EMISSIONS PERFORMANCE TEST PROGRAM

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed an emissions compliance test program on the Engine Group (FGGEN1-3) at the Coldwater Peaking Plant of Coldwater Board of Public Utilities in Coldwater, Michigan. The tests were authorized by and performed for Coldwater Board of Public Utilities

There are three engines in the FGGEN1-3 group, designated as EUGEN1, EUGEN2, and EUGEN3.

EUGEN 1 and EUGEN3 were tested on October 28, 2021. EUGEN2 had mechanical problems and could not be tested in conjunction with EUGEN1 and EUGEN3. EUGEN2 was tested, following repairs, on December 9, 2021.

The report for the October tests was submitted previously (TRC Report 456357A dated December 2, 2021). This report is for the EUGEN2 test results, only.

The purpose of this test program was to determine nitrogen oxides (NO$_X$), carbon monoxide (CO) and volatile organic compound (VOC) emission rates during normal full load operating conditions.

The results of the test program were used to verify compliance with the emissions performance test requirements presented in 40CFR60 Subpart JJJJ "Standards of performance for Stationary Spark Ignition Combustion Engines" and the facility air quality permit. The test program was conducted according to TRC Test Protocol 456357A, dated September 17, 2021.

1.1 Project Contact Information

Participants		
Test Facility	Coldwater Board of Public Utilities Coldwater Peaking Plant State Registration No. P0521 250 North Filmore Road Coldwater, Michigan 49036	Dave Luce Lead generation operator (517) 279-6953 (phone) dluce@coldwater.org
Test Coordinator	American Municipal Power, Inc. 1111 Schrock Road Columbus, Ohio 43229	David Chamberlain American Municipal Power, Inc. Director of Environmental Affairs (614) 540-0970 (phone) dchamberlain@amppartners.org
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Jeffery Daniels Senior Project Manager 630-880-4754 (cell) jdaniels@trccompanies.com

The tests were conducted by Chris Miller and Jeff Daniels of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) is appended.
The following regulatory personnel observed the testing on December 9, 2021:

Trevor Drost
Environmental Quality Analyst
Technical Programs Unit
Air Quality Division
Michigan Department of Environment, Great Lakes & Energy

1.2 Facility Description

The Coldwater Peaking Plant operates three engines with associated generators for electrical generation during peak (grid) demand periods. The engine group is designated as FGGEN1-3. The individual emission unit IDs for the engines are EUGEN1, EUGEN2, and EUGEN3. The total nominal capacity is approximately 13.0 MWe.

Each engine is a 6,023 horsepower (hp) natural gas-fueled engine with a 4,348 kilowatts (kWe) generator, manufactured in 2014. Emissions are controlled with selective catalytic reduction (SCR) and catalytic oxidation (CatOx).

The facility complies with the provisions of the federal Standards of Performance for New Stationary Sources (NSPS) as specified in 40 CFR Part 60, Subparts A and JJJJ, as they apply to each engine of FGGEN1-3.

2.0 SUMMARY OF RESULTS

EUGEN2 was not operating and could not be tested in conjunction with EUGEN1 and EUGEN3. The average test results are summarized in the table below. Detailed individual run results are presented in Section 6.0.

2.1 Average Test Results

Parameter	Units	EUGEN2	Emission Limit
NO_x	ppmvd	13.9	---
	lb/MMBtu	0.0330	0.0368
CO	ppmvd	2.1	---
	g/hp-hr	0.009	0.04
	ppmvd at 15% O_2	1.4	270
VOC	lb/MMBtu	0.0059	0.056

The table below summarizes the test methods used, as well as the number and duration of each at each test location:

2.2 Performance Test Methods

Unit ID	Parameter Measured	Test Method	No. of Runs	Run Duration (min)
EUGEN2	Sample Location Evaluation	1	Pre-test	
	Volumetric Flow rate	2	3	~30
	Moisture	4	3	60
	NOx	7E	3	60
	CO	10	3	60
	VOC	25A, ALT-106	3	60

3.0 DISCUSSION OF RESULTS

TRC observed an issue with the reference method O_2 analyzer following Test Run 1 on EU2. The analyzer calibrations were passing the acceptance criteria for error, bias, and drift, but there was a miss-match between the analyzer display and the data recorder, when sampling stack gas, that was becoming worse over time.

The analyzer was measuring correctly, but the voltage signal to the data recorder was erroneous. The recorded O_2 values were higher than the actual measured value displayed by the analyzer, which caused a positive bias to the pollutant lb/MMBtu test results.

The error appears to have started at Run 1 but initially not at a magnitude to cause a failed bias/drift calibration check. Run 1 results were included in the 3-run average. Run 2 was aborted when the problem was discovered and not included in the 3 run average. The suspect O_2/CO_2 analyzer was replaced with a new analyzer, which was calibrated according to Method 3 prior to resuming the test runs. An additional 4th run was performed to replace the voided Run 2.

The average O_2 value for Run 1 is suspect, and likely biased the overall average for NO_X and VOC lb/MMBtu high, but since the average test results were less than the emission limit Run 1 was not voided.

No other changes or problems were encountered that required modification of any procedures presented in the test plan. No adverse test or environmental conditions were encountered during the conduct of this test program. Weather data is appended.

The following source operating data parameters were recorded by facility personnel:

3.1 Source Operating Data Parameters

Parameter	Unit of Measure
Fuel Gas Flow	Standard Cubic Feet per Hour (SCFH)
Urea Flow	Gallon per Hour (GPH)
Pressure Before Catalyst	Millibar (mbar)
Temperature Before Catalyst	Degree Celsius (°C)
Pressure After Catalyst	mbar
Temperature After Catalyst	°C
Engine Load	Kilowatt (kW)
Stack Temperature	°C

4.0 SAMPLING AND ANALYSIS PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed in accordance with the methods presented in the following sections. Where applicable, the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, USEPA 600/R-94/038c, September 1994 was used to supplement procedures.

4.1 Determination of Sample Point Locations by USEPA Method 1

This method is applicable to gas streams flowing in ducts, stacks, and flues and is designed to aid in the representative measurement of pollutant emissions and/or total volumetric flow rates from stationary sources. In order to qualify as an acceptable sample location, it must be located at a position at least two stack or duct equivalent diameters downstream and a half equivalent diameter upstream from any flow disturbance.

The cross-section of the measurement site was divided into a number of equal areas, and the traverse points were then located in the center of these areas. The minimum number of points were determined from either Figure 1-1 (particulate) or Figure 1-2 (non-particulate) of USEPA Method 1.

4.2 Volumetric Flow Rate Determination by USEPA Method 2

This method is applicable for the determination of the average velocity and the volumetric flow rate of a gas stream.

The gas velocity head (ΔP) and temperature were measured at traverse points defined by USEPA Method 1. The velocity head was measured with a Type S (Stausscheibe or reverse type) pitot tube and oil-filled manometer; and the gas temperature was measured with a Type K thermocouple.

The average gas velocity in the flue was calculated based on: the gas density (as determined by USEPA Methods 3 and 4); the flue gas pressure; the average of the square roots of the velocity heads at each traverse point, and the average flue gas temperature.

4.3 Determination of the Concentration of Gaseous Pollutants Using a Multi-Pollutant Sampling System

Concentrations of the pollutants in the following sub-sections were determined using one sampling system. The number of points at which sample was collected was determined in accordance with Table 2 to Subpart JJJJ of Part 60 “Requirements for Performance Tests”.

A straight-extractive sampling system was used. A data logger continuously recorded pollutant concentrations and generated one-minute averages of those concentrations. All calibrations and system checks were conducted using USEPA Protocol 1 gases. Three-point linearity checks were performed prior to sampling, and in the event of a failing system bias or drift test (and subsequent corrective action). System bias and drift checks were performed using the low-level gas and either the mid- or high-level gas prior to and following each test run.

The Low Concentration Analyzers (those that routinely operate with a calibration span of less than 20 ppm) used by TRC are ambient-level analyzers. Per Section 3.12 of Method 7E, a Manufacturer's Stability Test is not required for ambient-level analyzers. Analyzer interference tests were conducted in accordance with the regulations in effect at the time that TRC placed an analyzer model in service.

4.3.1 CO_2 Determination by USEPA Method 3A

This method is applicable for the determination of CO_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The CO_2 analyzer was equipped with a non-dispersive infrared (IR) detector.

4.3.2 O_2 Determination by USEPA Method 3A

This method is applicable for the determination of O_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The O_2 analyzer was equipped with a paramagnetic-based detector.

4.3.3 NO_x Determination by USEPA Method 7E

This method is applicable for the determination of NO_x concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The NO_x analyzer utilized a photomultiplier tube to measure the linear and proportional luminescence caused by the reaction of nitric oxide and ozone.

4.3.4 CO Determination by USEPA Method 10

This method is applicable for the determination of CO concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The non-dispersive infrared analyzer (NDIR) CO analyzer was equipped with an internal gas correlation filter wheel, which eliminates potential detector interference. As such, use of an interference removal trap was not required.

4.4 Moisture Determination by USEPA Method 4

This method is applicable for the determination of the moisture content of stack gas.

A gas sample was extracted at a constant rate from the source. Moisture was removed from the sample stream by a series of pre-weighed impingers immersed in an ice bath. A minimum of 21 dry standard cubic feet of flue gas was collected during each sample run.

4.5 VOC Determination by USEPA Method 25A (Using GC/FID Instrumentation)

This method is applicable for the determination of non-methane, non-ethane organic (NMEOC) compound concentration, which was considered volatile organic compound (VOC) concentration.

A gas sample was extracted from the source through a heated sample line to a flame ionization analyzer which used gas chromatography (GC/FID) to separate the methane and ethane from the remaining (residual) gaseous organic compounds. The total non-methane/non-ethane mixture was quantified as propane.

TRC utilized a VIG Industries, Inc. Model 210 "Methane / Ethane / Non-Methane, Non-Ethane and Total Hydrocarbon Analyzer". The use of a non-methane/non-ethane flame ionization analyzer has been broadly approved for measurements from stationary spark ignition combustion engines.

The following approved alternate procedures have been approved by USEPA and are posted on the USEPA Emissions Measurement Center Website:

- Methane cutter analyzer (such as J.U.M. Engineering HFID Model 109A) (see reference in Table 2 of Subpart JJJJ)
- ALT-066 (approves use of TECO 55C GC/FID type hydrocarbon analyzer for methane measurement in lieu of Method 18)
- ALT-078 (approves use of TECO 55C GC/FID type hydrocarbon analyzer for NMOC measurement, with data quality considered equivalent to methane cutter analyzers)
- ALT-096 (approval of newer model TECO 55I GC/FID analyzer for same, states that use of the GC/FID instrument is broadly accepted for Subpart JJJJ, and specifies that Method 25A procedures are to be used for NMOC analyzer sampling and QA/QC)
- ALT-106 (approves use of VIG Industries GC/FID analyzers for same application, as well as additional procedures for non-methane/non-ethane measurements using the same equipment).

TRC utilized Method 25A and USPEA Approved Alternate procedure ALT-106 for this test program. The specified NMEOC analyzer used a direct interface measurement with a heated sampling line from the sampling point to the gas chromatographic injection valve. The sampling components remained heated (>220 °F) at all times.

The appropriate test procedure, calibration, and standardization requirements in sections 8, 9, and 10 of Method 25A were followed for linearity, calibration error, and calibration drift.

TRC performed a check to demonstrate proper separation of methane and ethane from the NMEOC residual. A methane/ethane/propane calibration gas standard was used to demonstrate the GC separation. The NMEOC residual was calibrated using propane in air calibration gas. Calibration gas certificates are appended. TRC recorded the Methane, Ethane, and NMEOC residual (VOC) continuously for each test run. The GC/FID measurement was considered wet for the emissions calculations.

5.0 QUALITY ASSURANCE PROCEDURES

TRC integrates our Quality Management System (QMS) into every aspect of our testing service. We follow the procedures specified in current published versions of the test Method(s) referenced in this report. Any modifications or deviations are specifically identified in the body of the report. We routinely participate in independent, third-party audits of our activities, and maintain:

- Accreditation from the Louisiana Environmental Laboratory Accreditation Program (LELAP).
- Accreditation from the Stack Testing Accreditation Council (STAC) and the American Association for Laboratory Accreditation (A2LA) that our operations conform with the requirements of ASTM D 7036 as an Air Emission Testing Body (AETB).

These accreditations demonstrate that our systems for training, equipment maintenance and calibration, document control and project management will fully ensure that project objectives are achieved in a timely and efficient manner with a strict commitment to quality.

All calibrations are performed in accordance with the test Method(s) identified in this report. If a Method allows for more than one calibration approach, or if approved alternatives are available, the calibration documentation in the appendices specifies which approach was used. All measurement devices are calibrated or verified at set intervals against standards traceable to the National Institute of Standards and Technology (NIST). NIST traceability information is available upon request.

ASTM D7036-04 specifies that: *"AETBs shall have and shall apply procedures for estimating the uncertainty of measurement. Conformance with this section may be demonstrated by the use of approved test protocols for all tests. When such protocols are used, reference shall be made to published literature, when available, where estimates of uncertainty for test methods may be found."* TRC conforms with this section by using approved test protocols for all tests.