COMPLIANCE TEST REPORT

for

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

EU02

Delray Peaking Facility (B2798)
Detroit, Michigan

September 08-09, 2021

Prepared By
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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Safety (EMS) 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 September 08-09, 2021, 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 testing was performed on one natural gas-fired peaker turbine for oxides of nitrogen (NO_x) and carbon monoxide (CO). The turbine is designated as EU02 (CTG 12-1) in the ROP.

The results of the emissions testing are highlighted below:

Emissions Testing Summary
Delray CTG 12-1
September 08-09, 2021

Unit[1]	Parameter[2]	High Load	Mid-High Load	Mid-Low Load	Low Load
EU02 (CTG 12-1)	**NOx** (ppm @ 15% O2)	**13.7**	**12.4**	**11.5**	**12.0**
	NOx (lbs/hr)	**43.5**	**35.6**	**31.1**	**34.5**
	CO (lbs/hr)	**13.5**	**18.7**	**19.6**	**13.7**

(1) Permit Limits: NOx – 15 ppm @ 15% O2
NOx – 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 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 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 enough 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 in Appendix B.

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 14.6 ppm. Results from the converter efficiency test demonstrated that the analyzer met the requirements of Method 7E (Eq-1).

Eq. 1

$$Eff_{NO2} = \frac{C_{Dir}}{C_v} = \frac{13.2}{14.6} = 90.7\%$$

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 A.

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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).

A natural gas sample was collected during the testing and analyzed for heat content and percent sulfur.

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

5.0 DISCUSSION OF RESULTS

Unit 12-1:

Table No. 1 presents the NOx and CO emissions testing results and operational data for CTG 12-1 at 4 loads (69.5MW, 62.0MW, 57.0MW, and 52.0MW). NOx 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 NOx emissions were 13.7 ppm and 43.5 lb/hr (69.5MW), 12.4 ppm and 35.8 lb/hr (62.0MW), 11.5 ppm and 31.1 lb/hr (57.0MW), and 12.0 ppm and 30.5 lb/hr (52.0MW). These values were all below the permit limits of 15 ppm and 66 lb/hr. The average CO emissions were 13.5 lbs/hr (69.5MW), and 18.7 lbs/hr (62.0MW). These values were below the permit limit of 64 lbs/hr.

The Results of the testing indicate that EU02 (Unit 12-1) is 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

NOx, CO Emissions Testing Results
CTG 12-1
Delray Peakers
DTE Energy
Low Load
September 8, 2021

CTG 12-1

	Run 1	Run 2	Run 3	Average
MW	52.0	52.0	52.0	52.0
NOx (ppm)	11.2	11.2	11.2	11.2
CO (ppm)	8.3	8.2	8.3	8.3
O2 (%)	15.3	15.4	15.4	15.4
NOx (ppm@15% O2)	11.9	12.0	12.0	12.0
CO (ppm @ 15% O2)	8.8	8.8	8.9	8.8
NOx (lb/mmBTU)	**0.044**	**0.044**	**0.044**	**0.044**
CO (lb/mmBtu)	**0.020**	**0.020**	**0.020**	**0.020**
Fuel Flow (lb/sec)	8.2	8.2	8.2	8.2
Fuel Flow (100 scf/hr)	6,727	6,730	6,730	6,729
Heat Input (mmBtu/hr)	**692.2**	**692.5**	**692.5**	**692.4**
Fuel Consumed (100 scf)	**3,027.2**	**2,804.1**	**2,916.3**	**2,915.9**
NOx Emission Rate (lb/hr)	30.22	30.53	30.69	30.48
CO Emission Rate (lb/hr)	13.72	13.69	13.76	13.72
CO Emission Rate (lb/mmscf fuel)	20.40	20.34	20.45	20.39

Gas Analysis:

Gross Heating Value (Btu/scf):	**1029**
Molecular Weight (lbs/lb.mol):	16.8936
Volume (ft^3/lb.mol):	385.14
Volume (ft^3/lb):	22.80

NOx, CO Emissions Testing Results
CTG 12-1
Delray Peakers
DTE Energy
Mid Low Load
September 9, 2021

CTG 12-1

	Run 1	Run 2	Run 3	Average
MW	57.0	57.0	57.0	57.0
NOx (ppm)	10.9	10.9	10.9	10.9
CO (ppm)	11.5	11.0	11.2	11.2
O2 (%)	15.3	15.3	15.3	15.3
NOx (ppm@15% O2)	11.5	11.6	11.5	11.5
CO (ppm @ 15% O2)	12.2	11.7	11.9	11.9
NOx (lb/mmBTU)	**0.042**	**0.043**	**0.042**	**0.042**
CO (lb/mmBtu)	**0.027**	**0.026**	**0.027**	**0.027**
Fuel Flow (lb/sec)	8.7	8.7	8.7	8.7
Fuel Flow (100 scf/hr)	7,121	7,125	7,115	7,120
Heat Input (mmBtu/hr)	**732.8**	**733.1**	**732.1**	**732.7**
Fuel Consumed (100 scf)	**2,967.2**	**2,968.5**	**2,964.6**	**2,966.8**
NOx Emission Rate (lb/hr)	30.97	31.22	31.09	31.09
CO Emission Rate (lb/hr)	19.98	19.15	19.50	19.55
CO Emission Rate (lb/mmscf fuel)	28.06	26.89	27.41	27.45

Gas Analysis:

Gross Heating Value (Btu/scf):	**1029**
Molecular Weight (lbs/lb.mol):	16.8936
Volume (ft^3/lb.mol):	385.14
Volume (ft^3/lb):	22.80

NOx, CO Emissions Testing Results
CTG 12-1
Delray Peakers
DTE Energy
Mid High Load
September 9, 2021

CTG 12-1

	Run 1	Run 2	Run 3	Average
MW	62.0	62.0	62.0	62.0
NOx (ppm)	11.4	11.8	12.0	11.7
CO (ppm)	12.1	10.0	8.2	10.1
O2 (%)	15.3	15.3	15.3	15.3
NOx (ppm@15% O2)	12.1	12.5	12.8	12.4
CO (ppm @ 15% O2)	12.8	10.5	8.7	10.7
NOx (lb/mmBTU)	**0.044**	**0.046**	**0.047**	**0.046**
CO (lb/mmBtu)	**0.029**	**0.024**	**0.020**	**0.024**
Fuel Flow (lb/sec)	9.3	9.2	9.2	9.2
Fuel Flow (100 scf/hr)	7,633	7,585	7,554	7,591
Heat Input (mmBtu/hr)	**785.4**	**780.5**	**777.3**	**781.1**
Fuel Consumed (100 scf)	**3,180.3**	**3,160.6**	**3,147.4**	**3,162.8**
NOx Emission Rate (lb/hr)	34.88	35.88	36.57	35.78
CO Emission Rate (lb/hr)	22.48	18.41	15.25	18.71
CO Emission Rate (lb/mmscf fuel)	29.46	24.27	20.19	24.64

Gas Analysis:

Gross Heating Value (Btu/scf):	**1029**
Molecular Weight (lbs/lb.mol):	16.8936
Volume (ft^3/lb.mol):	385.14
Volume (ft^3/lb):	22.80

NOx, CO Emissions Testing Results
CTG 12-1
Delray Peakers
DTE Energy
High Load
September 9, 2021

CTG 12-1

	Run 1	Run 2	Run 3	Average
MW	70.5	69.3	68.7	69.5
NOx (ppm)	13.4	12.4	12.5	12.8
CO (ppm)	5.2	7.2	7.2	6.5
O2 (%)	15.3	15.4	15.4	15.4
NOx (ppm@15% O2)	14.1	13.4	13.5	13.7
CO (ppm @ 15% O2)	5.5	7.7	7.8	7.0
NOx (lb/mmBtu)	**0.052**	**0.049**	**0.050**	**0.050**
CO (lb/mmBtu)	**0.012**	**0.017**	**0.017**	**0.016**
Fuel Flow (lb/sec)	10.4	10.2	10.1	10.2
Fuel Flow (100 scf/hr)	8,509	8,386	8,299	8,398
Heat Input (mmBtu/hr)	**875.6**	**862.9**	**853.9**	**864.2**
Fuel Consumed (100 scf)	**3,545.5**	**3,773.7**	**3,457.8**	**3,592.4**
NOx Emission Rate (lb/hr)	45.53	42.53	42.38	43.48
CO Emission Rate (lb/hr)	10.74	14.96	14.90	13.53
CO Emission Rate (lb/mmscf fuel)	12.63	17.83	17.95	16.14

Gas Analysis:

Gross Heating Value (Btu/scf):	**1029**
Molecular Weight (lbs/lb.mol):	16.8936
Volume (ft^3/lb.mol):	385.14
Volume (ft^3/lb):	22.80

Calculations:

NOx corr. (ppm) = NOx (ppm) x (5.9/(20.9-O2%))

NOx (lb/mmBTU) = NOx(ppm) x 8710 x 1.194-7 x (20.9/(20.9-O2))

Fuel Flow (100scf/hr) = Fuel Flow ((lb/sec) x 3600 x (Gas volume (cf/lb))/100

Heat Input (MBtu/hr) = (Fuel Flow (100scf/hr) x 100 x 991) /10-6

NOx Emission Rate (lb/hr) = NOx (ppm) x 1.194E-7 x 8710 (ft3/Btu) x (20.9/(20.9-O2)) x Fuel Flow (100 scf/hr) x GHV (Btu/scf)

CO Emission Rate (lb/hr) = CO (ppm) x 7.268E-8 x 8710 (ft3/Btu) x (20.9/(20.9-O2)) x Fuel Flow (100 scf/hr) x GHV (Btu/scf)

CO Emission Rate (lb/mm-scf) = CO Emission Rate (lbs/hr) / { Fuel Flow (lb/sec) x 3600 (sec/hr) x Gas volume (scf/lb) / 1,000,000 }

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FIGURES

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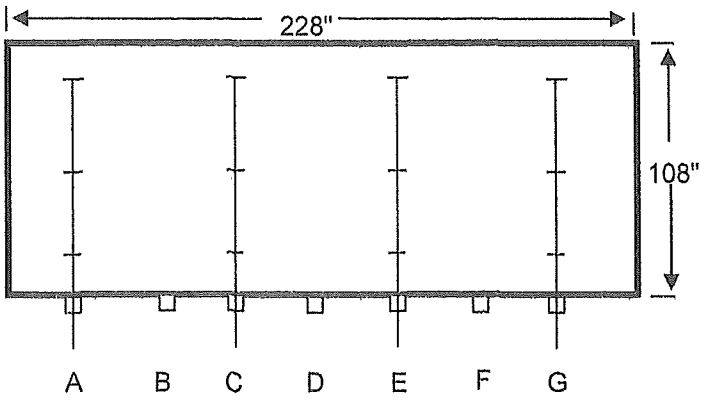
Figure 1 – Sampling Location
DTE – Delray Peaking Station CTGs
September 08-09, 2021

NOx & CO sampling points

Point	Distance (in.)
3	18
2	54
1	90



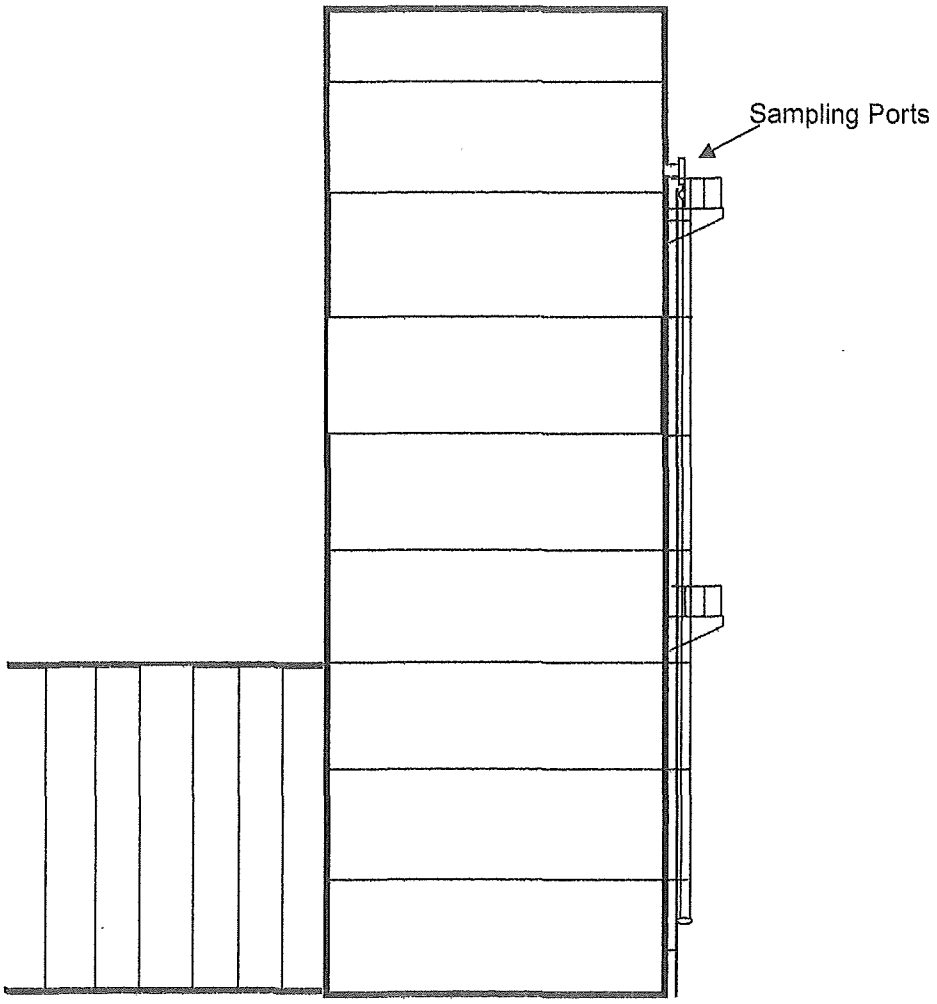


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Figure 2 – Method 3A/7E/10 Sample Train Drawing
DTE – Delray Peaking Station CTGs
September 08-09, 2021