COMPLIANCE TEST REPORT

for

OXIDES OF NITROGEN (NO_X) AND CARBON MONOXIDE (CO) EMISSIONS

CTG's UNITs 11-1, 11-2, 12-1, and 12-2

Dean Peaker Station
East China, Michigan

June 13 through June 22, 2017

Prepared By
Environmental Management & Resources
Environmental Field Services Group
DTE Corporate Services, LLC
7940 Livernois H-136
Detroit, MI 48210

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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EMR) Field Services Group performed gaseous emissions testing at the DTE Energy, Dean Peaker Station, located in East China, Michigan. The fieldwork, performed during the period of June 13 - June 22, 2017, was conducted to satisfy testing requirements of Michigan Renewable Operating Permit No. MI-ROP-B2796-2015b. Emissions tests were performed on four natural gas-fired Combustion Turbine Generators (CTG's) (Units 11-1, 11-2, 12-1, and 12-2) for oxides of nitrogen (NO_x) and carbon monoxide (CO).

The average results of the emissions testing are highlighted below:

Emissions Testing Summary
CTG's 11-1, 11-2, 12-1, and 12-2
Dean Peaker Station
June 13 – June 22, 2017

Unit[1]	Parameter[2] (ppm @ 15% O2)	High Load	Mid-High Load	Mid-Low Load	Low Load
11-1	NO_x	6.4	6.0	5.9	6.0
	CO	5.2	12.8	16.4	9.8
11-2	NO_x	6.3	6.1	6.2	6.2
	CO	9.3	12.3	8.4	6.7
12-1	NO_x	7	7.2	6.6	6.2
	CO	10.7	9.3	10.2	11.4
12-2	NO_x	7.4	7.7	7.7	7.8
	CO	3.5	3.3	3.7	2.7

(1) Permit Limits: NOx – 9.0 ppm @ 15% O2
CO – 25.0 ppm @15% O2

(2) Concentration corrected per USEPA Method 7E

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EMR) Field Services Group performed gaseous emissions testing at the DTE Energy, Dean Peaker Station, located in East China, Michigan. The fieldwork, performed during the period of June 13 – June 22, 2017, was conducted to satisfy testing requirements of Michigan Renewable Operating Permit No. MI-ROP-B2796-2015b. Emissions tests were performed on four natural gas-fired Combustion Turbine Generators (CTG's) (Units 11-1, 11-2, 12-1, and 12-2) for oxides of nitrogen (NO_x) and carbon monoxide (CO).

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 3A, 7E, 10 and 19.

The fieldwork was performed in accordance with EPA Reference Methods and DTE Energy's Intent to Test[1], which was approved in a letter[2] by Mr. Tom Gasloli from the Michigan Department of Environmental Quality – Air Quality Division (MDEQ-AQD). The following DTE Energy personnel participated in the testing program: Mr. Mark Westerberg, Environmental Specialist, Mr. Ken St. Amant, Senior Environmental Technician and Mr. Jacob Maas, Summer Student. Mr. Westerberg was the project leader. Mr. Bob Graves, Lead O & M Technician, with the DTE Energy Peaker Group provided process coordination for the testing program. Mr. Tom Gasloli with the Air Quality Division of the Michigan Department of Environmental Quality (MDEQ) reviewed the Test Plan and observed portions of the testing.

2.0 SOURCE DESCRIPTION

The DTE Energy, Dean Peaker Station, located at 4490 North River Road, East China, Michigan, employs the use of four General Electric Frame 7, simple-cycle, combustion turbines nominally rated at 82.4 megawatts (MW) each at 100% load (dependent upon ambient conditions). Flue gases from each unit exhaust through a separate rectangular stack (108" x 228") that has an exit height of 56.0 feet above ground level. See Figure 1 for a diagram of the units' sampling locations and stack dimensions.

3.0 SAMPLING AND ANALYTICAL PROCEDURES

DTE Energy obtained emissions measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources*. The sampling and analytical methods used in the testing program are indicated in the table below:

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[1] DTE Test Plan, Submitted May 1, 2017. (Attached-Appendix A)

[2] MDEQ Approval Letter received May 30, 2017 (Attached-Appendix A)

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Sampling Method	Parameter	Analysis
USEPA Method 3A	Oxygen	Instrumental Analyzer Method
USEPA Method 7E	Oxides of Nitrogen	Chemiluminecent Instrumental Analyzer Method
USEPA Method 10	Carbon Monoxide	NDIR Instrumental Analyzer Method
USEPA Method 19	Exhaust Gas Flow rates	Stoichiometric Calculations
USEPA Method 20	Oxides of Nitrogen	Ref. Method 7E

3.1 OXYGEN AND CARBON DIOXIDE (USEPA METHOD 3A)

3.1.1 Sampling Method

Stack gas Oxygen (O_2) and Carbon Dioxide (CO_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The O_2/CO_2 analyzers utilize paramagnetic sensors.

3.1.2 O_2 / CO_2 Sampling Train

The EPA Method 3A sampling system (Figure 2) consisted of the following:

(1) Stainless Steel sampling probe (traversed across 12 points of each stack)
(2) Heated Teflon™ sampling line
(3) MAK® gas conditioner with gaseous filter
(4) Flexible unheated Teflon™ sampling line
(5) Servomex O_2/CO_2 gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System.

3.1.3 *Sampling Train Calibration*

The sampling train was calibrated per procedures outlined in USEPA Method 7E. Zero, span, and mid-range calibration gases were introduced directly into the analyzer to determine the instruments linearity. A zero and mid-range span gas for each pollutant was then introduced through the entire sampling system to determine sampling system bias for the analyzer at the completion of each test.

3.2 OXIDES OF NITROGEN AND CARBON MONOXIDE (USEPA METHODS 7E AND 10)

3.2.1 *Sampling Method*

Oxides of nitrogen (NO_x) emissions were evaluated using USEPA Method 7E, "Determination of Oxides of Nitrogen Emissions from Stationary Sources". The NO_x analyzer utilizes a Chemiluminecent detector. Carbon monoxide (CO) emissions were evaluated using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources". The CO analyzer utilizes an NDIR detector.

The EPA Methods 7E and 10 sampling system (Figure 2) consisted of the following:

(1) Stainless Steel sampling probe (traversed across 12 points of each stack)
(2) Heated Teflon™ sampling line
(3) MAK® gas conditioner with gaseous filter
(4) Flexible unheated Teflon™ sampling line
(5) 42i Chemiluminecent NO/NO_x gas analyzer and TECO 48i NDIR CO gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System.

Oxides of Nitrogen and carbon monoxide emissions testing were performed per Method 20, and Sub-Part GG. Testing at each of four loads (equally spaced between max load and 50 MW) was performed. Each load was tested in triplicate with a run consisting of sampling for 1-minute at each of 12 points. The probe was moved to each point with sufficient time to allow for sampling system response per the guidelines of Sub-Part GG. Diluent (O_2) concentrations were measured simultaneously during all sampling.

3.2.2 *Quality Control and Assurance*

All sampling and analytical equipment were calibrated per the guidelines referenced in Methods 7E and 10. Calibration gases were EPA Protocol 1 gases and the concentrations

were within the acceptable ranges (40-60% mid-range and span) specified in Method 7E. Calibration gas certification sheets are in Appendix C.

Zero, span, and mid-range calibration gases were introduced directly into the analyzer to determine the instruments linearity. A zero and mid-range span gas for each pollutant was then introduced through the entire sampling system to determine sampling system bias for each analyzer at the completion of each test.

DTE performed NO_x converter efficiency testing by directly challenging the NO_x analyzer with a nitrogen dioxide (NO_2) calibration gas of 15.60 ppm. Results from the converter efficiency test demonstrated that the analyzer met the requirements of Method 7E (Eq-1).

Eq. 1

$$Eff_{NO2} = \frac{C_{Dir}}{C_v} = \frac{14.4}{15.6} = 92.3\%$$

3.2.3 Data Reduction

Data was recorded at 10-second intervals and averaged in 1-minute increments. The NO_x and CO emissions were reported in parts per million corrected to 15% oxygen (ppm @ 15% O_2). The 1-minute readings collected can be found in Appendix B.

4.0 OPERATING PARAMETERS

The test program included the collection of turbine operating data during each test run. Parameters recorded included fuel flowrate (pounds per second), power generation (MW), inlet guide vane angle (%), compressor discharge temperature (°F), compressor discharge pressure (psi), and exhaust temperature (°F). Unit operational data collected during each test can be found in Appendix E.

Natural gas samples were collected once during the testing of each unit and analyzed for heat content. The results of the fuel analysis can be found in Appendix E.

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5.0 DISCUSSION OF RESULTS

11-1:
Table No. 1 presents the nitrogen oxides (NO_x) and carbon monoxide (CO) emission testing results for CTG Unit 11-1 at four (4) operating loads between 50 MW and the highest load attainable. The NO_x and CO emissions are presented in parts per million corrected to fifteen percent oxygen (ppm @ 15% O_2). The NO_x and CO emissions for each of the 4 loads were below the permit limits of 9 ppm @15% O_2 and 25 ppm @ 15% O_2 respectively.

11-2:
Table No. 2 presents the nitrogen oxides (NO_x) and carbon monoxide (CO) emission testing results for CTG Unit 11-2 at four (4) operating loads between 50 MW and the highest load attainable. The NO_x and CO emissions are presented in parts per million corrected to fifteen percent oxygen (ppm @ 15% O_2). The NO_x and CO emissions for each of the 4 loads were below the permit limits of 9 ppm @15% O_2 and 25 ppm @ 15% O_2 respectively.

12-1:
Table No. 3 presents the nitrogen oxides (NO_x) and carbon monoxide (CO) emission testing results for CTG Unit 12-1 at four (4) operating loads between 50 MW and the highest load attainable. The NO_x and CO emissions are presented in parts per million corrected to fifteen percent oxygen (ppm @ 15% O_2). The NO_x and CO emissions for each of the 4 loads were below the permit limits of 9 ppm @15% O_2 and 25 ppm @ 15% O_2 respectively.

12-2:
Table No. 4 presents the nitrogen oxides (NO_x) and carbon monoxide (CO) emission testing results for CTG Unit 12-2 at four (4) operating loads between 50 MW and the highest load attainable. The NO_x and CO emissions are presented in parts per million corrected to fifteen percent oxygen (ppm @ 15% O_2). The NO_x and CO emissions for each of the 4 loads were below the permit limits of 9 ppm @15% O_2 and 25 ppm @ 15% O_2 respectively.

The Auxiliary test data presented in each NO_x/CO Emissions Table for each test includes the Unit Load in gross megawatts (GMW), stack temperature in degrees Fahrenheit (°F), fuel flow in pounds per second (lbs/sec), inlet guide vane angle in degrees (°), Compressor discharge temperature in degrees Fahrenheit (°F), Compressor discharge pressure in pounds per square inch (PSI), and heat input in Million British Thermal units per hour (MMBtu/hr).

The results of the testing indicate that Units 1 through 4 are in compliance with Permit Requirements for NO_x & CO.

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6.0 CERTIFICATION STATEMENT

"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally accepted in the trade."

Mark R. Grigereit, QSTI

This report prepared by:

Mr. Mark R. Grigereit, QSTI
Principal Engineer, Environmental Field Services
Environmental Management and Resources
DTE Energy

This report reviewed by:

Mr. Mark Westerberg, QSTI
Environmental Specialist, Environmental Field Services
Environmental Management and Resources
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TABLE NO. 1

NO_x & CO EMISSIONS TESTING RESULTS

Dean Peaker Station - Unit 11-1

June 13 & 14, 2017

Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Fuel Flow (lb/sec)	Inlet Guide Vane Angle	Compressor Discharge Temperature	Compressor Discharge Pressure	Heat Input (MMBtu/hr)	NOx Emissions (ppm@15%O_2)[1]	CO Emissions (ppm@15%O_2)[2]
High	13-Jun-17	8:06-9:48	76.6	1011.0	11.1	84.0	686.7	158.8	974.9	6.4	5.2
Mid-High		10:19-11:57	66.7	1028.4	9.9	65.0	652.8	136.5	864.7	6.0	12.8
Mid-Low	14-Jun-17	7:30-9:12	58.5	1047.0	9.1	57.7	630.0	124.5	795.4	5.9	16.4
Low		9:35-11:14	49.6	1081.9	8.3	53.7	630.9	111.8	726.1	6.0	9.8
	Average:		*62.9*	*1042.1*	*9.6*	*65.1*	*650.1*	*132.9*	*840.3*	*6.1*	*11.1*

(1) Permit Limit = 9 ppm@15%O2

(2) Permit Limit = 25 ppm@15%O2

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TABLE NO. 2

NO_x & CO EMISSIONS TESTING RESULTS

Dean Peaker Station - Unit 11-2

June 15 & 16, 2017

Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Fuel Flow (lb/sec)	Inlet Guide Vane Angle	Compressor Discharge Temperature	Comoressor Discharge Pressure	Heat Input (MMBtu/hr)	NOx Emissions (ppm@15%O_2)[1]	CO Emissions (ppm@15%O_2)[2]
High	15-Jun-17	8:08-9:46	75.3	998.3	10.6	83.9	673.1	157.1	933.1	6.3	9.3
Mid-High		10:12-11:52	67.0	1020.3	9.6	66.3	644.8	139.2	841.7	6.1	12.3
Mid-Low	16-Jun-17	7:39-9:21	58.2	1046.8	8.8	59.1	639.3	124.8	773.5	6.2	8.4
Low		9:38-11:16	49.9	1074.7	8.0	54.4	634.6	112.5	702.1	6.2	6.7
	Average:		*62.6*	*1035.0*	*9.2*	*65.9*	*648.0*	*133.4*	*812.6*	*6.2*	*9.2*

(1) Permit Limit = 9 ppm@15%O2

(2) Permit Limit = 25 ppm@15%O2

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TABLE NO. 3
NO_x & CO EMISSIONS TESTING RESULTS
Dean Peaker Station - Unit 12-1
June 21 & 22, 2017

Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Fuel Flow (lb/sec)	Inlet Guide Vane Angle	Compressor Discharge Temperature	Compressor Discharge Pressure	Heat Input (MMBtu/hr)	NOx Emissions (ppm@15%O_2)[1]	CO Emissions (ppm@15%O_2)[2]
High	21-Jun-17	8:06-9:47	79.2	991.3	11.1	84.1	665.7	157.8	1,003.1	7.0	10.7
Mid-High		10:10-11:50	69.9	1012.4	10.0	66.4	642.2	140.0	902.2	7.2	9.3
Mid-Low	22-Jun-17	7:33-9:16	59.9	1042.0	9.0	56.9	621.5	121.8	812.8	6.6	10.2
Low		9:33-11:20	49.9	1075.9	8.1	51.8	618.8	107.6	732.1	5.2	11.4
	Average:		*64.7*	*1030.4*	*9.6*	*64.8*	*637.1*	*131.8*	*862.6*	*6.8*	*10.4*

(1) Permit Limit = 9 ppm@15%O2

(2) Permit Limit = 25 ppm@15%O2

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TABLE NO. 4

NO_x & CO EMISSIONS TESTING RESULTS

Dean Peaker Station - Unit 12-2

June 19 & 20, 2017

Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Fuel Flow (lb/sec)	Inlet Guide Vane Angle	Compressor Discharge Temperature	Compressor Discharge Pressure	Heat Input (MMBtu/hr)	NOx Emissions (ppm@15%O_2)[1]	CO Emissions (ppm@15%O_2)[2]
High	19-Jun-17	7:50-9:36	75.9	1003.7	10.8	83.8	682.4	156.4	978.8	7.4	3.5
Mid-High		9:52-11:31	67.7	1028.7	9.8	66.6	654.9	138.1	879.6	7.7	3.3
Mid-Low	20-Jun-17	7:19-8:57	58.6	1052.4	8.9	56.5	622.3	122.2	798.9	7.7	3.7
Low		9:22-11:02	49.6	1085.7	8.0	52.0	624.6	109.4	723.8	7.8	2.7
	Average:		*63.0*	*1042.6*	*9.4*	*64.7*	*646.1*	*131.5*	*845.3*	*7.7*	*3.3*

(1) Permit Limit = 9 ppm@15%O2

(2) Permit Limit = 25 ppm@15%O2

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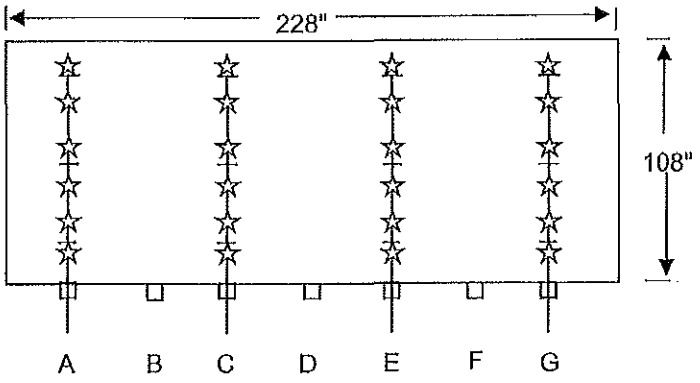
Figure 1 – Sampling Location
DTE Dean Peaker Station
June 13-22, 2017



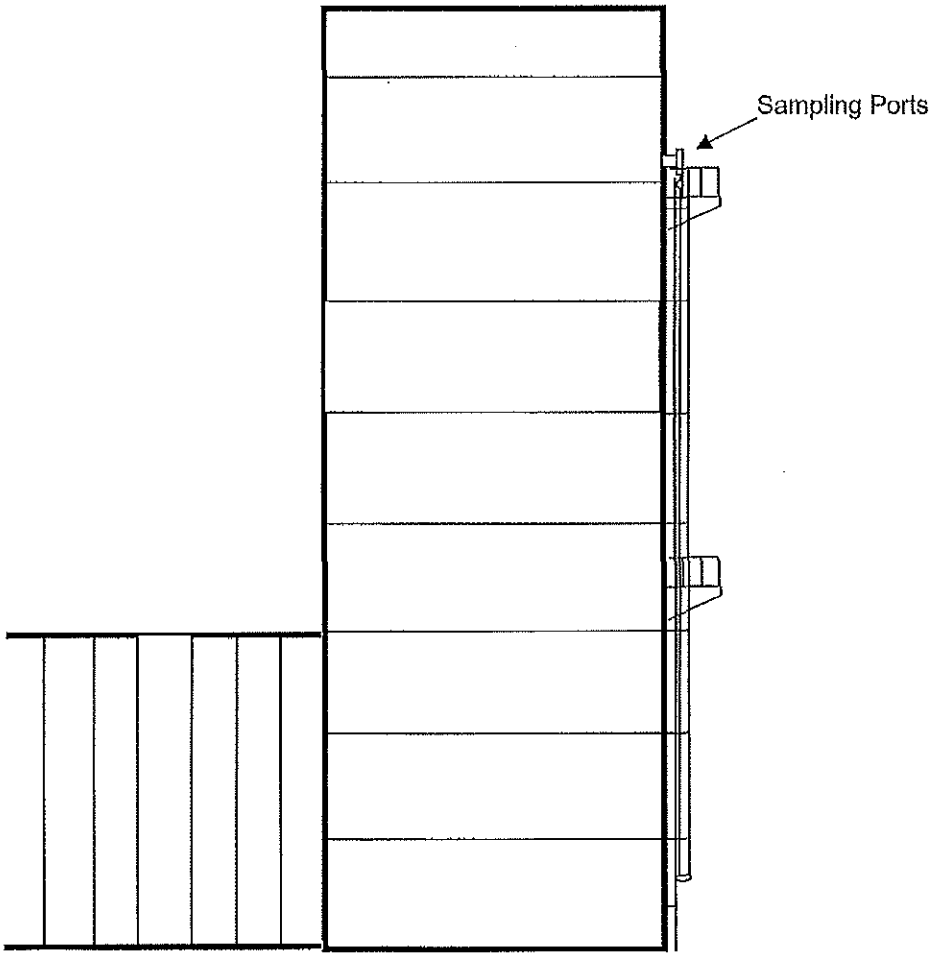


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Figure 2 – EPA Method 7E/10
DTE Dean Peaker Station
June 13-22, 2017