approved to used as valid by EGLE representative Jeremy Howe in an email dated 11/10/2020 despite the B train not meeting the sample volume within 20% of the field recovery test runs (~32% deviation from the average sample volume for valid runs on Unit 1, all runs with spiked traps). RCTS believes the data quality of this run was not affected by the difference in sample volumes from the A and B train. The other QA criteria indicates this run was an accurate measurement with a 97.9% spike recovery, relative deviation of 0.4% between A and B train Hg concentrations, and relative deviation of 1.4% between A and B moisture by volume measurements.

For both Units 1 and 2, Run 4 was invalidated due to not meeting the method requirement for sample volumes falling within 20% of the sample volumes measured during the field recovery test. The flow control valve was not set properly on Unit 1 and there was an issue with the Unit 2 sampling console dry gas meter (DGM). It appears that following Run 3, the DGM was not accurately measuring the sample gas. Another run was attempted with this console as RCTS had not received the rental sampler yet. This run showed the same issue and the console was replaced with a rental Hg sampling console (console 3228) on November 10, 2020 which was used for the remainder of the test runs for Unit 2.

The sorbent traps for Units 1 and 2, Run 3, were analyzed by Ohio Lumex due to RCTS staff being unavailable. The analysis package including results, raw data, spectrometer calibration and MDL determination are included in Appendices C and E.

Analyses of several sorbent trap section 2 carbon beds during this test program resulted in Hg masses that exceeded the analyzer's minimum detection limit (MDL) of 1.57 ng but were less than the lowest point of the daily calibration curve (50 ng). In these instances, an additional low-level Hg standard (5 ng) was analyzed to determine a response factor in accordance with USEPA Method 30B section 11.3. The resulting area counts were divided by the Hg mass of the standard to determine the counts per nanogram response factor; refer to Table 5-1 for specific response factors. These response factors were then applied to the measured area counts of the affected section 2 carbon beds in order to estimate Hg mass and fully validate the emissions data. Note that the Appendix tables reflect the adjusted section 2 masses, as applicable, while the section 2 sorbent trap analysis results in Appendix C do not reflect these adjustments.

Table 5-1
Response Factors (MDL < Hg Catch < Lowest Point on the Calibration Curve)

Trap Analysis Date	Response Factor (area counts/ng)	Basis for the Response Factor
10/13/2020	76.0	5 ng sample resulting in 380 area counts
10/21/2020	47.0	5 ng sample resulting in 235 area counts
10/28/2020	96.4	5 ng sample resulting in 482 area counts
11/12/2020	67.4	5 ng sample resulting in 337 area counts
11/17/2020	95.4	5 ng sample resulting in 477 area counts
11/21/2020	106.4	5 ng sample resulting in 532 area counts

In cases where the section 2 Hg masses were less than the detection limit, no adjustments were made. This approach is consistent with past guidance from EPA's Emissions Measurement Center (EMC), confirming that the MDL should not be used in lieu of the measured mass in cases where the measured section 2 mass is below the MDL.

Following the completion of the 30-day sampling period, both RCTS sampling consoles were challenged with a post-test console audit to verify the barometric pressure sensors, thermocouples, and dry gas meters met the method quality assurance requirements. All components of the sample console serial number 3310 (used for sampling TES Filer City Unit 1) met the acceptable QA/QC tolerances. However, the results of the post-test audit on sample console serial number 3311 (used for sampling Unit 2 until November 10, 2020) indicated that there was an issue with the Dry Gas Meter, or DGM. This console was previously tested on September 19, 2020 and the DGM accuracy was observed to be within 1.4% of the reference flowmeter. The other components of sample console 3311 passed the QA/QC requirements. RCTS believes this issue arose during Run 4 as the console was sampling as-expected prior to that run. In this circumstance, the post-test meter console 3311 audit regarding the DGM is not believed to be reflective of DGM performance during Runs 1-3, and failure of the audit should not inherently invalidate those runs.

The results of the post-test console audits, as well as the pre-test console audits are presented in Appendix E.

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.

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, it is believed that 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 2021.

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 Appendices C and E. Refer to Appendix E for additional supporting documentation.

Table 5-2
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.

Table 5-2
Summary of USEPA Method 30B QA/QC Procedures

QA/QC Test or Specification	Acceptance Criteria	Frequency	Consequences if not 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 5-2
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 <0.4%. 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.