



Review and Certification

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature:

Date:

November 17, 2023

Name:

John Nestor, QI

Title:

District Manager

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1.0 Introduction

1.1 Summary of Test Program

CMS Generation Michigan Power LLC-Kalamazoo River Generating Station (KRGs) (State Registration No.: N6731) contracted Montrose Air Quality Services, LLC (Montrose) to perform a nitrogen oxides heat input correlation check at four corresponding load levels on the simple cycle General Electric Frame 7E Combustion Turbine (EUCOMBTURB01) at the CMS Generation Michigan Power LLC-Kalamazoo River Generating Station facility located in Comstock, Michigan

The tests were conducted to meet the requirements of emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit No. MI-ROP-N6731-2021, and 40 CFR Part 75, Appendix E.

EUCOMBTURB01 is currently a peaking unit and the site is a "qualifying facility" as defined under Part 75, utilizing Appendix E alternative monitoring for reporting under the Transport Rule requirements in their ROP.

The specific objectives were to:

- Measure emissions of nitrogen oxides (NO_x) and oxygen (O₂) at four load ranges during normal operations at the exhaust stack of EUCOMBTURB01

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

Table 1-1
Summary of Test Program

Test Dates	Unit ID/ Source Name	Activity/Parameters	Test Methods	No. of Runs	Duration (Minutes)
9/21/2023	EUCOMBTURB01	O ₂ ,	EPA 3A	3	24
9/21/2023	EUCOMBTURB01	NO _x	EPA 7E & 19	3	44

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.

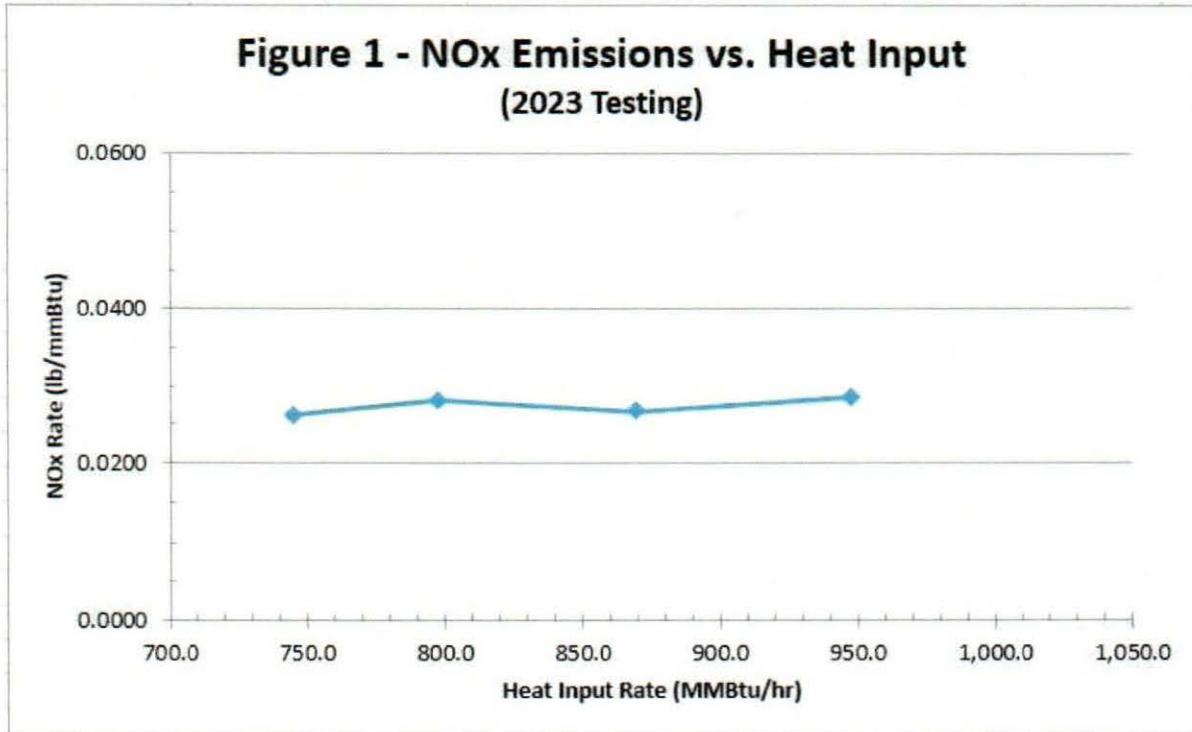
This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized in Tables 1-2 and 1-3. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The tests were conducted according to the Test Protocol No. MW049AS-027884-PP-689 submitted to EGLE on August 21, 2023.

Table 1-2
Summary of Average Natural Gas Results – Combustion Turbine
September 21, 2023

Run	Time	Megawatts (MW)	Fuel Heat Input (MMBtu/hr)	O ₂ (% dry)	NO _x (ppmvd)	NO _x (lb/MMBtu)
1	5:45-6:25	78.1	947.7	14.8	8.2	0.029
2	6:27-7:03	78.7	948.4	14.7	8.0	0.028
3	7:05-7:47	78.5	947.4	14.7	8.1	0.028
Average	--	78.4	947.8	14.7	8.1	0.029
4	8:20-9:03	70.9	868.8	14.8	7.3	0.026
5	9:05-9:41	70.9	869.3	14.8	7.5	0.027
6	9:44-10:24	70.9	871.0	14.8	7.7	0.027
Average	--	70.9	869.7	14.8	7.5	0.027
7	10:52-11:27	62.9	796.5	15.0	7.4	0.027
8	11:30-12:04	62.9	797.7	15.0	7.7	0.028
9	12:06-12:57	63.0	798.3	15.0	7.8	0.029
Average	--	62.9	797.5	15.0	7.6	0.028
10	13:20-13:57	56.4	747.7	14.9	7.2	0.026
11	14:02-14:41	56.0	744.2	15.0	7.1	0.026
12	14:44-15:23	56.0	743.7	15.0	7.1	0.026
Average	--	56.1	745.2	15.0	7.1	0.026

FIGURE 1-1
NOx Emissions to Heat Input Comparison



1.2 Key Personnel

A list of project participants is included below:

Facility Information

Source Location: CMS Generation Michigan Power LLC
 Kalamazoo River Generating Station (KRGs)
 6900 East Michigan Avenue
 Comstock, MI 49093

Project Contact: Kathryn Cunningham
 Role: Corporate Environmental
 Telephone: 517-375-3043
 Email: kathryn.cunningham@CMS.com

Agency Information

Regulatory Agency: EGLE
 Agency Contact: Jeremy Howe
 Email: howej@michigan.gov

Testing Company Information

Testing Firm: Montrose Air Quality Services, LLC
 Contact: John Nestor
 Title: District Manager
 Telephone: 248-765-5032
 Email: jnestor@montrose-env.com

Test personnel and observers are summarized in Table 1-4.

Table 1-4

Test Personnel and Observers

Name	Affiliation	Role/Responsibility
John Nestor	Montrose	District Manager/Field Team Leader/QI/Trailer Operator
Clayton DeRonne	Montrose	Field Technician
Kathryn Cunningham	Northstar Clean Energy	Client Liaison/Test Coordinator

2.0 Plant and Sampling Location Descriptions

2.1 Process Description, Operation, and Control Equipment

The KRGS facility located in Comstock, Michigan operates one simple-cycle GE Frame 7E Combustion Turbine (EUCOMBTURB01) that fires natural gas (NG). The turbine has a nominal output capacity of approximately 86 Megawatts (MW) and exclusively uses natural gas as the fuel. The turbine generator consists of a compressor, combustion turbine, and generator. Energy is generated at the combustion turbine by drawing in ambient air by means of burning fuel and expanding the hot combustion gases in a three-stage turbine. EUCOMBTURB01 was in operation for this test event.

2.2 Flue Gas Sampling Locations

**Table 2-1
Sampling Location**

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
SVCOMBTURB01 Exhaust Stack	138.0 x 174.0	600.0 / 3.9	300.0 / 1.9	12*

* In accordance with 40 CFR Part 75 Appendix E, 12 Sample points will be utilized for each run.

The sample locations conformed to EPA Method 1. Appendix A presents stack schematics and process flow diagrams.

2.3 Operating Conditions and Process Data

Emission testing was conducted in accordance with 40 CFR Part 75, Appendix E. The turbine was tested at four operational loads equally spaced between about 65% and 91% load (approximately 56 to 79 MW) as ambient conditions allowed. The sampling time at each traverse point will be at least one minute plus twice the system response time. Based upon the preceding criteria, it is anticipated that each test run will be about twenty-four minutes in duration. Three test runs were conducted at each of the four load levels.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B.

3.0 Sampling and Analytical Procedures

3.1 Test Methods

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

3.1.1 EPA Methods 3A and 7E, Determination of Oxygen and Nitrogen Oxides Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

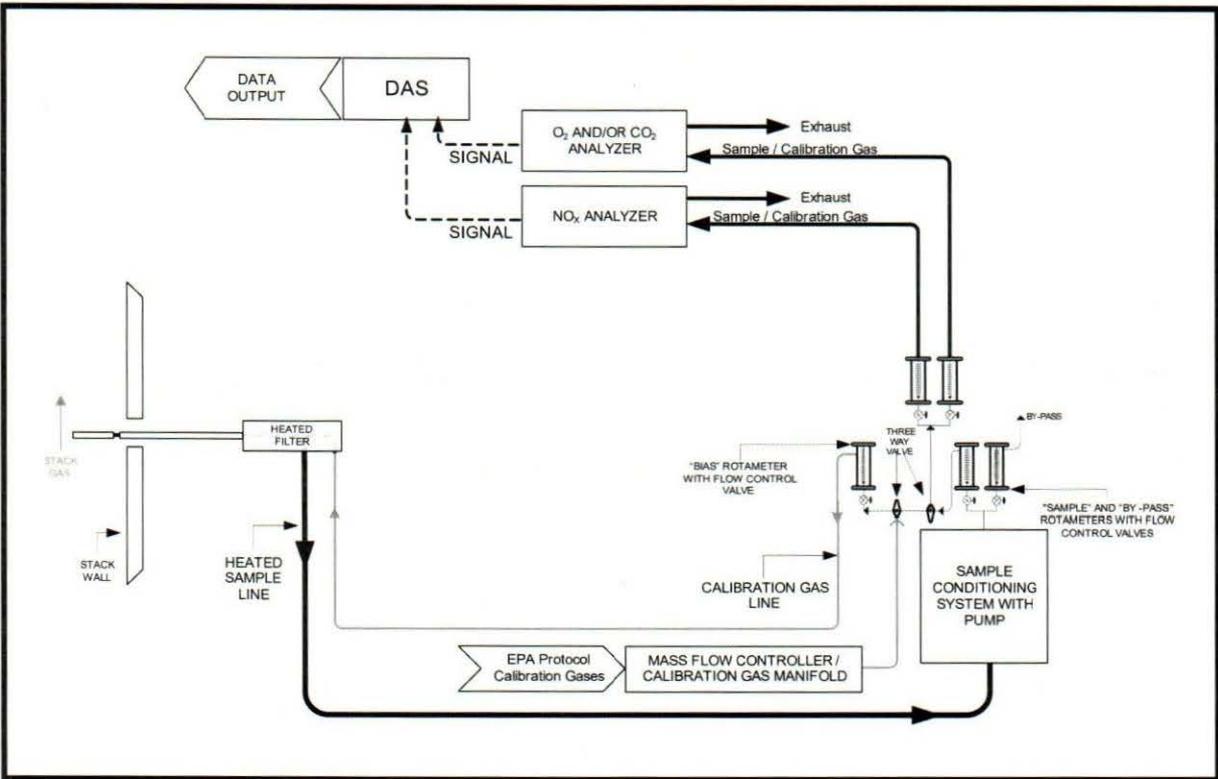
Concentrations of O₂ and NO_x are measured simultaneously using EPA Methods 3A and 7E, which are instrumental test methods. Conditioned gas is sent to a series of analyzers to measure the gaseous emission concentrations. The performance requirements of the method must be met to validate the data.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
 - A dry extractive sampling system is used to report emissions on a dry basis
 - A paramagnetic analyzer is used to measure O₂
 - A chemiluminescent analyzer is used to measure NO_x
- Method Exceptions:
 - None
- Target and/or Minimum Required Sample Duration: 44 minutes
- Target Analytes: O₂ and NO_x

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

FIGURE 3-1
EPA METHOD 3A AND 7E SAMPLING TRAIN



3.1.2 EPA Method 19, Measurement of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is a manual method used to determine (a) PM, SO₂, and NO_x emission rates; (b) sulfur removal efficiencies of fuel pretreatment and SO₂ control devices; and (c) overall reduction of potential SO₂ emissions. This method provides data reduction procedures, but does not include any sample collection or analysis procedures.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
 - F factor is the oxygen-based F factor, dry basis (F_d)
 - An F_d factor of 8,710 dscf/MMBtu was used for natural gas

3.2 Process Test Methods

The regulations 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 average results are presented in Table 1-2. The results of individual test runs performed are presented in Table 4-1. 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.

**Table 4-1
NO_x Emissions Results -**

Approximate Load (% Load Based on Rating of 86 MW)	Run No.	Start Date/Time	End Date/Time	No. of Values	Summary of Per Run Averages for DAHS Data								Summary of Per Run Average Test Results					
					Comp Dis	Exh Temp	Gas Flow	Gas GCV	Gross Heat	Inlet Temp	Load	Pitch	NO _x Conc. (ppmvd)	O ₂ Conc. (Vol-%)	NO _x Conc. (ppmvd @15% O ₂)	NO _x Rate (lb/mmBtu)	NO _x Mass Emissions (lbs/hr)	Heat Input Per Run (mmBtu)
					(psia)	(oF)	(HSCFH)	(Btu/scf)	(mmBtu/hr)	(°F)	(MW)	Pitch	(ppmvd)	(Vol-%)	(ppmvd @15% O ₂)	(lb/mmBtu)	(lbs/hr)	(mmBtu)
91.2%	1	9/21/23 5:45	9/21/23 6:25	41	157.10	1024.19	8,865.24	1,069.0	947.7	660.97	78.1	85.78	8.20	14.80	7.93	0.029	27.69	647.6
91.2%	2	9/21/23 6:27	9/21/23 7:03	37	157.38	1023.58	8,871.67	1,069.0	948.4	660.06	78.7	85.78	8.00	14.70	7.61	0.028	26.60	584.8
91.2%	3	9/21/23 7:05	9/21/23 7:47	43	157.29	1023.78	8,862.54	1,069.0	947.4	659.83	78.5	85.78	8.10	14.70	7.71	0.028	26.90	679.0
82.4%	4	9/21/23 8:20	9/21/23 9:03	44	144.12	1029.51	8,126.94	1,069.0	868.8	640.10	70.9	73.60	7.30	14.80	7.06	0.026	22.60	637.1
82.4%	5	9/21/23 9:05	9/21/23 9:41	37	144.47	1030.81	8,132.04	1,069.0	869.3	645.71	70.9	74.51	7.50	14.80	7.25	0.027	23.23	536.1
82.4%	6	9/21/23 9:44	9/21/23 10:24	41	145.07	1032.55	8,147.63	1,069.0	871.0	653.97	70.9	76.41	7.70	14.80	7.45	0.027	23.90	595.2
73.2%	7	9/21/23 10:52	9/21/23 11:27	36	130.71	1053.70	7,450.44	1,069.0	796.5	632.35	62.9	64.00	7.40	15.00	7.40	0.027	21.71	477.9
73.2%	8	9/21/23 11:30	9/21/23 12:04	35	130.89	1054.34	7,462.61	1,069.0	797.7	635.20	62.9	64.15	7.70	15.00	7.70	0.028	22.63	465.4
73.2%	9	9/21/23 12:06	9/21/23 12:57	52	131.23	1054.96	7,467.42	1,069.0	798.3	639.21	63.0	64.84	7.80	15.00	7.80	0.029	22.94	691.8
65.3%	10	9/21/23 13:20	9/21/23 13:57	38	122.32	1073.07	6,994.72	1,069.0	747.7	634.68	56.4	60.84	7.20	14.90	7.08	0.026	19.50	473.6
65.3%	11	9/21/23 14:02	9/21/23 14:41	40	121.66	1074.58	6,961.89	1,069.0	744.2	635.05	56.0	60.42	7.10	15.00	7.10	0.026	19.47	496.2
65.3%	12	9/21/23 14:44	9/21/23 15:23	40	121.52	1074.61	6,957.14	1,069.0	743.7	634.29	56.0	60.14	7.10	15.00	7.10	0.026	19.45	495.8
91.2% Averages				40.3	157.26	1023.85	8,866.5	1,069.0	947.8	660.29	78.4	85.78	8.10	14.73	7.75	0.029	27.06	637.1
82.4% Averages				40.7	144.55	1030.95	8,135.5	1,069.0	869.7	646.59	70.9	74.84	7.50	14.80	7.25	0.027	23.24	589.4
73.2% Averages				41.0	130.94	1054.33	7,460.2	1,069.0	797.5	635.59	62.9	64.33	7.63	15.00	7.63	0.028	22.43	545.0
65.3% Averages				39.3	121.84	1074.09	6,971.3	1,069.0	745.2	634.67	56.1	60.47	7.13	14.97	7.09	0.026	19.47	488.5

5.0 Internal QA/QC Activities

5.1 QA/QC Audits

EPA Methods 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 NO₂ 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 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

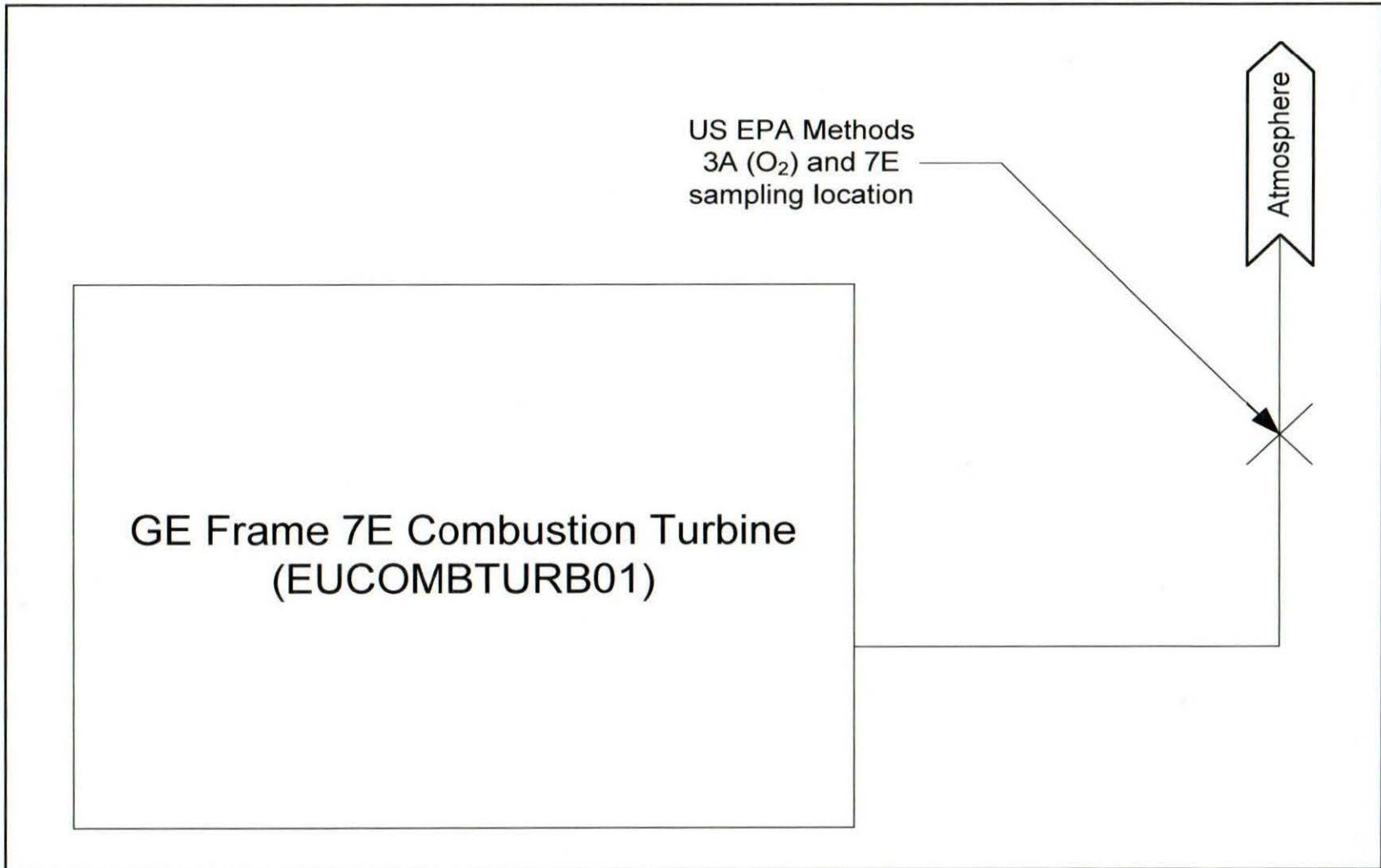


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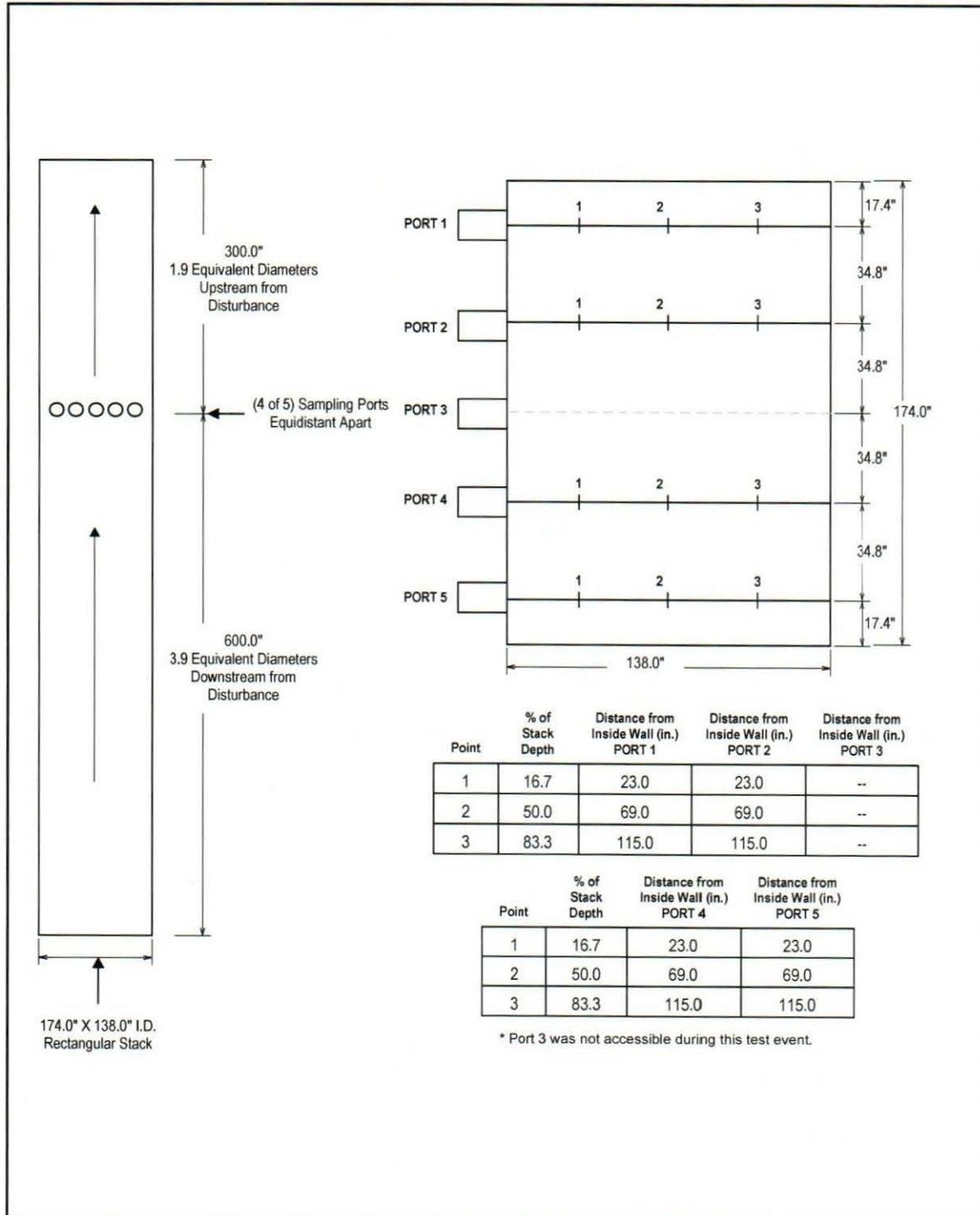
Appendix A.1

Instrumental Test Method Data

EUCOMBTURB01 SAMPLING LOCATION SCHEMATIC



EUCOMBTURB01 EXHAUST STACK TRAVERSE POINT LOCATION DRAWING



Date		
9/21/2023		
Time	O₂	NO_x
	(%)	(ppm)
Average	14.6	8.4

5:45:00	14.7	7.7
5:46:00	14.7	7.9
5:47:00	14.7	7.5
5:48:00	14.6	7.8
5:49:00	14.6	8.1
5:50:00	14.6	7.8
5:59:00	14.6	8.1
6:00:00	14.6	8.9
6:01:00	14.6	8.0
6:02:00	14.6	7.8
6:03:00	14.6	7.7
6:04:00	14.6	7.8
6:10:00	14.5	8.6
6:11:00	14.6	8.6
6:12:00	14.6	9.2
6:13:00	14.6	8.7
6:14:00	14.6	8.3
6:15:00	14.6	8.7
6:20:00	14.6	8.6
6:21:00	14.6	8.9
6:22:00	14.6	9.5
6:23:00	14.6	8.7
6:24:00	14.6	8.6
6:25:00	14.6	9.2