

COMPLIANCE TEST REPORT

for

OXIDES OF NITROGEN (NO_x) & CARBON MONOXIDE EMISSIONS (CO)

EU01 & EU02

**Delray Peaking Facility (B2798)
Detroit, Michigan**

October 23-24, 2019

**Prepared By
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CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	III
1.0 INTRODUCTION	1
2.0 SOURCE DESCRIPTION	1
3.0 SAMPLING AND ANALYTICAL PROCEDURES	2
3.1 OXYGEN, OXIDES OF NITROGEN AND CARBON MONOXIDE (USEPA METHODS 3A, 7E, 10)	2
3.1.1 Sampling Method	2
3.1.2 Quality Control and Assurance.....	3
3.1.3 Data Reduction.....	3
4.0 OPERATING PARAMETERS	4
5.0 DISCUSSION OF RESULTS	4
6.0 CERTIFICATION STATEMENT	5

RESULTS TABLES

Table No. 1	CO and NOx Emissions Testing Results: EU01
Table No. 2	CO and NOx Emissions Testing Results: EU02

FIGURES

1	Stack Drawing & Exhaust Sampling Point Location
2	USEPA Method 3A, 7E, and 10 Sampling Train

APPENDICES

A	EGLE Test Plan and Approval Letter
B	Raw Analyzer Data
C	Equipment and Analyzer Calibration Data
D	Analytical Data
E	Example Calculations
F	Operational Data



EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EMR) Field Services Group performed emissions testing at the DTE Electric Company, Delray Peaking Facility, located at 6603 West Jefferson Avenue in Detroit, Michigan. The fieldwork, performed on October 23-24, 2019, was conducted to satisfy requirements of Michigan Renewable Operating Permit (ROP) No. MI-ROP-B2798-2017a and 40 CFR Part 75 Appendix E, "Optional NOX Emissions Estimation Protocol for Gas-Fired Peaking Units and Oil-Fired Peaking Units". Emissions tests were performed on two natural gas-fired peaker turbines for oxides of nitrogen (NO_x) and carbon monoxide (CO). The turbines are designated as EU01 (CTG 11-1) and EU02 (CTG 12-1) in the ROP.

The results of the emissions testing are highlighted below:

Emissions Testing Summary Delray CTG's 11-1 and 12-1 October 23-24, 2019

Unit ¹	Parameter ²	High Load	Mid-High Load	Mid-Low Load	Low Load
EU01 (CTG 11-1)	NO_x (ppm @ 15% O ₂)	10.6	10.6	10.5	10.5
	NO_x (lbs/hr)	33.5	32.5	30.8	30.0
	CO (lbs/hr)	25.5	22.9		
EU02 (CTG 12-1)	NO_x (ppm @ 15% O ₂)	13.5	14.2	12.6	12.2
	NO_x (lbs/hr)	42.9	43.7	36.9	34.0
	CO (lbs/hr)	8.0	5.3		

- (1) Permit Limits: NO_x – 15 ppm @ 15% O₂
NO_x – 66 lb/hr
CO – 64 lbs/hr
- (2) Concentrations corrected according to USEPA Method 7E

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The EPA Methods 3A, 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 particulate filter
- (4) Flexible unheated Teflon™ sampling line
- (5) Servomex 1400 O₂ gas analyzer, TECO 42i Chemiluminescent 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 according to Method 20, and 40 CFR Part 60 Subpart GG. Testing was performed at four (4) equally spaced loads. Each load was tested in triplicate with a run consisting of sampling for 2-minutes at 12 points. The probe was moved to each point with sufficient time to allow for sampling system response. Oxygen concentrations were also measured during sampling.

3.1.2 Quality Control and Assurance

All sampling and analytical equipment were calibrated according to the guidelines referenced in Methods 3A, 7E, and 10. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges specified in Method 7E. Calibration gas certification sheets are located 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 (NO₂) calibration gas of 15.60 ppm. Results from the converter efficiency test demonstrated that the analyzer met the requirements of Method 7E (Eq-1).

$$\text{Eq. 1} \quad \text{Eff}_{NO_2} = \frac{C_{Dir}}{C_v} = \frac{14.07}{15.60} = 90.2\%$$

3.1.3 Data Reduction

Data was recorded at 10-second intervals and averaged in 1-minute increments. NO_x emissions are reported in parts per million, dry, at 15% oxygen (ppm @ 15% O₂) and pounds per hour (lb/hr). CO emissions are reported in lb/hr. The 1-minute readings collected can be found in Appendix B.

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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).

Natural gas samples were collected once during the testing of each unit and analyzed for heat content and percent sulfur.

Operational data is located in Appendix F and results of the fuel analysis are located in Appendix D.

5.0 DISCUSSION OF RESULTS

Unit 11-1:

Table No. 1 presents the NO_x and CO emissions testing results and operational data for CTG 11-1 at 4 loads (73MW, 69.7MW, 66.3MW, and 63MW). NO_x emissions are presented as ppm (parts per million) at 15% Oxygen and pounds per hour (lb/hr). Carbon Monoxide emissions are presented as pounds per hour (lbs/hr). The average NO_x emissions were 10.6 ppm and 33.5 lb/hr (73MW), 10.6 ppm and 32.5 lb/hr (69.7MW), 10.5 ppm and 30.8 lb/hr (66.3MW), and 10.5 ppm and 30.0 lb/hr (63MW). These values were all below the permit limits of 15 ppm and 66 lb/hr. The average CO emissions were 25.5 lbs/hr (73MW), and 22.9 lbs/hr (69.7MW). These values were below the permit limit of 64 lbs/hr.

Unit 12-1:

Table No. 2 presents the NO_x and CO emissions testing results and operational data for CTG 12-1 at 4 loads (72.3MW, 68.7MW, 64.3MW, and 60MW). NO_x emissions are presented as ppm (parts per million) at 15% Oxygen and pounds per hour (lb/hr). Carbon Monoxide emissions are presented as pounds per hour (lbs/hr). The average NO_x emissions were 13.5 ppm and 42.9 lb/hr (72.3MW), 14.2 ppm and 43.7 lb/hr (68.7MW), 12.6 ppm and 36.9 lb/hr (64.3MW), and 12.2 ppm and 34.0 lb/hr (60MW). These values were all below the permit limits of 15 ppm and 66 lb/hr. The average CO emissions were 8.00 lbs/hr (72.3MW), and 5.34 lbs/hr (68.7MW). These values were below the permit limit of 64 lbs/hr.

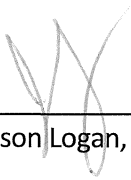
The Results of the testing indicate that EU01 and EU02 (Units 11-1 & 12-1) are in compliance with Michigan ROP No. MI-ROP-B2798-2017a for NO_x and CO across all operating ranges tested.

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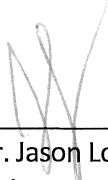
6.0 CERTIFICATION STATEMENT

“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.”



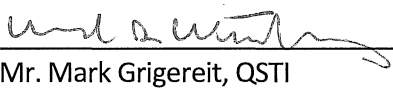
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RESULTS TABLES



TABLE NO. 1
NOx & CO EMISSIONS TESTING RESULTS
Delray Power Plant - EU01 (CTG 11-1)
October 24, 2019

High Load 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⁾	NOx Emissions (lbs/hr) ⁽²⁾	CO Emissions (lbs/hr) ⁽³⁾
Run 1	24-Oct-19	8:07-8:40	73.0	1003.2	10.0	68.6	618.6	144.7	860.6	10.9	34.6	22.4
Run 2		10:33-11:07	73.0	1001.9	10.0	68.4	614.4	144.6	860.6	10.3	32.7	26.8
Run 3		11:15-11:48	73.0	1001.9	10.0	68.4	614.5	144.7	860.6	10.5	33.3	27.4
<i>Average:</i>				<i>73.0</i>	<i>1002.3</i>	<i>10.0</i>	<i>68.5</i>	<i>615.8</i>	<i>144.7</i>	<i>860.6</i>	<i>10.6</i>	<i>33.5</i>

Mid-High Load 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⁾	NOx Emissions (lbs/hr) ⁽²⁾	CO Emissions (lbs/hr) ⁽³⁾
Run 1	24-Oct-19	16:16-16:51	69.7	1012.9	9.7	65.3	613.7	139.0	834.8	10.6	32.6	23.0
Run 2		17:00-17:38	69.6	1013.1	9.6	65.4	614.0	139.0	826.2	10.6	32.3	22.4
Run 3		17:47-18:20	69.7	1012.6	9.7	65.3	613.0	139.0	834.8	10.6	32.6	23.2
<i>Average:</i>				<i>69.7</i>	<i>1012.9</i>	<i>9.7</i>	<i>65.3</i>	<i>613.6</i>	<i>139.0</i>	<i>831.9</i>	<i>10.6</i>	<i>32.5</i>

Mid-Low Load 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⁾	NOx Emissions (lbs/hr) ⁽²⁾
Run 1	24-Oct-19	14:09-14:42	66.3	1021.3	9.3	61.5	602.7	132.9	800.4	10.5	31.0
Run 2		14:51-15:24	66.3	1021.7	9.3	61.6	603.8	132.9	800.4	10.4	30.7
Run 3		15:33-16:06	66.3	1021.8	9.3	61.4	604.6	133.0	800.4	10.4	30.7
<i>Average:</i>				<i>66.3</i>	<i>1021.6</i>	<i>9.3</i>	<i>61.5</i>	<i>603.7</i>	<i>132.9</i>	<i>800.4</i>	<i>10.5</i>

Low Load 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⁾	NOx Emissions (lbs/hr) ⁽²⁾
Run 1	24-Oct-19	12:04-12:37	62.9	1029.2	9.0	58.2	590.1	127.0	774.5	10.5	30.0
Run 2		12:45-13:18	63.0	1029.4	9.0	58.3	591.3	127.1	774.5	10.5	30.0
Run 3		13:27-14:00	63.0	1029.7	9.0	58.4	592.4	127.1	774.5	10.5	30.0
<i>Average:</i>				<i>63.0</i>	<i>1029.4</i>	<i>9.0</i>	<i>58.3</i>	<i>591.3</i>	<i>127.1</i>	<i>774.5</i>	<i>10.5</i>

(1) Permit Limit = 15 ppm@15%O₂

(2) Permit Limit = 66 lbs/hr

(3) Permit Limit = 64 lbs/hr



TABLE NO. 2
NOx & CO EMISSIONS TESTING RESULTS
Delray Power Plant - EU02 (CTG 12-1)
October 23, 2019

High Load 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%O2) ⁽¹⁾	NOx Emissions (lbs/hr) ⁽²⁾	CO Emissions (lbs/hr) ⁽³⁾
Run 1	23-Oct-19	8:35-9:09	72.8	1005.4	10.1	70.0	601.6	143.9	869.5	13.4	42.9	8.6
Run 2		9:19-9:49	72.3	1007.1	10.0	69.6	601.8	142.8	860.9	13.4	42.5	8.1
Run 3		9:59-10:30	71.8	1009.2	10.0	69.3	602.9	141.9	860.9	13.6	43.1	7.4
<i>Average:</i>			<i>72.3</i>	<i>1007.2</i>	<i>10.0</i>	<i>69.6</i>	<i>602.1</i>	<i>142.9</i>	<i>863.8</i>	<i>13.5</i>	<i>42.9</i>	<i>8.0</i>

Mid-High Load 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%O2) ⁽¹⁾	NOx Emissions (lbs/hr) ⁽²⁾	CO Emissions (lbs/hr) ⁽³⁾
Run 1	23-Oct-19	15:15-15:47	68.7	1020.0	9.7	68.2	615.4	138.2	835.1	14.2	43.7	5.4
Run 2		15:57-16:29	68.7	1020.1	9.7	68.4	616.9	138.4	835.1	14.1	43.4	5.2
Run 3		16:42-17:14	68.7	1019.9	9.7	68.3	616.2	138.3	835.1	14.3	44.1	5.3
<i>Average:</i>			<i>68.7</i>	<i>1020.0</i>	<i>9.7</i>	<i>68.3</i>	<i>616.2</i>	<i>138.3</i>	<i>835.1</i>	<i>14.2</i>	<i>43.7</i>	<i>5.3</i>

Mid-Low Load 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%O2) ⁽¹⁾	NOx Emissions (lbs/hr) ⁽²⁾
Run 1	23-Oct-19	13:07-13:39	64.3	1028.3	9.2	62.7	580.7	129.6	792.0	12.8	37.4
Run 2		13:50-14:22	64.3	1028.3	9.2	63.0	582.6	130.2	792.0	12.6	36.8
Run 3		12:25-12:57	64.3	1028.3	9.2	63.2	584.7	130.5	792.0	12.5	36.5
<i>Average:</i>			<i>64.3</i>	<i>1028.3</i>	<i>9.2</i>	<i>63.0</i>	<i>582.7</i>	<i>130.1</i>	<i>792.0</i>	<i>12.6</i>	<i>36.9</i>

Low Load 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%O2) ⁽¹⁾	NOx Emissions (lbs/hr) ⁽²⁾
Run 1	23-Oct-19	11:00-11:32	60.0	1039.6	8.8	57.7	580.7	122.2	757.6	12.1	33.8
Run 2		11:43-12:15	60.0	1040.0	8.8	58.1	582.6	122.4	757.6	12.2	34.1
Run 3		12:25-12:57	60.0	1040.6	8.8	58.3	584.7	122.5	757.6	12.2	34.1
<i>Average:</i>			<i>60.0</i>	<i>1040.1</i>	<i>8.8</i>	<i>58.0</i>	<i>582.7</i>	<i>122.4</i>	<i>757.6</i>	<i>12.2</i>	<i>34.0</i>

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

(2) Permit Limit = 66 lbs/hr

(3) Permit Limit = 64 lbs/hr

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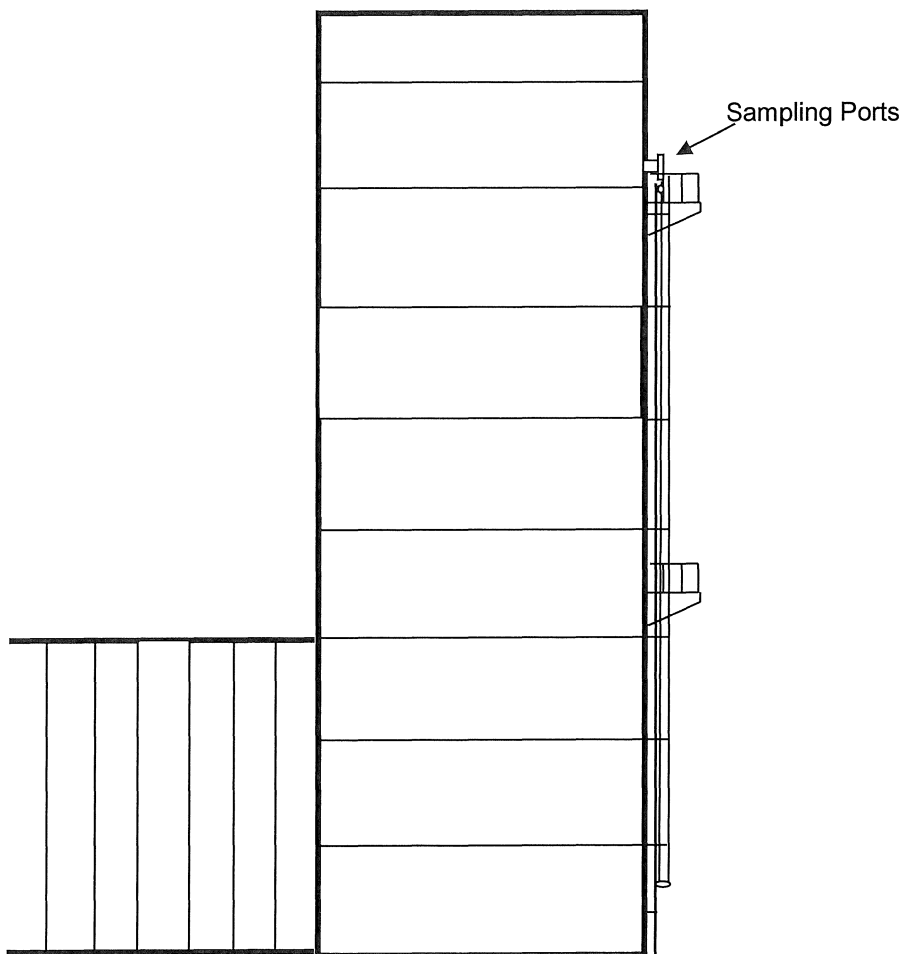
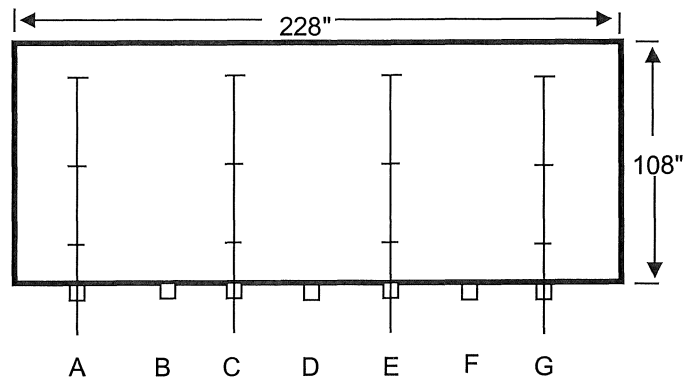
FIGURES

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Figure 1 – Sampling Location
DTE – Delray Peaking Station CTGs
October 23-24, 2019

NOx & CO sampling points

<u>Point</u>	<u>Distance (in.)</u>
3	18
2	54
1	90



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Figure 2 – Method 3A/7E/10 Sample Train Drawing
DTE – Delray Peaking Station CTGs
October 23-24, 2019

