40 CFR 60 Subpart JJJJ Compliance Test Report

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EUEMERGENGINEGEN

Overisel Compressor Station
4131 138th Avenue
Hamilton, Michigan 49419
State Registration Number (SRN) N5792

Test Date: March 7, 2017

Report Submitted:
April 25, 2017

Work Order No. 22182713
Report Revision 0

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

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Overisel Compressor Station County Allegan

Source Address 4131 138th Avenue City Hamilton

AQD Source ID (SRN) N5792 ROP No. MI-ROP-N5792-2012a ROP Section No. ______

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From ______ To ______

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Test Report for EUEMERGENGINEGEN

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Gregory Baustian	Ex. Manager, Gas Compression & Storage	(616) 237-4009
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official — Date 04/24/2017

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1.0 INTRODUCTION

Identification, location and dates of tests

Consumers Energy Company's (CEC) Regulatory Compliance Testing Section (RCTS) performed air emission testing on one (1) 4SLB, natural gas-fired, Caterpillar Model G3516 LE emergency reciprocating internal combustion engine (RICE), identified as EUEMERGENGINEGEN, installed and operating at CEC's Overisel Compressor Station on March 7, 2017. A Test Protocol, dated January 23, 2017, was submitted and subsequently approved by the Michigan Department of Environmental Quality (MDEQ) in their letter dated February 27, 2017.

Please note this document follows the MDEQ format described in the December, 2013, *Format for Submittal of Source Emission Test Plans and Reports* and reproducing only a portion may omit critical substantiating documentation or cause information to be taken out of context. If any portion of this report is reproduced, please exercise due care in this regard.

Purpose of testing

The test event was performed to evaluate compliance with Standards of Performance for Stationary Spark Ignition (SI) Internal Combustion Engines (ICE), 40 CFR Part 60, Subpart JJJJ, and the facility Renewable Operating Permit (ROP) No. MI-ROP- N5792-2012a, revised on August 8, 2014. A summary of specific test parameters is shown in Table 1:

TABLE 1
Summary of EUEMERGENEGINEGEN Test Parameters

Test Parameter	Measurement Unit	Test Location	Regulation
Nitrogen Oxides (NO_x), Carbon Monoxide (CO) & Volatile Organic Compounds[1] (VOCs), [as Non-Methane Organic Compound (NMOC)]	grams per horsepower hour (g/HP-hr)	Post Oxidation Catalyst (Engine Exhaust)	40 CFR Part 60 Subpart JJJJ

[1] Although 40 CFR Part 60 Subpart JJJJ refers to volatile organic compounds as defined in 40 CFR 51.100(s)(1), which specifies a VOC definition including "*any compound of carbon…other than the following, which have been determined to have negligible photochemical reactivity: methane, ethane…*", for this test event, the Subpart JJJJ exhaust gas measurements of VOC include ethane.

Brief description of source

The Overisel Compressor Station maintains EUEMERGENENGINE as an emergency generator when emergency power is needed. The 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 March 7, 2017 testing was performed by CEC RCTS employees Joe Mason and Gregg Koteskey. MDEQ representatives Mr. David Patterson and Mr. Dale Turton observed the test event. CEC Corporate Environmental Senior Engineer Ms. Amy Kapuga coordinated the test and collected operating data. Table 3 contains the test program participant contact information.

TABLE 2
Overisel Compressor Station Test Program Participants

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 Croswell Street West Olive, Michigan 49460	Mr. Joe Mason, QSTI 231-720-4856 joe.mason@cmsenergy.com
State Representative	MDEQ 525 W. Allegan, Constitution Hall Lansing, Michigan 48909	Mr. David Patterson 517-284-6782 Pattersond2@michigan.gov
	MDEQ AQD – Kalamazoo District Office 7953 Adobe Road Kalamazoo, Michigan 49009	Mr. Dale Turton 269-567-3554 Turtond@michigan.gov

2.0 SUMMARY OF RESULTS

The 40 CFR Part 60, Subpart JJJJ results are provided in Table 2 below.

TABLE 3
Summary of 40 CFR 60 Subpart JJJJ Emission Results, EUEMERGENGINEGEN

Test Parameter	Emission Rate (g/HP-hr)	JJJJ Limit (g/HP-hr)
NO_x	1.14	2.0
CO	1.11	4.0
VOC, (as NMOC)	0.09	1.0

The NO_x, CO and VOC (as NMOC) results in the preceding table indicate the emergency generator operating at Overisel Compressor Station is in compliance with Subpart JJJJ and facility-specific ROP emission limits.

Operating Data

A portable load bank provided by Caterpillar was connected to the engine during the performance testing so that an operating load of ±10% of full load could be achieved, 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.* Operating data collected during each test run consisted of engine rpm, fuel flow rate, and power rate. Brake horsepower was calculated by multiplying the vendor supplied horsepower output of 1,462 by the logged percent power rate. Ambient temperature, barometric pressure and humidity data was also collected.

Applicable Permit Number

The Overisel Compressor Station is currently operating pursuant to the terms and conditions of ROP No. MI-ROP- N5792-2012a, revised on August 8, 2014.

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 and into/out of storage. The emergency generator was installed in 2013 to provide emergency power for the compressor site. 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 Caterpillar Model 3516 LE engine has a rated heat input of 11.5 million British thermal unit (mmBtu) per hour and a rated output of 1,462 horsepower. Table 5 contains pertinent vendor provided engine specifications.

TABLE 4

Summary of EUEMERGENENGINEGEN Manufacturer Specifications

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

[1] Engine specifications based upon vendor engine data at 100% of rated capacity.

Description of Process Instrumentation Monitored During the Test

In addition to the engine operating data described earlier, electric generator amperage and kilowatts was logged and averaged for each test run.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Description of sampling train(s) and field procedures

Triplicate one-hour NO_x, CO, VOC and O_2 runs were conducted at the engine exhaust with the unit operating within 10% of 100% peak (or the highest achievable) load using Reference Methods from 40 CFR Part 60, Appendix A.

All components of the extractive sample systems in contact with flue gas were constructed of Type 316 stainless steel and/or Teflon. The O_2, NO_x and CO engine exhaust gases were conveyed via a heated sample line to an electronic gas sample conditioner to remove moisture and any particulate matter from the gas prior to analyzer injection. The VOC instrument measures concentrations on a wet basis as ppmv, so a separate heated sample line was used to convey the wet sample to the instrument. The output signal from each analyzer was connected to a computerized data acquisition system (DAS).

The O_2, 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 field VOC instrument was calibrated with zero air and three propane and methane in air 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). The output signal from each analyzer was connected to a computerized data acquisition system (DAS) and each instrument was operated to insure zero drift, calibration gas drift, bias and calibration error met the applicable method requirements. The *Methods 3A, 7E, 10 & 25A Sampling Apparatus Schematic* is shown in Figure 1.

The NO_x CO and VOC concentrations are reported as grams per horsepower hour (g/HP-hr), on a dry basis using Equations 1-3 and Table 2 in 40 CFR Part 60, Subpart JJJJ §60.4244. Exhaust gas moisture content was determined once during the test program to convert wet basis VOC concentrations to dry in the field. Note that VOC emissions contained in this report reflect the actual moisture content derived from the natural gas fuel sample analysis required by 40 CFR Part 60 Subpart JJJJ, incorporating the moisture mole fraction of ambient air, free water in the fuel fired, and hydrogen in the fuel.

Detailed Discussion of Test Methods

4.1 Traverse Points

The engine exhaust traverse points were determined based on U.S. EPA Method 1 *Sample and Velocity Traverses for Stationary Sources* criteria. During run 1, gas concentrations were measured from twelve traverse points. After determining the duct was not stratified, one traverse points was selected for each run thereafter which most closely matched the average concentration measured. Figure 2 of this report illustrates the path of engine effluent as it enters and exits the oxidation catalyst.

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4.2 Diluent/Molecular Weight

O_2 concentrations were measured at the outlet using a paramagnetic 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).*

4.3 Moisture Content

The exhaust gas moisture content was measured in the field using U.S. EPA Alternate Method 008, *Alternative Moisture Measurement Method Midget Impingers* during one Subpart JJJJ test. Effluent gas was drawn through a series of four impingers; the first two of which contained water, the third was empty and the fourth contained indicating silica gel. The impingers were immersed in an ice bath during each test to achieve efficient moisture condensation, and collected water vapor was determined gravimetrically for calculating percent moisture. This measurement served as a surrogate moisture value in the field until the moisture results from the natural gas fuel sample collected as required by 40 CFR Part 60 Subpart JJJJ were received, whereupon the alternate fuel factor (F-Factor) approach in 40 CFR Part 60, Appendix A Method 4, *Determination of Moisture Content in Stack Gases*, § 16.4 was used to calculate moisture content by summing the moisture mole fraction of the ambient air, the free water in the fuel fired, and the hydrogen in the fuel. The natural gas fuel sample analyses are contained in Attachment 6 of this report.

4.4 Nitrogen Oxides

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

4.5 Carbon Monoxide

CO concentrations were measured using a gas filter correlation (GFC) analyzer following the guidelines of U.S. EPA Reference Method 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure).*

4.6 Volatile Organic Compounds, as NMOC

VOC (as NMOC) 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)*. The flame ionization detector (FID) analytical principal is employed to determine the total hydrocarbon concentration and a gas chromatographic column is used to separate methane from other organic compounds.

Sample gas is injected into the column. Due to methane's low molecular weight and high volatility, the compound moves through the column more quickly than other existing organic compounds and exits the column to be analyzed in the FID. The column is then flushed with inert carrier gas and the remaining non-methane organic compounds are analyzed in the FID. This analytical technique allows separate measurements for methane and non-methane organic compounds via the use of a single FID.

Sampling and Analytical 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 Parts 60 and 63 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 daily testing began, an analyzer calibration error (ACE) test was conducted by introducing the calibration gases directly into each analyzer. If the measured response was greater than ±2 percent of instrument span (or greater than 0.5 ppmv absolute difference), corrective action was taken followed by another ACE. Thereafter, an initial system bias check was conducted by injecting low and upscale calibration gases consecutively into the sampling system at the probe outlet which emulates the manner in which an exhaust gas sample is collected. The sample system response time to the calibration gas is documented and the sample system bias requirement of ≤ 5.0 percent of instrument span is verified. If the bias criteria are not met, additional corrective action is taken to do so. After completing these QA requirements, the first run began after waiting twice the system response time. After each run was completed, low and upscale bias calibrations were performed to again quantify sample system drift and bias before waiting twice the system response time to start the next run.

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 1 contains a summary of the emission rates observed for the emergency generator engine during the March 7, 2017 test. RICE operating data, calculation spreadsheets, field data sheets, calibration information, fuel analyses and analytical data are contained in Attachments 1 - 6.

Discussion of significance of results relative to operating parameters and emission regulations

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.

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

While not required by Method 25A, the VOC as NMOC field data was adjusted for analyzer drift using U.S. EPA Method 7E, *Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure* specifications. This adjustment was not specifically requested by the MDEQ in their protocol approval letter response; however this presentation is consistent with previous MDEQ Method 25A data requests. For the purposes of this test program, RCTS did not quality assure the methane channel on the Thermo Model 55i analyzer.

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

In the event of a re-test, a description of any changes made to the process or air pollution control device(s)

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, NO_2 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 presented in Attachment 5, which 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.

TABLE 5

Summary Of 40 CFR Part 60 Subpart JJJJ Concentrations and Emissions

OVERISEL COMPRESSOR STATION

EUEMERGENGINEGEN

March 7, 2017

Time Period	Run 1	Run 2	Run 3	Averages
	3/7/2017	3/7/2017	3/7/2017	
	1037-1137	1156-1256	1317-1417	
Process Conditions				
Engine Speed, Revolutions Per Minute:	1,803	1,803	1,804	**1,803**
Brake Horsepower:	1,403	1,401	1,401	**1,402**
Load, Percent:	95.9	95.8	95.9	**95.9**
Fuel Flow, SCFM	119.6	119.0	119.5	**119.4**
Exhaust Gas Conditions				
Drift Corrected Oxygen Concentration, Dry (Percent):	7.5	7.5	7.5	**7.5**
Drift Corrected CO Concentration, Dry (ppmdv):	466.9	462.8	457.7	**462.5**
Drift Corrected CO Concentration (ppmdv @ 15% O2):	205.6	203.9	201.7	**203.7**
CO Emission Rate, Grams Per Horsepower-Hour (g/hp-hr):	1.1	1.1	1.1	**1.1**
CO Emission Limit, g/hp-hr:	4.0	4.0	4.0	**4.0**
Drift Corrected NO_x Concentration, Dry (ppmdv):	291.6	290.9	290.5	**291.0**
NO_x Emission Rate, g/hp-hr:	1.2	1.1	1.1	**1.1**
NO_x Emission Limit, g/hp-hr:	2.0	2.0	2.0	**2.0**
VOC (as NMOC) Concentration, Dry (ppmdv), Expressed as Propane:	41.3	41.3	41.0	**41.2**
VOC (as NMOC) Emission Rate, g/hp-hr:	0.1	0.1	0.1	**0.1**
VOC (as NMOC) Emission Limit, g/hp-hr:	1.0	1.0	1.0	**1.0**

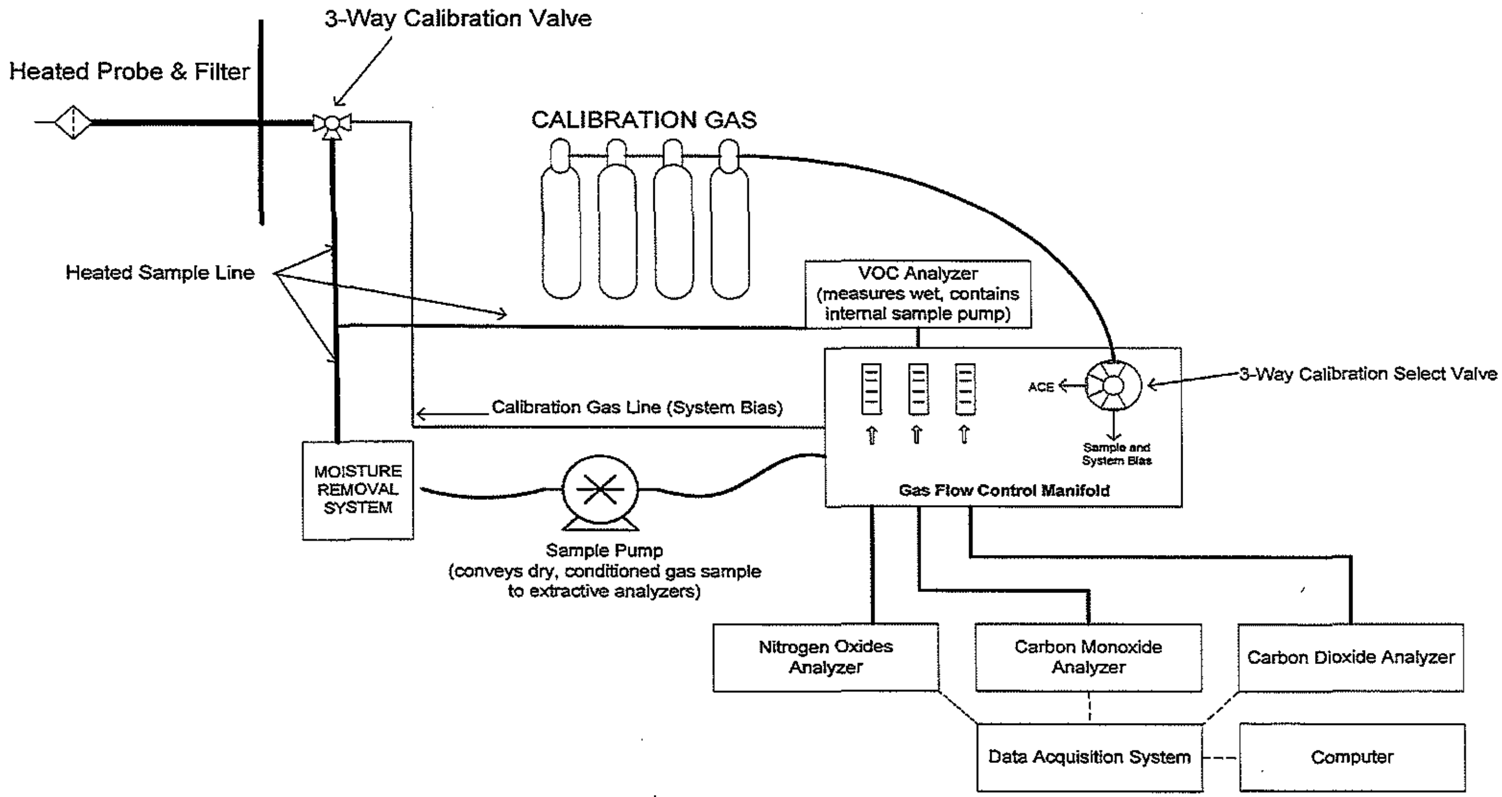
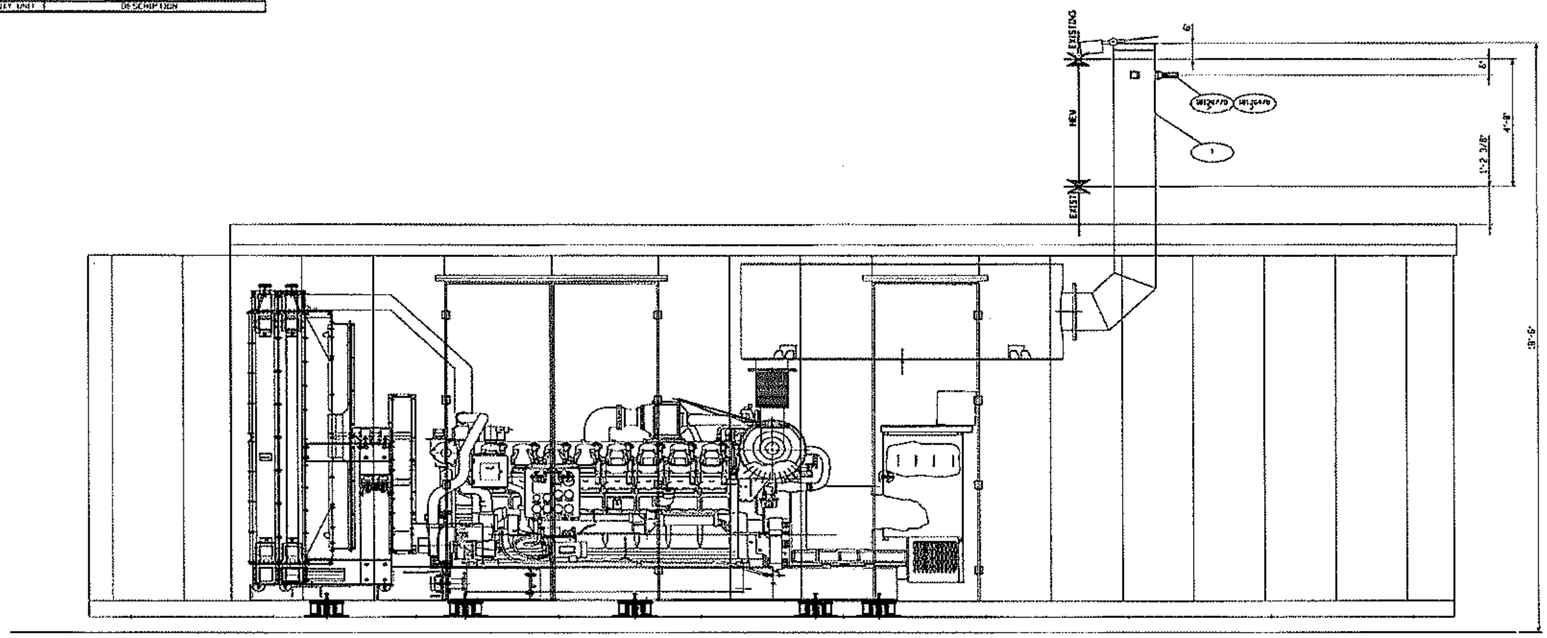


FIGURE 1

DRY AND WET EXTRACTIVE GASEOUS SAMPLE APPARATUS

ITEM	QTY UNIT	DESCRIPTION
1	4 LF	PIPE, 24" DIA [illegible] WT ASTM A-106 GR B ENDS BEV BARE
[illegible]	2 EA	PLUG, BULL, 1" HEX HEAD NPT 3000# FS MATERIAL PER ASTM [illegible]
[illegible]	2 EA	THREAD-O-LET, PIPE, 1" [illegible] TO [illegible] FS PER [illegible] MATERIAL PER ASTM [illegible] TO MATCH [illegible] YIELD PARENT MATERIAL



GENERATOR EXHAUST STACK HEIGHT

DETAIL "X"

SCALE: NONE

DWG. NO.	REFERENCE DRAWINGS	REV.	DATE	DESCRIPTION	DR	CK	APP	REV.	DATE	DESCRIPTION	DR	CK	APP

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