DTE

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March 14, 2019

Mr. Scott Miller
Air Quality Division
Michigan Department of Environmental Quality
301 E. Louis B Glick Highway
Jackson, MI 49201

-- transmitted via FedEx --

Subject: ***Submittal of Emissions Test Report:***
EURICE1, EURICE2, EURICE3
DTE Willow Run Compressor Station – PTI 44-16A
Ypsilanti, MI

Dear Mr. Miller:

Enclosed find the report for emissions testing conducted on three (3) new RICE engines at the DTE – Willow Run Compressor Station. The testing was conducted on January 15-16, 2019. The testing was conducted by Montrose Air Quality Services.

The attached report details the results of nitrogen oxides (NO_X) testing in the emissions from each of the three engines referenced above. Only NO_X was tested at that time. CO destruction efficiency testing was not conducted, and will need to be conducted a not yet determined date. The previously submitted ***Request for a Test Deadline Extension***, dated January 17, 2019, explains why CO destruction could not be tested at that time.

If you have any questions about this report or would like to discuss plans for completing the CO destruction efficiency testing, please contact me at (313) 897-0298 or thomas.durham@dteenergy.com.

Sincerely,
DTE ENERGY CORPORATE SERVICES, LLC

Thomas Durham
Manager, Environmental Field Services
Environmental Management & Resources (EM&R)

enc *Emission Test Report – EURICE1, EURICE2, EURICE3*

cc Karen Kajiya-Mills – MDEQ (with enc)

EXECUTIVE SUMMARY

Montrose Air Quality Services (MAQS) was retained by DTE Energy Corporate Services (DTE) to evaluate nitrogen oxides (NOx) emission rates from three engines while operating at 90% load or greater at the Willow Run Compressor Station located in Ypsilanti, Michigan. The emissions test program was conducted on January 15th-16th, 2019.

Testing of engines consisted of triplicate 60-minute test runs while each unit was operating at 90% load or greater. The emissions test program was required by MDEQ Air Quality Division Permit to Install No. 44-16A. Permitted emissions limits for all three engines were met. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: January 15th-16th, 2019

Engine 2100 (EURICE 1)		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	27 ppmvd[1]	82 ppmvd[1]
NOx	3.49 lb/hr	5.51 lb/hr
Engine 2200 (EURICE 2)		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	32 ppmvd[1]	82 ppmvd[1]
NOx	2.05 lb/hr	2.76 lb/hr
Engine 2300 (EURICE 3)		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	34 ppmvd[1]	82 ppmvd[1]
NOx	2.00 lb/hr	2.76 lb/hr

[1] NOx ppmvd corrected to 15% O_2

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1. Introduction

Montrose Air Quality Services (MAQS) was retained by DTE Energy Corporate Services (DTE) to evaluate nitrogen oxides (NOx) emission rates from three engines while operating at 90% load or greater at the Willow Run Compressor Station located in Ypsilanti, Michigan. The emissions test program was conducted on January 15th-16th, 2019.

Michigan Department of Environmental Quality – Air Quality Division has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (March 2018). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on January 15th-16th, 2019 at the Willow Run Compressor Station located in Ypsilanti, Michigan. The test program included evaluation of NOx and O_2 emissions from Engines 2100, 2200, and 2300.

1.b Purpose of Testing

AQD issued PTI 44-16A to DTE. This permit limits emissions from each engine as summarized by Table 1.

Table 1
NOx Emission Limitations
DTE Willow Run

Engine	NOx Emission Limits
2100 (EURICE1)	82 ppmvd*
	5.51 lbs/hr**
2200 (EURICE2) and 2300 (EURICE3)	82 ppmvd*
	2.76 lbs/hr**

*Corrected to 15% O_2
** Per Method 19

1.c Source Description

The Willow Run Compressor Station located at 3020 East Michigan Ave, Ypsilanti, Michigan, employs the use of three non-emergency natural gas-fired reciprocating internal combustion engines (RICE). The engines are identified as EURICE1, EURICE2, and EURICE3 in PTI 44-16A. EURICE2 and EURICE3 are rated at 2,500 HP and EURICE1 are rated at 5,000 HP.

1.d Test Program Contacts

The contacts for the source and test report are:

Mr. Chris Conley
Manager, Transmission & Storage Operations
DTE GAS
3515 Childs Lake Rd
Milford, MI 48381
(248) 685-9606

Mr. Thomas Durham
Manager, Environmental Field Services
DTE Energy
7940 Livernois Ave., WSC, H-136
Detroit, MI 49210
(313) 897-0298

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Brad Piontek	DTE Gas Compressor Station Willow Run 3020 East Michigan Ave Ypsilanti, MI	(248) 217-7355
Mr. Steven Smith Field Project Manager	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mike Nummer Field Technician	MAQS 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Tom Gasoli	MDEQ Air Quality Division	(517) 402-6315

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

Operating parameters used to regulate the engines include speed & torque (BHp), fuel flow, inlet & exhaust temperature & pressure, and timing.

2.b Applicable Permit

The applicable permit for this emissions test program is PTI 44-16A.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). NOx emissions from each engine were below the corresponding limit of 5.51 lb/hr for engine 2100 and 2.76 lb/hr for engine 2200 and 2300.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

Each of the three compressor engines operate on an as needed basis providing pipeline pressure. Each engine was tested at 100% (+/- 10%) rated capacity.

3.b Process Flow Diagram

Due to the simplicity of the natural gas engine, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The engines are natural gas-fired units. Fuel consumption varies with operating parameters and will be measured throughout the emissions test.

3.d Process Capacity

Engine 2100 is rated at 5,000 HP and engines 2200 and 2300 are rated at 2,500 HP. The engines were tested at loads over 90% capacity.

3.e Process Instrumentation

Operating parameters used to regulate the engines include speed & torque (BHp), fuel flow, inlet & exhaust temperature & pressure, and timing. Operating parameters were documented during each run.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Engine exhaust NOx content was measured using a Teledyne Model T-200H NOx gas analyzer and the O_2 content was measured using a Servomex 4100 O_2/CO_2 gas analyzer. A sample of the gas stream was drawn through an insulated stainless-steel probe with an in-line glass fiber filter to remove any particulate, a heated Teflon® sample line, and through an electronic sample conditioner to remove the moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with data acquisition software.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United State's National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A schematic of the sampling train is provided as Figure 1.

Sampling and analysis procedures utilized the following test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 3A, "*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources*", was used to measure the O_2 concentration of the exhaust gas.

- Method 7E, "*Determination of Nitrogen Oxide Emissions from Stationary Sources*", was used to measure the NOx concentration of the exhaust gas.

- Method 19, "*Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates*", was used to calculate the exhaust gas flowrates.

The accuracy of the gas dilution system was verified using the procedures detailed by Method 205 and the NOx converter efficiency was verified as specified by Method 7E.

4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

4.c Sampling Ports

A single outlet port was used for sampling at three traverse points.

4.d Traverse Points

Three traverse points were used for sampling each run.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 3. Detailed results for the emissions test program are summarized by Tables 4-6.

Table 3
Overall Emission Summary
Test Date: January 15th-16th, 2019

Engine 2100 (EURICE 1)		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	27 ppmvd[1]	82 ppmvd[1]
NOx	3.49 lb/hr	5.51 lb/hr
Engine 2200 (EURICE 2)		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	32 ppmvd[1]	82 ppmvd[1]
NOx	2.05 lb/hr	2.76 lb/hr
Engine 2300 (EURICE 3)		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	34 ppmvd[1]	82 ppmvd[1]
NOx	2.00 lb/hr	2.76 lb/hr

1 NOx ppmvd corrected to 15% O_2

5.b Discussion of Results

NOx emissions from each engine were below the corresponding limit of 5.51 lb/hr for engine 2100 and 2.76 lb/hr for engine 2200 and 2300.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

There was no control equipment maintenance performed during the emissions test program.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.

5.i Sample Calculations

Sample calculations are provided in Appendix C.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

5.k Laboratory Data

There are no laboratory results for this test program. Raw CEM data is provided electronically in Appendix D.

MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment

calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

All testing performed was done in conformance to the ASTM D7036-04 standard. The information and opinions rendered in this report are exclusively for use by DTE Energy. MAQS will not distribute or publish this report without DTE Energy's consent except as required by law or court order. MAQS accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by: _____

Steven Smith
Client Project Manager

This report was reviewed by: _____

Matt Young
Client Project Manager

Tables

Table 4
Engine 2100 Nox Emission Rates
DTE Willow Run
Ypsilanti, Michigan
MAQS Project Number 049AS-549969
Sampling Dates: January 15, 2019

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/15/2019	1/15/2019	1/15/2019	
Test Run Time	17:32-18:32	18:42-19:42	19:52-20:52	
Gas flowrate (scfh)	33,727	33,741	33,778	**33,749**
Oxygen Concentration (%)	10.9	10.9	10.9	**10.9**
Oxygen Concentration (%, drift corrected as per USEPA 7E)	11.2	11.2	11.1	**11.2**
Outlet Oxides of Nitrogen Concentration (ppmv)	44.4	44.5	45.3	**44.7**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	44.3	44.3	45.4	**44.7**
Outlet NOx Concentration (ppmv, corrected to 15% O_2)	**26.9**	**26.9**	**27.4**	**27.1**
Outlet NOx (lb/mmbtu)	0.099	0.099	0.101	**0.100**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E) Method-19	**3.47**	**3.47**	**3.54**	**3.49**

O_2 Correction			
Co	0.00	0.00	0.00
Cma	10.08	10.08	10.08
Cm	9.85	9.82	9.87

NOx Correction			
Co	1.07	0.96	0.92
Cma	100	100	100
Cm	98.82	99.13	98.61

Natureal gas BTU = 1038
scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, SO_2 = 64.05, C_3H_8 = 44.10, carbon = 12.01)
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Co= Average of initial and final zero gases
Cma=Actual concentration of the calibration gas
Cm= Average of initial and final calibration gases
[1]emission rate calculated on dry basis
[2]emission rate calculated on wet basis

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***dcfm*** * 60
$Conc_{@15\%O2}$ = Conc * (20.9 -15)/(20.9 - $\%O_2$)

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Table 5
Engine 2200 Nox Emission Rates
DTE Willow Run
Ypsilanti, Michigan
MAQS Project Number 049AS-549969
Sampling Dates: January 15, 2019

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/15/2019	1/15/2019	1/15/2019	
Test Run Time	13:05-14:05	14:15-15:16	15:27-16:27	
Gas flowrate (scfh)	16,912	16,904	16,860	**16,892**
Oxygen Concentration (%)	11.1	11.1	11.0	**11.1**
Oxygen Concentration (%, drift corrected as per USEPA 7E)	11.3	11.3	11.2	**11.3**
Outlet Oxides of Nitrogen Concentration (ppmv)	50.8	51.4	52.2	**51.5**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	51.3	51.5	53.0	**51.9**
Outlet NOx Concentration (ppmv, corrected to 15% O_2)	**31.3**	**31.5**	**32.4**	**31.7**
Outlet NOx (lb/mmbtu)	0.115	0.116	0.119	**0.117**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E) Method-19	**2.03**	**2.04**	**2.09**	**2.05**

O_2 Correction			
Co	0.00	0.00	0.00
Cma	10.08	10.08	10.08
Cm	9.95	9.91	9.89

NOx Correction			
Co	1.46	1.90	1.14
Cma	100	100	100
Cm	97.76	98.04	97.57

Natureal gas BTU = 1038
scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, SO_2 = 64.05, C_3H_8 = 44.10, carbon = 12.01)
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Co= Average of initial and final zero gases
Cma=Actual concentration of the calibration gas
Cm= Average of initial and final calibration gases
[1]emission rate calculated on dry basis
[2]emission rate calculated on wet basis

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***dcfm*** * 60
$Conc_{@15\%O2}$ = Conc * (20.9 -15)/(20.9 - $\%O_2$)

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Table 6
Engine 2300 Nox Emission Rates
DTE Willow Run
Ypsilanti, Michigan
MAQS Project Number 049AS-549969
Sampling Dates: January 16, 2019

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/16/2019	1/16/2019	1/16/2019	
Test Run Time	9:20-10:20	10:28-11:28	11:38-12:38	
Gas flowrate (scfh)	15,156	15,761	15,915	**15,611**
Oxygen Concentration (%)	11.4	11.4	11.4	**11.4**
Oxygen Concentration (%, drift corrected as per USEPA 7E)	11.5	11.5	11.6	**11.5**
Outlet Oxides of Nitrogen Concentration (ppmv)	52.0	52.2	52.3	**52.2**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	53.2	53.1	53.3	**53.2**
Outlet NOx Concentration (ppmv, corrected to 15% O_2)	**33.4**	**33.5**	**33.6**	**33.5**
Outlet NOx (lb/mmbtu)	0.123	0.123	0.124	**0.123**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E) Method-19	**1.94**	**2.02**	**2.05**	**2.00**

O_2 Correction			
Co	0.07	0.05	0.02
Cma	10.08	10.08	10.08
Cm	9.98	9.97	9.94

NOx Correction			
Co	0.26	0.63	0.80
Cma	100	100	100
Cm	97.46	97.87	97.57

Natureal gas BTU = 1038
scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, SO_2 = 64.05, C_3H_8 = 44.10, carbon = 12.01)
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Co= Average of initial and final zero gases
Cma=Actual concentration of the calibration gas
Cm= Average of initial and final calibration gases
[1]emission rate calculated on dry basis
[2]emission rate calculated on wet basis

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***dcfm*** * 60
$Conc_{@15\%O2}$ = Conc * (20.9 -15)/(20.9 - $\%O_2$)

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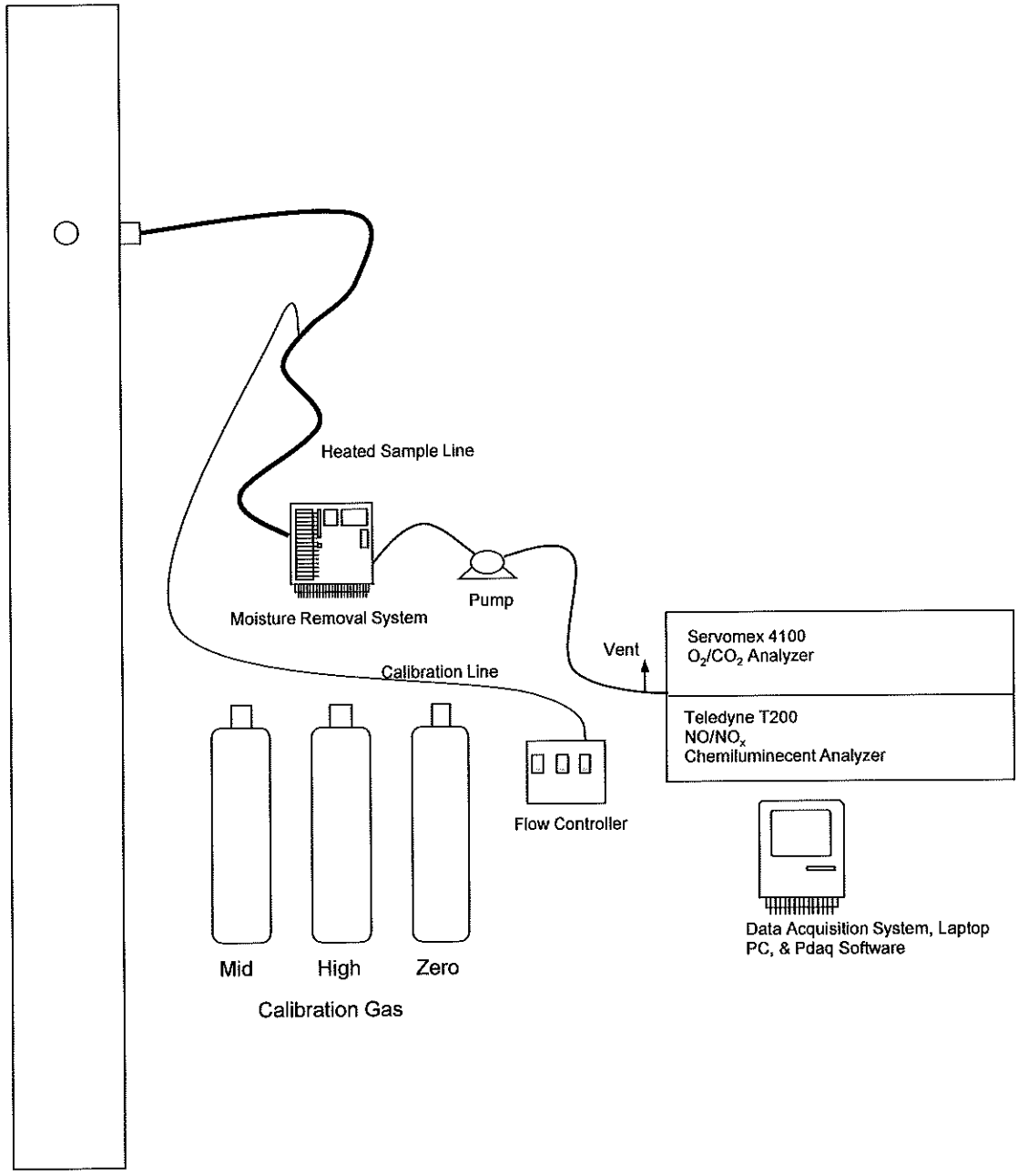

Figure No. 1

Site: **USEPA Method 3A and 7E** **DTE Willow Run** **Ypsilanti, Michigan**	**Sampling Date:** **January 15-16, 2019**	**Montrose Air Quality Services** **4949 Fernlee Avenue** **Royal Oak, MI 48073**