

## 1.0 INTRODUCTION

### 1.1 SUMMARY OF TEST PROGRAM

General Motors Global Technical Center (State Registration No.: B4049) contracted Montrose Air Quality Services, LLC (Montrose) to perform the Relative Accuracy Audit (RAA) for the Predictive Emission Monitoring Systems (PEMS) associated with the FG-BOILERSBLDG107 (EU-Boiler1-107, EU-Boiler2-107, and EU-Boiler3-107) at the General Motors Global Technical Center facility located in Warren, Michigan. Testing was performed on October 26, 2021, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Title V Permit No. MI-ROP-B4049-2019 by evaluating the quality of the emissions data produced by General Motors Global Technical Center's PEMS in accordance with 40 CFR Part 60, Appendices B and F.

The specific objectives were to:

- Verify the relative accuracy (RA) of the PEMS for the concentrations of nitrogen oxides (NO<sub>x</sub>) (ppm) and oxygen (O<sub>2</sub>) (%-Dry) in accordance with Performance Specification 16 (PS-16)
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

**TABLE 1-1  
SUMMARY OF TEST PROGRAM**

Test Date	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
10/26/2021	EU-BOILER1- 107	O <sub>2</sub> , NO <sub>x</sub>	EPA 3A, EPA 7E	3	30
10/26/2021	EU- BOILER2- 107	O <sub>2</sub> , NO <sub>x</sub>	EPA 3A, EPA 7E	3	30
10/26/2021	EU- BOILER3- 107	O <sub>2</sub> , NO <sub>x</sub>	EPA 3A, EPA 7E	3	30

To simplify this report, a list of Units and Abbreviations is included in Appendix C.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The RAA test results are summarized in Tables 1-2 through 1-4. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

**TABLE 1-2  
 SUMMARY OF PART 60 RAA TEST RESULTS -  
 EU-BOILER1-107  
 OCTOBER 26, 2021**

Parameter/Units	Regulatory Reference	RAA	Allowable
<b>Part 60</b>			
Oxygen (O <sub>2</sub> ), %-dry % as O <sub>2</sub>	PS-16	-0.12	± 1
NO <sub>x</sub> , ppmvd %	PS-16	7.97	± 20

**TABLE 1-3  
 SUMMARY OF PART 60 RAA TEST RESULTS -  
 EU-BOILER2-107  
 OCTOBER 26, 2021**

Parameter/Units	Regulatory Reference	RAA	Allowable
<b>Part 60</b>			
Oxygen (O <sub>2</sub> ), %-dry % as O <sub>2</sub>	PS-16	-0.27	± 1
NO <sub>x</sub> , ppmvd %	PS-16	-8.88	± 20

**TABLE 1-4  
 SUMMARY OF PART 60 RAA TEST RESULTS -  
 EU-BOILER3-107  
 OCTOBER 26, 2021**

Parameter/Units	Regulatory Reference	RAA	Allowable
<b>Part 60</b>			
Oxygen (O <sub>2</sub> ), %-dry % as O <sub>2</sub>	PS-16	-0.30	± 1
NO <sub>x</sub> , ppmvd %	PS-16	-6.74	± 20

## 1.2 KEY PERSONNEL

A list of project participants is included below:

### Facility Information

Source Location: General Motors LLC - Technical Center  
31295 Charles Kettering Road  
Warren, MI 48092-2042

Project Contact: Marianne Secrest  
Role: Environmental Engineer  
Company: General Motors LLC  
Telephone: 248-535-5032  
Email: marianne.secrest@gm.com

### Testing Company Information

Testing Firm: Montrose Air Quality Services, LLC  
Contact: Todd Wessel  
Title: Client Project Manager  
Telephone: 248-548-8070  
Email: twessel@montrose-env.com

**TABLE1-5  
TEST PERSONNEL AND OBSERVERS**

<b>Name</b>	<b>Affiliation</b>	<b>Role/Responsibility</b>
Todd Wessel	Montrose	Client Project Manager, QI
Shane Rabideau	Montrose	Field Technician
Marianne Secrest	General Motors LLC	Coordinator

## 2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

### 2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

General Motors LLC - Technical Center operates three natural gas fired boilers. EU- BOILER1-107, EU- BOILER2-107, and EU- BOILER3-107 each have an input capacity of 108 MMBtu/hr while firing natural gas (NG). Steam from each boiler utilized for process equipment at the facility. Low-NOx combustors and flue gas recirculation to minimize the emissions of nitrogen oxides from the boilers.

### 2.2 PEMS AND RM DESCRIPTION

The Facility PEMS analyzers are presented in Table 2-1 and the RM CEMS analyzers are presented in Table 2-2.

**TABLE 2-1  
 PEMS ANALYZER INFORMATION**

<b>Analyzer Type</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>
EU- BOILER1-107 O <sub>2</sub>	CMC Solutions	SmartCEMS-60™ Analyzer	GMBL122041
EU- BOILER1-107 NO <sub>x</sub>	CMC Solutions	SmartCEMS-60™ Analyzer	GMBL122042
EU- BOILER2-107 O <sub>2</sub>	CMC Solutions	SmartCEMS-60™ Analyzer	GMBL222041
EU- BOILER2-107 NO <sub>x</sub>	CMC Solutions	SmartCEMS-60™ Analyzer	GMBL222042
EU- BOILER3-107 O <sub>2</sub>	CMC Solutions	SmartCEMS-60™ Analyzer	GMBL322041
EU- BOILER3-107 NO <sub>x</sub>	CMC Solutions	SmartCEMS-60™ Analyzer	GMBL322042

**TABLE 2-2  
 RM ANALYZER INFORMATION**

Analyzer Type	Manufacturer	Model No.	Serial No.	Span
O <sub>2</sub>	M&C	PMA100-L	0502189	0-19.69%
NO <sub>x</sub>	Teledyne	T200H	84	0-90.68 ppm

**2.3 FLUE GAS SAMPLING LOCATION(S)**

Information regarding the sampling locations is presented in Table 2-3.

**TABLE 2-3  
 SAMPLING LOCATIONS**

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EU- BOILER1-107 Exhaust Stack	40	≥80 / ≥2.0	≥20 / ≥0.5	Gaseous: 3
EU- BOILER2-107 Exhaust Stack	40	≥80 / ≥2.0	≥20 / ≥0.5	Gaseous: 3
EU- BOILER3-107 Exhaust Stack	40	≥80 / ≥2.0	≥20 / ≥0.5	Gaseous: 3

EPA Method 1 stack dimensions and traverse points for the boilers associated with FG-BOILERSBLDG107 are based on historical data. See General Motors LLC - Global Technical Center personnel for more information.

## 2.4 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while the boilers and low-NO<sub>x</sub> burners were operating at the conditions required by the permit. The boilers were tested when operating at normal (>50%) capacity.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The PEMS and process data that was provided is presented in Appendix B. Data collected includes the following parameters for each boiler:

- PEMS data associated with the 30-minute RAA runs
- NO<sub>x</sub>, lb/MMBtu
- Steam Load, klbs/hr

### **3.0 SAMPLING AND ANALYTICAL PROCEDURES**

#### **3.1 TEST METHODS**

The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

##### **3.1.1 EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)**

EPA Method 3A is an instrumental test method used to measure the concentration of O<sub>2</sub> and CO<sub>2</sub> in stack gas. Conditioned gas is sent to analyzers that measure the concentration of O<sub>2</sub> and CO<sub>2</sub>. The performance requirements of the method must be met to validate the data.

The typical sampling system is detailed in Figure 3-1.

##### **3.1.2 EPA Method 7E, Determination of Nitrogen Oxides Emissions from Stationary Source (Instrumental Analyzer Procedure)**

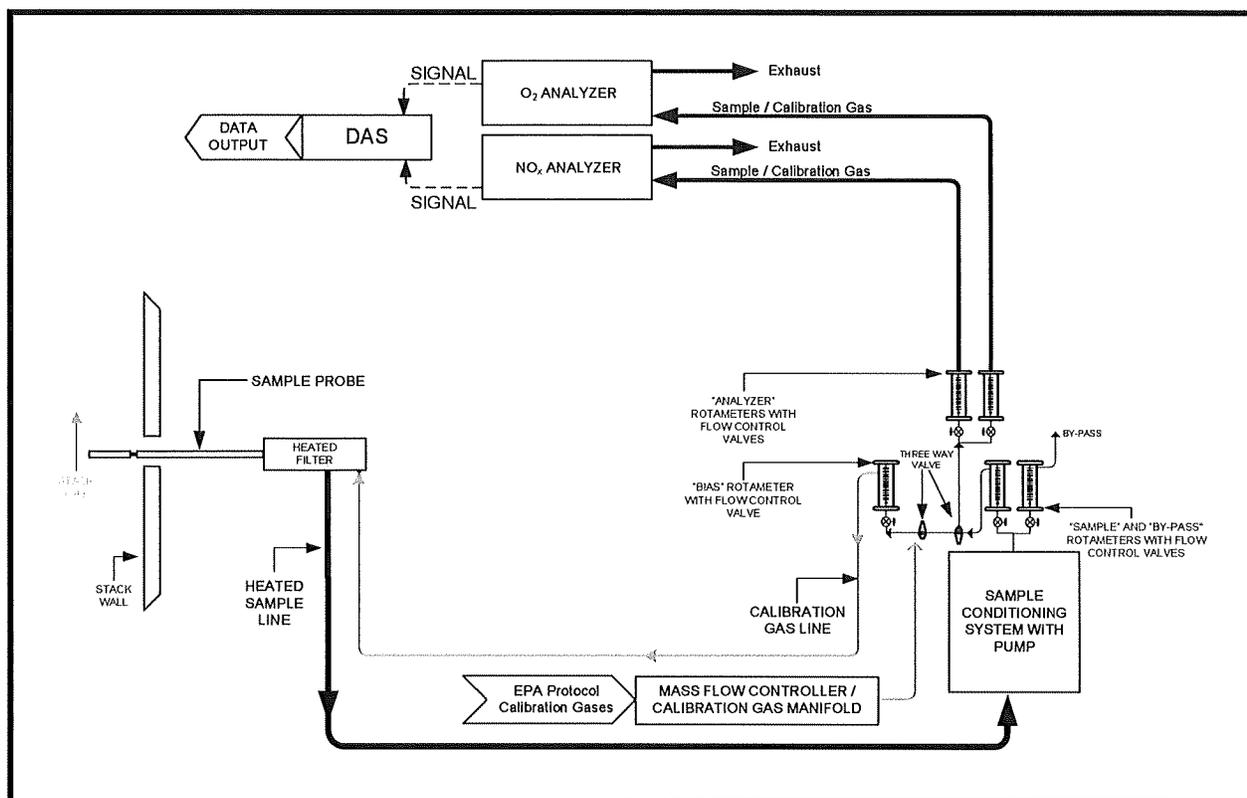
EPA Method 7E is an instrumental test method used to continuously measure emissions of NO<sub>x</sub> as NO<sub>2</sub>. Conditioned gas is sent to an analyzer to measure the concentration of NO<sub>x</sub>. For the purposes of this method, NO<sub>x</sub> is the sum of NO and NO<sub>2</sub>. The performance requirements of the method must be met to validate the data.

The typical sampling system is detailed in Figure 3-1.

##### **3.1.3 EPA Performance Specification 16, Specifications and Test Procedures for Predictive Emission Monitoring Systems in Stationary Sources**

EPA Performance Specification 16 is a specification used to evaluate the acceptability of Predictive Emission Monitoring Systems (PEMS) to show compliance with an emission limitation under 40 CFR 60, 61, or 63. These procedures are used to certify a PEMS after initial installation and periodically thereafter to ensure the system is operating properly and meets the requirements of all applicable regulations. Ongoing QA/QC tests include sensor evaluation, bias correction, quarterly Relative Accuracy Audits (RAA), and annual Relative Accuracy Test Audits (RAA).

**FIGURE 3-1**  
**EPA METHODS 3A (O<sub>2</sub>) AND 7E SAMPLING TRAIN**



### 3.2 PROCESS TEST METHODS

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

## **4.0 TEST DISCUSSION AND RESULTS**

### **4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS**

No field deviations or exceptions from the test plan or test methods occurred during this test program.

### **4.2 PRESENTATION OF RESULTS**

The RA results for EU-BOILER1-107 are compared to the regulatory requirements in Table 1-2 and the results of individual test runs performed at EU- BOILER1-107 are presented in Tables 4-1 and 4-2.

The RA results for EU- BOILER2-107 are compared to the regulatory requirements in Table 1-3 and the results of individual test runs performed at EU- BOILER2-107 are presented in Tables 4-3 and 4-4.

The RA results for EU- BOILER3-107 are compared to the regulatory requirements in Table 1-4 and the results of individual test runs performed at EU- BOILER3-107 are presented in Tables 4-5 and 4-6.

Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

Times displayed in Tables 4-1 through 4-6 are in Central Standard Time plus one hour.

**TABLE 4-1  
 NOx (ppmvd) PEMS RAA RESULTS -  
 EU-BOILER1-107**

Run #	Date	Time	RM	PEMS	Difference (d)
1	10/26/2021	8:52-9:22	21.921	23.790	1.869
2	10/26/2021	9:34-10:04	22.445	24.390	1.945
3	10/26/2021	10:19-10:49	22.734	24.270	1.536
Averages			22.367	24.150	1.7832

Unit load Normal  
 RA based on RM mean 7.97 %

**TABLE 4-2  
 O<sub>2</sub> (%) PEMS RAA RESULTS -  
 EU- BOILER1-107**

Run #	Date	Time	RM	PEMS	Difference (d)
1	10/26/2021	8:52-9:22	4.146	4.200	0.054
2	10/26/2021	9:34-10:04	4.118	3.800	-0.318
3	10/26/2021	10:19-10:49	4.105	4.000	-0.105
Averages			4.123	4.000	-0.123

Unit load Normal  
 RA based on mean difference -0.12 % as O<sub>2</sub>

**TABLE 4-3**  
**NOx (ppmvd) PEMS RAA RESULTS -**  
**EU- BOILER2-107**

Run #	Date	Time	RM	PEMS	Difference (d)
1	10/26/2021	11:16-11:46	23.268	21.430	-1.838
2	10/26/2021	11:58-12:28	23.645	21.430	-2.215
3	10/26/2021	12:41-13:11	23.639	21.430	-2.209
Averages			23.517	21.430	-2.087
Unit load			Normal		
RA based on RM mean			-8.88 %		

**TABLE 4-4**  
**O<sub>2</sub> (%) PEMS RAA RESULTS -**  
**EU- BOILER2-107**

Run #	Date	Time	RM	PEMS	Difference (d)
1	10/26/2021	11:16-11:46	4.041	3.800	-0.241
2	10/26/2021	11:58-12:28	4.067	3.800	-0.267
3	10/26/2021	12:41-13:11	4.088	3.800	-0.288
Averages			4.066	3.800	-0.266
Unit load			Normal		
RA based on mean difference			-0.27 % as O <sub>2</sub>		

**TABLE 4-5**  
**NOx (ppmvd) PEMS RAA RESULTS -**  
**EU- BOILER3-107**

Run #	Date	Time	RM	PEMS	Difference (d)
1	10/26/2021	14:15-14:45	36.205	34.060	-2.145
2	10/26/2021	14:57-15:27	36.516	34.060	-2.456
3	10/26/2021	15:40-16:10	36.850	34.060	-2.790
Averages			36.524	34.060	-2.464

Unit load Normal  
 RA based on RM mean -6.74 %

**TABLE 4-6**  
**O<sub>2</sub> (%) PEMS RAA RESULTS -**  
**EU- BOILER3-107**

Run #	Date	Time	RM	PEMS	Difference (d)
1	10/26/2021	14:15-14:45	4.403	4.100	-0.303
2	10/26/2021	14:57-15:27	4.407	4.100	-0.307
3	10/26/2021	15:40-16:10	4.396	4.100	-0.296
Averages			4.402	4.100	-0.302

Unit load Normal  
 RA based on mean difference -0.30 % as O<sub>2</sub>

## 5.0 INTERNAL QA/QC ACTIVITIES

Table 5-1 presents a summary of the gas cylinder information.

**TABLE 5-1  
 PART 60 GAS CYLINDER INFORMATION**

Gas Type	Gas Level	Gas Concentration	Cylinder ID	Expiration Date
O <sub>2</sub> , Balance N <sub>2</sub>	Mid	9.736%	CC185775	5/17/2029
	High	19.69%	SG9183487BAL	3/19/2028
NO <sub>x</sub> , Balance N <sub>2</sub>	Mid	49.80 ppmv	CC205959	5/20/2024
	High	90.68 ppmv	XC025152B	6/3/2029
NO <sub>2</sub> , Balance N <sub>2</sub>	--	51.92 ppmv	CC513944	1/4/2024

### 5.1 QA/QC AUDITS

EPA Method 3A and 7E calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

The NO<sub>2</sub> to NO converter efficiency check of the analyzer was conducted per the procedures in EPA Method 7E, Section 8.2.4. The conversion efficiency met the criteria.

### 5.2 QA/QC DISCUSSION

All QA/QC criteria were met during this test program.

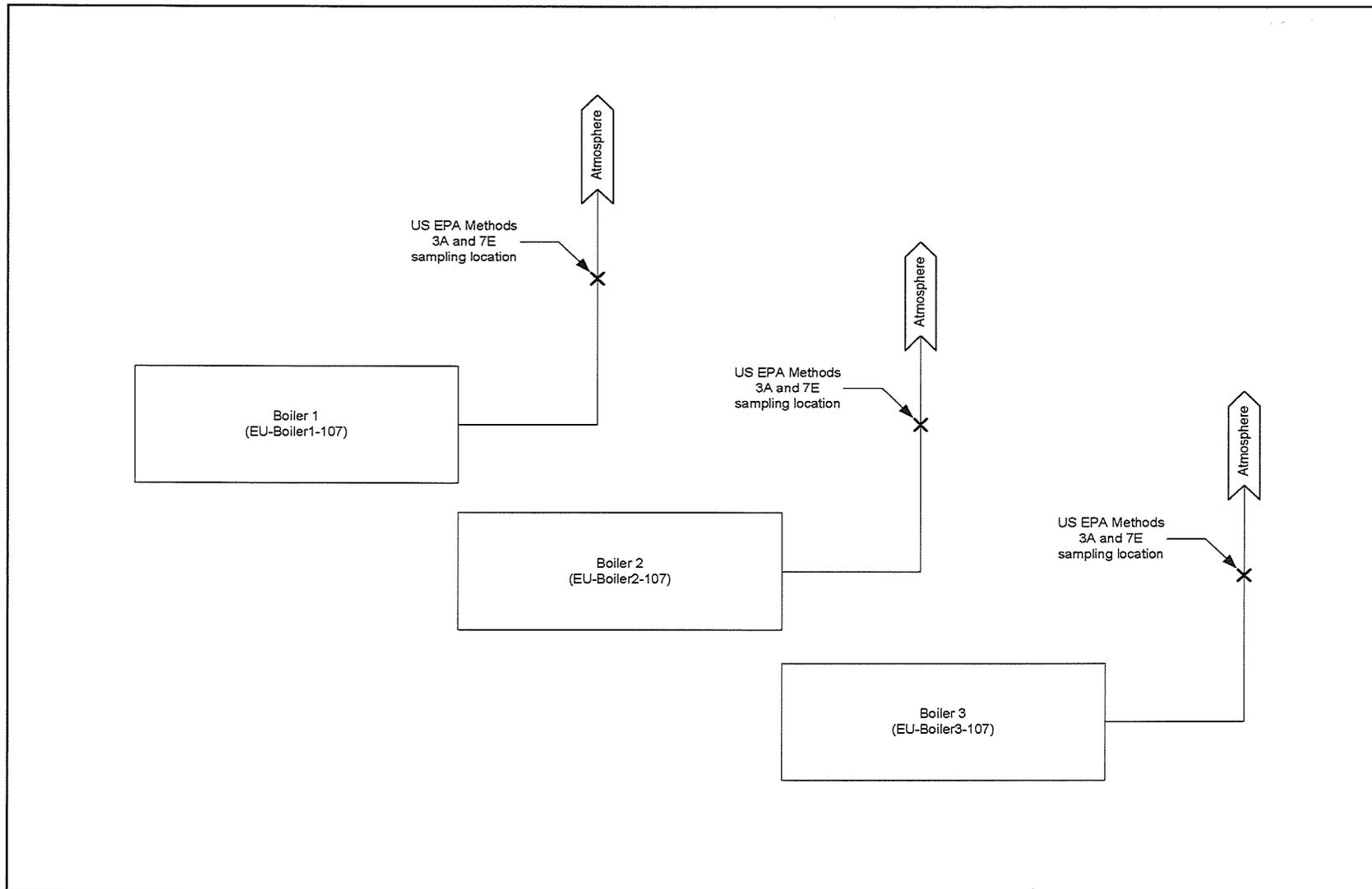
### 5.3 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

# APPENDIX A FIELD DATA AND CALCULATIONS

## Appendix A.1 Sampling Locations

### EU-BOILER1-107, EU-BOILER2-107, AND EU-BOILER3-107 SAMPLING LOCATION SCHEMATIC



**BOILERS 1, 2, AND 3 EXHAUST STACK TRAVERSE POINT LOCATION DRAWING**

