

Consumers Energy

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Compliance Test Report

**OVERISEL COMPRESSOR STATION
EUEMERGENGINEGEN**

**Overisel Compressor Station
4131 138th Avenue
Hamilton, Michigan 49419**

Test Date: April 21, 2014

**Report Submitted:
June 19, 2014**

**Work Order No. 22182713
Report Revision 0**

**Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Laboratory Services Department**

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1.0 INTRODUCTION

Identification, location and dates of tests

This report summarizes the results of testing conducted on April 21, 2014 at Consumers Energy Company's (CEC) Overisel Compressor Station. CEC's Regulatory Compliance Testing Section (RCTS) conducted air emission tests on one (1) (4SLB) natural gas-fired, emergency reciprocating internal combustion engine (RICE), identified as EUEMERGENGINEGEN. The engine is located and operating at the Overisel Compressor Station in Hamilton, Michigan.

Purpose of testing

The purpose of the testing was to evaluate compliance with Standards of Performance for Stationary Spark Ignition (SI) Internal Combustion Engines (ICE), 40 CFR Part 60, Subpart JJJJ (Special Condition V.1 of PTI No. 9-13). This test program reflects the initial Subpart JJJJ performance test for the emergency engine and consisted of the following:

Unit	Parameter to be Tested	Underlying Regulation
EUEMERGENGINEGEN	Nitrogen Oxides (NO _x), Carbon Monoxide (CO) & Volatile Organic Compound (VOC) emissions & diluent gas (O ₂ or CO ₂) at exhaust outlet	Subpart JJJJ

Brief description of source

The Overisel Compressor Station is a natural gas compressor station. The purpose of the facility is to compress and maintain natural gas pipeline system pressure along the pipeline system.

EUEMERGENGINEGEN is a Caterpillar Model G3516 LE 4SLB design and is exclusively fired with pipeline quality natural gas. This RICE is not equipped with add-on controls.

Names, addresses, and telephone numbers of the contacts for information regarding the test and the test report, and names and affiliation of all personnel involved in conducting the testing

The testing was performed by CEC RCTS employees Brian Glendening, Joe Mason and Gregg Koteskey on April 21, 2014. MDEQ representatives Mr. Dennis Dunlap and Mr. Nathan Hude observed portions of the test. CEC Senior Technician, Mr. Craig Jaeger, coordinated the test and collected operating data. The following table contains the test program participant contact information.

**Test Program Participants
Overisel Compressor Station**

Responsible Party	Address	Contact
Test Facility	Overisel Compressor Station 4131 138th Avenue Hamilton, MI 49419	Mr. Leslie Bradshaw 269-751-3042 leslie.bradshaw@cmsenergy.com
Corporate Air Quality Contact	Consumers Energy Company Environmental Services Department 1945 West Parnall Road Jackson, Michigan 49201	Ms. Amy Kapuga 517-788-2201 amy.kapuga@cmsenergy.com
Test Representative	Consumers Energy Company Regulatory Compliance Testing Section 17010 Crosswell Street West Olive, Michigan 49460	Mr. Joe Mason, QSTI 231-720-4856 joe.mason@cmsenergy.com
State Representative	Michigan Department of Environmental Quality Air Quality Division 525 W. Allegan, Constitution Hall Lansing, Michigan 48909	Mr. Dennis Dunlap 269-567-3553 dunlapd@michigan.gov
		Mr. Nathan Hude 517-284-6779 HudeN@michigan.gov

2.0 SUMMARY OF RESULTS

Operating Data

EUEMERGENGINEGEN

Operating data collected during each test run for the emergency engine included amps, kilowatts, fuel flow rate, horsepower, power rate, rpm, ambient temperature, barometric pressure and humidity. The purpose of documenting horsepower is to verify that the unit was operating at full load during the performance test, as Subpart JJJJ § 60.4244(a) states *each performance test must be conducted within 10 percent of 100 percent peak (or the highest achievable) load.*

Applicable Permit Number

The Overisel Compressor Station is currently operating pursuant to the terms and conditions of Renewable Operating Permit (ROP) No. MI-ROP-N5792-2012 and Permit to Install (PTI) No. 9-13, which was issued on March 11, 2013. Performance tests were conducted, as required, on one (1) 4SLB natural gas-fired emergency RICE, identified as EUEMERGENGINEGEN.

Results

The purpose of the testing was to evaluate compliance with Standards of Performance for Stationary Spark Ignition (SI) Internal Combustion Engines (ICE), 40 CFR Part 60, Subpart JJJJ. A summary of the test results are presented below.

NO_x, CO and VOC emission rates were verified for the natural gas-fired RICE pursuant to PTI No. 9-13, which was issued on March 11, 2013. Installation of the emergency RICE authorized in PTI No. 9-13 was completed on November 26, 2013.

Summary of 40 CFR 60 Subpart JJJJ NO_x, CO and VOC Emission Rates

Source	NO _x Emission Rate (g/HP-hr) [PTI/JJJJ Limit = 2.0]	CO Emission Rate (g/HP-hr) [PTI/JJJJ Limit = 4.0]	VOC Emission Rate, Expressed as NMOC (g/HP-hr) [JJJJ Limit = 1.0]
EUEMERGENGINEGEN	1.59	1.637	0.055

The NO_x, CO and VOC engine emission rates shown above all fall within the permit requirements, as well as the applicable emission limits within 40 CFR Part 60, Subpart JJJJ in cases where the permit does not contain an explicit emission limit (i.e., VOCs).

3.0 SOURCE DESCRIPTION

Description of Process

The Overisel Compressor Station is a natural gas compressor station. The purpose of the facility is to maintain pressure of natural gas in order to move it along the pipeline system. The engine relevant to this regulation and emission compliance test demonstration is a natural gas-fired engine which operates an emergency electric generator for the compressor site. The engine is identified as EUEMERGENGINEGEN, which was installed in 2013.

The NO_x emissions are minimized through the use of lean-burn combustion technology. Lean-burn combustion refers to a high level of excess air (generally 50% to 100% relative to the stoichiometric amount) in the combustion chamber. The excess air absorbs heat during the combustion process, thereby reducing the combustion temperature and pressure and resulting in lower NO_x emissions.

Since original installation, significant maintenance has not been performed on the engine.

Process Flow Sheet or Diagram

NA

Type and Quantity of Raw Material Processed During the Tests

NA

Maximum and Normal Rated Capacity of the Process

The Overisel Compressor Station operates one natural gas-fired, 4SLB Caterpillar engine, without add-on controls, which supplies emergency power. The following table contains pertinent engine specifications.

Summary of Specifications for Overisel Compressor Station RICE

Parameter ¹	EUEMERGENGINEGEN
Make	Caterpillar
Model	G3516 LE
Output (brake-horsepower)	1,462
Heat Input, LHV (mmBtu/hour)	11.5
Exhaust Gas Temp. (°F)	875

¹ All engine specifications are based upon vendor data for operation at 100% of rated engine capacity.

Description of Process Instrumentation Monitored During the Test

Emergency engine process data collected included torque, rpm, engine load, fuel flow rate, ambient temperature, barometric pressure and humidity. The preceding data was logged at least once every clock minute and then averaged to determine the per-test run values.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Description of sampling train(s) and field procedures

All testing, sampling, analytical, and calibration procedures used for this test program were performed in accordance with specific Reference Methods from 40 CFR Part 60, Appendix A. These Reference Methods include Methods 1 (Sampling Point Locations), 3A (O₂/CO₂ – Instrumental), 4 (Moisture), 7E (NO_x – Instrumental), 10 (CO – Instrumental) and 25A (VOC – Flame Ionization). In addition, 40 CFR Part 60, Appendix A, Method 19 (Emissions Rates via Use of Fuel Factors) was used to determine the RICE exhaust gas flow rates to permit calculation of gram per brake horsepower emission rates for NO_x, CO and VOCs.

All testing was conducted with the engine operating within 10% of 100% peak (or the highest achievable) load. The compliance demonstration test consisted of triplicate, one-hour test runs performed at the exhaust stack.

On February 27, 2014, the US EPA promulgated revisions to various sections of 40 CFR Parts 51, 60, 61 and 63 in order to change specific testing requirements and Federal Reference Methods. Among these changes was a revision to Table 2 of 40 CFR Part 60, Subpart JJJJ which allows NO_x, CO, VOC and diluent testing to be conducted at sampling points located at 16.7%, 50.0% and 83.3% of the measurement line if the following criteria are met: 1) duct is greater than 12 inches in diameter and 2) the test ports are located at least 2 duct diameters downstream and ½ duct diameters upstream from the nearest flow disturbances. As the EUEMERGENGEN test location met the preceding criteria, sampling was conducted along the allowed 3-point measurement line. Because of this provision, stratification testing according to the criteria of Section 8.1.2 of Method 7E was not conducted.

All components of the O₂/CO₂, NO_x, CO and VOC extractive sample systems in contact with flue gas are constructed of Type 316 stainless steel and/or Teflon. Engine exhaust gas was drawn from the stack via two different sample probes and heated sample lines with the O₂/CO₂, NO_x and CO routed through an ice bath gas dryer for moisture removal prior to being distributed from a gas manifold into the respective analyzers. Conversely, the VOC sample system measures exhaust gas organic concentration on a wet basis; therefore, the gas sampling system did not include any moisture removal. The output signal from each analyzer was connected to a computerized data acquisition system (DAS).

The O₂/CO₂, NO_x, and CO analyzers were calibrated with U.S. EPA Protocol calibration gases at a minimum of three points: zero (0-20% of calibration span), mid-level (40-60% of calibration span) and high-level gas (equal to the calibration span). The VOC instrument were calibrated using the bias and drift correction conditions described in U.S. EPA Method 7E and calibrated following the calibration gas specifications of U.S. EPA Method 25A with four gases consisting of zero, low (25 to 35 percent of calibration span), mid (45 to 55 percent of calibration span) and high (equivalent to instrument span), using propane. All instruments were operated thereafter to insure that zero drift, calibration gas drift, bias and calibration error meet the specified method requirements.

The data measured from the pollutant and diluent analyzers were averaged for each run and corrected for drift and bias. O₂ or CO₂ concentrations were measured as percent by volume, dry basis. The extractive sample system apparatus diagram is shown in Figure 1.

Detailed Discussion of Test Methods

O₂ and/or CO₂ diluent concentrations were monitored using a non-dispersive infrared (NDIR) analyzer following the guidelines of U.S. EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from a Stationary Source (Instrumental Analyzer Procedure).

NO_x concentrations were monitored using a chemiluminescence analyzer following the guidelines of U.S. EPA Method 7E, Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure).

The CO concentrations were measured using an NDIR analyzer following the guidelines of U.S. EPA Reference Method 10, Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure).

VOC concentrations were monitored using a flame ionization analyzer following the guidelines of U.S. EPA Method 25A, Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer (FIA) using the drift and bias corrections specified in U.S. EPA Method 7E, Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure). A Thermo Model 55i Direct Methane and Non-methane Analyzer was used for the VOC determinations. This instrument is similar to a Method 25A analyzer with methane cutter in that it employs a flame ionization detector (FID) analytical principal and is capable of providing a total hydrocarbon concentration, minus methane. However, with the Thermo 55i analyzer, the method of determining the methane and non-methane organic concentrations is slightly different. Specifically, while the Thermo 55i does rely upon a FID to determine the concentration of organic compounds, it also contains a gas chromatographic column which is used to separate methane from the other organic compounds. It works by first injecting the sample gas into the column, after which the methane fraction of the sample gas moves through the column more quickly than the other organic compounds (due to its low molecular weight and high volatility). The methane then exits the column and is analyzed in the FID. After the methane has been analyzed, the column is flushed with inert carrier gas and the remaining non-methane organic compounds are then analyzed in the FID. The preceding analytical technique results in separate measurements for methane and non-methane organic compounds via the use of a single FID, and these measurements were recorded by the data acquisition system. Compared to more conventional Method 25A analyzers with methane cutters, the Thermo 55i is expected to yield more accurate low-level non-methane hydrocarbon measurements, even in the presence of high levels of methane. It should be noted that, for purposes of this test program, RCTS did not quality assure the methane channel on the Thermo Model 55i analyzer. Volumetric flow rate was determined by Method 19, SO₂ Removal & PM, SO₂, NO_x Rates from Electric Utility Steam Generators, as allowed by Table 2 of Subpart JJJJ. Although Subpart JJJJ does not

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provide any instruction on the use of Method 19 for the flow rate determination, the US EPA's Emission Measurement Center website does contain detailed guidance for such use of Method 19 (for more information see <http://www.epa.gov/ttn/emc/methods/method19.html>).

Consumers Energy implemented the following procedures, consistent with the US EPA guidance for Method 19 when used in this capacity:

- For each day of the Subpart JJJJ stack testing, a representative natural gas sample was obtained and the ultimate analysis and gross heating value of the fuel were determined.
- The preceding information was used to calculate test specific F_d or F_c fuel factors using Method 19, Equations 19-13 or 19-15, respectively.
- A permanently mounted gas fuel flow meter was used to measure the amount of fuel combusted during each test, and the readings were arranged such that they correspond with the start and stop times for each test run. In addition, Consumers Energy ensured that the fuel flow meter was calibrated prior to the test event, with the calibration meeting the criteria in Reference Method 2A, Section 6.1 (i.e., volume accuracy of $\pm 2\%$).

Moisture determinations were completed following the guidelines of U.S. EPA Reference Method 4, Determination of Moisture Content in Stack Gases. The moisture measurements were utilized during all test runs in which moisture is used to correct pollutant or diluent concentrations from a wet to dry, or dry to wet basis. The preceding primarily relates to the correction of Method 25A VOC concentrations from a wet to dry basis. It should be noted that the February 27, 2014 revisions to 40 CFR Parts 51, 60, 61 and 63 also introduced an additional technique within Method 4 for purposes of determining exhaust gas moisture content. Section 16.4 now contains an approach based on the use of fuel factors, exhaust gas oxygen content, moisture content of the fuel and ambient conditions (i.e., temperature, barometric pressure and relative humidity). RCTS chose to employ the technique in Section 16.4 in lieu of conducting a conventional Method 4 test.

Variances to Method or Regulation Measurements

Variances proposed in the test protocol and accepted by the regulatory agency (MDEQ) include two specific issues:

- Table 2 of Subpart JJJJ requires that O₂ concentrations be determined in conjunction with the NO_x, CO and VOC measurements. Consumers Energy measured CO₂ as the diluent gas in conjunction with the pollutant measurements. In regards to Subpart JJJJ, the O₂ data primarily seems relevant for those attempting to demonstrate compliance with the alternate concentration based limits, which are corrected to 15% O₂. Instead, Consumers Energy demonstrated compliance with the g/HP-hr emission limits in Subpart JJJJ.

- Table 2 of Subpart JJJJ requires the use of U.S. EPA Method 18 (VOC by Gas Chromatography) whenever Method 25A is employed to measure VOCs in order to permit the deduction of formaldehyde (note that the Subpart JJJJ VOC emission limits exclude formaldehyde). Consumers Energy directly compared the Method 25A VOC derived emission rate to the applicable emission limit within Subpart JJJJ.

Quality Assurance Procedures

Each U.S. EPA reference method performed during this test contains specific language stating that to obtain reliable results, persons using these methods should have a thorough knowledge of the techniques associated with each method. To that end, CEC RCTS attempts to minimize any factors which could cause sampling errors by implementing a quality assurance (QA) program into every component of field testing, including the following information.

U.S. EPA Protocol gas standards certified according to the U.S. EPA Traceability Protocol for Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997 or May, 2012 version and certified to have a total relative uncertainty of ± 1 percent were used to calibrate the analyzers during the test program. Although not required in the context of this test program, the vendors providing the calibration gases also participate in the Protocol Gas Verification Program (PGVP), an EPA audited program recently developed for 40 CFR Part 75.

The extractive sample system instruments were calibrated and operated following the appropriate method guidelines, based on specifications contained in Method 7E (as referenced in Methods 3A and 10). Before testing on the source began, an analyzer calibration error (ACE) test was conducted by introducing the calibration gases directly into each analyzer. If the measured response didn't meet the ± 2 percent of instrument span specification or within 0.5 ppmv absolute difference to pass the ACE check, appropriate action was taken and the ACE was redone. Prior to beginning the first run, an initial system bias check was conducted by introducing the low and upscale calibration gases into the sampling system at the probe outlet and drawing it through the sample conditioning system in the same manner as the exhaust gas sample, while measuring the instrument response. Each instrument response met a specification of ≤ 5.0 percent of the instrument span value.

Low and upscale bias calibrations were performed after each test run thereafter to quantify system calibration drift and bias. During the initial system bias tests, system response time was measured and the sample flow rate throughout the remainder of the test was monitored to maintain the sample rate within 10 percent of the average flow rate observed during the response time test. Sampling for each test run was commenced after twice the system response time had elapsed.

All components of the CO₂, O₂, NO_x, CO and VOC extractive sample systems which contacted flue gas were constructed of Type 316 stainless steel and/or Teflon. Because of the different individual sample flow rate requirements of the VOC instrument and the trailer system (i.e., CO₂, O₂, NO_x, CO), two

independent sample systems were used. The systems consisted of two separate sample probes securely clamped together and co-located in the duct at the same location and two separate heated sample lines. The CO₂, O₂, NO_x and CO samples were routed to an ice/water bath to remove moisture from the gas prior to injection into the respective analyzer, while the VOC sample was injected directly into the analyzer from the heated sample line as the VOC instrument measures gas on a wet basis. The output signal from each analyzer was connected to a computerized data acquisition system (DAS).

The CO₂, O₂, NO_x, and CO analyzers were calibrated with U.S. EPA Protocol calibration gases at a minimum of three points: low (0-20% of calibration span), mid-level (40-60% of calibration span) and high-level gas (equal to the calibration span) following specifications in U.S. EPA Method 7E. The VOC instrument was calibrated with four propane in nitrogen gases following U.S. EPA Method 25A specifications at the zero level, low (25 to 35 percent of calibration span), mid (45 to 55 percent of calibration span) and high (equivalent to instrument span). All instruments were operated thereafter to insure that zero drift, calibration gas drift, bias and calibration error met the specified method requirements.

The data measured from the pollutant and diluent analyzers was averaged for each run and corrected for drift and bias. CO₂ concentrations were measured as percent by volume, dry basis, while NO_x concentrations were measured as ppmv, dry basis.

CO₂ diluent concentrations were monitored using a non-dispersive infrared (NDIR) analyzer following the guidelines of U.S. EPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from a Stationary Source (Instrumental Analyzer Procedure)*.

NO_x concentrations were monitored using a chemiluminescence analyzer following the guidelines of U.S. EPA Method 7E, *Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure)*.

The CO concentrations were measured using an NDIR analyzer following the guidelines of U.S. EPA Reference Method 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)*.

VOC concentrations were monitored using a Thermo Model 55i Direct Methane and Non-methane Analyzer following the guidelines of U.S. EPA Method 25A, *Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer (FIA)* using the drift and bias corrections specified in U.S. EPA Method 7E, *Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure)*. This instrument is similar to a Method 25A analyzer with methane cutter in that it employs a flame ionization detector (FID) analytical principal and is capable of providing a total hydrocarbon concentration, minus methane. However, with the Thermo 55i analyzer, the method of determining the methane and non-methane organic concentrations is slightly different. Specifically, while the Thermo 55i

does rely upon a FID to determine the concentration of organic compounds, it also contains a gas chromatographic column which is used to separate methane from the other organic compounds. It works by first injecting the sample gas into the column, after which the methane fraction of the sample gas moves through the column more quickly than the other organic compounds (due to its low molecular weight and high volatility). The methane then exits the column and is analyzed in the FID. After the methane has been analyzed, the column is flushed with inert carrier gas and the remaining non-methane organic compounds are then analyzed in the FID. The preceding analytical technique results in separate measurements for methane and non-methane organic compounds via the use of a single FID, and these measurements are recorded by a data acquisition system. Compared to more conventional Method 25A analyzers with methane cutters, the Thermo 55i is expected to yield more accurate low-level non-methane hydrocarbon measurements, even in the presence of high levels of methane. It should be noted that, for purposes of this test program, RCTS did not quality assure the methane channel on the Thermo Model 55i analyzer.

Description of recovery and analytical procedures

NA

Dimensioned sketch showing all sampling ports in relation to breeching and to upstream and downstream disturbances or obstructions of gas flow and a sketch of cross-sectional view of stack indicating traverse point locations and exact stack dimensions

The exhaust stack configuration for the emergency engine (EUEMERGENGINEGEN) is shown in Figure 2.

5.0 TEST RESULTS AND DISCUSSION

Detailed tabulation of results, including process operating conditions and flue gas conditions

Table I contains a summary of the emission rates observed for the emergency generator engine during testing conducted on April 21, 2014. RICE operating data, calculation spreadsheets, field data sheets, calibration information, fuel analyses and analytical data are contained in Attachments 1 - 6.

40 CFR 60 Subpart JJJJ

The NO_x, CO and VOC emission rates are within the MDEQ ROP and 40 CFR 60 Subpart JJJJ emission limits for the emergency engine. RCTS monitored for VOC concentrations using the Thermo Model 55i Direct Methane and Non-methane Analyzer described above, however previous problems with sample delivery and instrument calibrations prompted RCTS to also extract VOC samples into Tedlar bags for each test run. These grab samples were analyzed by an outside laboratory in order to calculate the VOC concentrations; the results of these analyses provided methane, ethane and total non-methane, non-ethane organic concentration (TNMNEOC). While neither methane nor ethane is classified as a VOC, RCTS also used this data to calculate the non-methane organic concentration (NMOC), as 40 CFR Part 60, Subpart JJJJ only explicitly states that formaldehyde and methane can be excluded from the total organic concentrations when assessing compliance with the VOC emission limits. The test summary tables utilized the analysis data from outside laboratory to provide VOC g/HP-hr emission rates as both NMOC and NMNEOC; in all cases, the VOC emission rates are well below the Subpart JJJJ emission limit of 2.0 g/HP-hr.

Discussion of any variations from normal sampling procedures or operating conditions, which could have affected the results

As noted above, the Thermo 55i analyzer had a history of not consistently passing calibrations and onsite MDEQ personnel allowed Tedlar bag grab samples to be taken at the engine exhaust during each test run for purposes of determining VOC concentration. The samples were sent to an off-site laboratory to be analyzed for methane, ethene, ethane and total non-methane, non-ethane organic carbon (TNMNEOC) according to CTM-035, *Determination of Low Concentration Non-Methane Non-Ethane Organic Compound Emissions from Clean Fueled Combustion Sources*. The laboratory conducting the analyses was Atmospheric Analysis & Consulting, Inc. (AAC), located in Ventura, California. Attachment 6 contains the analytical reports from AAC, including the Quality Control/Quality Assurance (QA/QC) reports associated with the CTM-035 analyses.

Per the discussion of the 40 CFR Part 60, Subpart JJJJ test results, the ethane and TNMNEOC concentrations provided by AAC were also used determine the NMOC concentrations associated with each test run. The TNMNEOC values provided by AAC were expressed as propane, and AAC stated that the NMOC concentration as propane could be calculated by multiplying the ethane concentration by 2 (for two carbon atoms per ethane molecule) and then dividing by 3 (for three carbon atoms per propane molecule), and then adding the resulting concentration to the provided TNMNEOC values (already expressed as propane). This process is illustrated below for Run 1.

- Ethane Concentration = 7.4 ppmv; TNMNEOC = 5.2 ppmv

$$NMOC = \frac{\text{Ethane ppmv} \times 2}{3} + \text{TNMNEOC ppmv}$$

$$NMOC = \frac{7.4 \text{ ppmv} \times 2}{3} + 5.2 \text{ ppmv} = 10.1 \text{ ppmv}$$

Documentation of any process or control equipment upset condition which occurred during the testing
NA

Description of any major maintenance performed on the air pollution control device(s) during the three month period prior to testing
NA

Results of any quality assurance audit sample analyses required by the reference method
NA

Calibration sheets for the dry gas meter, orifice meter, pitot tube, and any other equipment or analytical procedures which require calibration
Attachment 4 contains the analyzer calibration data, response time test results, NO₂ to NO converter efficiency check and calibration gas Certificates of Analysis.

Sample calculations of all the formulas used to calculate the results
Sample calculations for all formulas used in the test report are contained in Attachment 7.

Copies of all field data sheets, including any pre-testing, aborted tests, and/or repeat attempts
Please refer to Attachment 1 for process data collected during the test runs; Attachment 2 for calculation spreadsheets for each of the test runs; and Attachment 3 for data sheets with the measured concentrations for each test run.

Copies of all laboratory data including QA/QC
For this testing event, laboratory data includes the results of the natural gas fuel analyses which are presented in Attachment 5, and the VOC grab samples analyses which are presented in Attachment 6. The information in Attachment 5 also includes a calculation spreadsheet for each natural gas fuel analysis for purposes of calculating the F_d, F_c and F_w fuel factors. The analytical test reports for VOC analysis in Attachment 6 include Quality Control/Quality Assurance Reports which document the acceptability of the test results.

TABLE 1
SUMMARY OF RICE EFFICIENCY AND EMISSIONS
OVERISEL COMPRESSOR STATION
EUEMERGENGINEGEN
April 21, 2014

Time Period	Run 1	Run 2	Run 3	Averages
	4/21/2014	4/21/2014	4/21/2014	
	1558-1657	1714-1813	1824-1923	
Process Conditions				
Engine Speed, Revolutions Per Minute:	1,807	1,807	1,807	1,807
Brake Horsepower:	1,430	1,430	1,432	1,431
Load, Percent:	97.8	97.8	97.9	97.9
Fuel Flow, SCFM	196.5	196.9	198.0	197.2
Outlet Gas Conditions				
Drift Corrected Carbon Dioxide Concentration, Dry (Percent):	7.88	7.90	7.79	7.86
Drift Corrected Carbon Monoxide Concentration, Dry (ppmdv):	423.34	429.06	451.96	434.79
Drift Corrected Carbon Monoxide Concentration (ppmdv @ 15% O2):	183.09	183.68	196.12	187.63
Emission Rate, Grams Per Brake Horsepower:	1.592	1.601	1.717	1.637
PTI/40 CFR Part 60, Subpart JJJJ Emission Limit, Grams Per Brake Horsepower:	4.0	4.0	4.0	4.0
Drift Corrected Nitrogen Oxides Concentration, Dry (ppmdv):	254.1	268.6	247.5	256.7
Emission Rate, Grams Per Brake Horsepower:	1.57	1.65	1.54	1.59
PTI/40 CFR Part 60, Subpart JJJJ Emission Limit, Grams Per Brake Horsepower ¹ :	2.0	2.0	2.0	2.0
Volatile Organic Compounds (as NMNEOC) Concentration, Dry (ppmdv), Expressed as Propane:	6.11	3.18	4.46	4.58
VOC (as NMNEOC) Emission Rate, Grams Per Brake Horsepower:	0.036	0.019	0.027	0.027
Volatile Organic Compounds (as NMOC) Concentration, Dry (ppmdv), Expressed as Propane:	14.25	5.29	8.28	9.27
VOC (as NMOC) Emission Rate, Grams Per Brake Horsepower:	0.084	0.031	0.050	0.055
40 CFR Part 60, Subpart JJJJ Emission Limit, Grams Per Brake Horsepower:	2.0	2.0	2.0	2.0

¹ The ROP NO_x emission limit is equivalent to the applicable NO_x limit in 40 CFR Part 60, Subpart JJJJ, which is 2.0 grams/HP-hour.

FIGURE 1

Methods 3A, 7E, 10 & 25A Sampling Apparatus Schematic

FIGURE 2

**Caterpillar Model G3516 LE Stack Schematic
(EUEMERGENGENEEN)**