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EMISSION PERFORMANCE TEST REPORT
40CFR60 JJJJ ENGINE TESTING

Performed At
Coldwater Board of Public Utilities
Coldwater Peaking Plant
Coldwater, Michigan

Permit 80-14, SRN: P0521

Engine Group (FGGEN1-3)
Emission Units:
EUGEN1 (Unit 1)
EUGEN2 (Unit 2)
EUGEN3 (Unit 3)

Test Dates
October 22 and 23, 2024

Report No.
TRC Environmental Corporation Report 562563A

Report Submittal Date
December 18, 2024

TRC Environmental Corporation
207C Eisenhower Lane South
Lombard Illinois 60148
USA

Report Certification

I certify that to the best of my knowledge:

- Testing data and all corresponding information have been checked for accuracy and completeness.
- Sampling and analysis have been conducted in accordance with the approved protocol and applicable reference methods (as applicable).
- All deviations, method modifications, or sampling and analytical anomalies are summarized in the appropriate report narrative(s).

Jeff Daniels
Senior Project Manager

December 18, 2024
Date

TRC was operating in conformance with the requirements of ASTM D7036-04 during this test program.

Jon T. Howard
TRC Emission Testing Manager

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1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed an emission compliance test program on the Engine Group (FGGEN1-3) at the Coldwater Peaking Plant of Coldwater Board of Public Utilities in Coldwater, Michigan on October 22 and 23, 2024. The tests were authorized by and performed for Coldwater Board of Public Utilities

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 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 ENVIRONMENTAL CORPORATION Protocol 562563.

1.1 Project Contact Information

Participants		
Test Facility	Coldwater Board of Public Utilities Coldwater Peaking Plant 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	Dylan Shays Director of Environmental and Hydropower Compliance (614) 540-6917 (phone) dshays@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 Archer Jones, David Wells, and Jeff Daniels of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) is appended.

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

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	EUGEN1	EUGEN2	EUGEN3	Emission Limit
NO_x	ppmvd	14.42	14.21	13.29	---
	lb/MMBtu	0.0317	0.0310	0.0294	0.0368
CO	ppmvd	2.92	1.99	3.09	---
	g/hp-hr	0.01	0.01	0.01	0.04
	ppmvd at 15% O_2	1.7	1.2	1.9	270
VOC	ppmvd	1.18	14.82	2.39	---
	lb/MMBtu	0.002	0.031	0.005	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)
EUGEN1 and EUGEN3	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

Source operation for EUGEN1, EUGEN2, and EUGEN3 was normal during the entire test program.

The VOC analyzer TRC initially used was a VIG Industries, Inc. Model 210 hydrocarbon analyzer. The Model 210 is a gas chromatography flame ionization detector (GC/FID) type analyzer that measures methane, ethane, and non-methane non-ethane hydrocarbons at preset intervals and continuously measures total hydrocarbons in real time. The VIG analyzer failed before the second test run started on Engine 1. The analyzer AC transformer apparently shorted out, which caused the power supply board to take on a significant amount of current, causing it to fail. TRC paused the test program until a replacement analyzer was installed.

A second VIG 210 analyzer was not available. The only available instrument was a JUM Engineering HFID Model 109A, which is a methane cutter type analyzer.

Both the VIG and JUM analyzers were described in TRC Protocol 562563 for VOC determinations. The JUM did not have the same capabilities as the VIG analyzer. Ethane emissions are not measured separately by the 109A and Ethane emissions are a significant component in the emissions from the Coldwater Plant engines. To determine VOC using the JUM analyzers additional Tedlar bag samples were collected and analyzed by a qualified laboratory to determine the amount of ethane in the exhaust gas.

For the run where the VIG 210 was used to measure VOC, the actual non-methane non-ethane organic concentration measurement (NMEHC) was used for the VOC test result.

For the remaining test runs where the JUM 109A was used to measure VOC, the non-methane organic concentration (NMOC) less the Tedlar® bag ethane result was used for the VOC test result. The NMOC measurement was wet basis. The Tedlar® bag ethane result was dry basis.

The following formula was used to determine the NMEOC test result, which was the VOC test result, for the test runs where the JUM 109A was used:

$$NMEOC\ ppmd\ as C_3H_8 = NMOC\ ppmw\ as\ C_3H_8 - [(Ethane\ ppmd \times 1 - B_{WS}) \times (2/3)]$$

Where:
NMEOC ppmd as C_3H_8 = Non-Methane Non-Ethane Organic Concentration as Propane.
NMOC ppmw as C_3H_8 = Non-Methane Organic Concentration as Propane.
Ethane ppmd = Ethane test result from AAC Tedlar® bag analysis (Method 18).
1-B_{WS} = Correction factor from Method 4 moisture tests to convert dry basis to wet basis.
2/3 = Correction factor to use Ethane (C_2H_6) result as Propane (C_3H_8) equivalent.

The complete AAC analytical report is attached in the appendix. There were eight Tedlar® bag samples. There was no bag sample needed for Engine 1 Test 1. Bag samples were collected for the rest of the tests.

Each bag was analyzed using GC/FID and the reports show the C1 to C6+ hydrocarbons in the sample to show not only the Ethane fraction but the Methane and derived Total Hydrocarbon results.

The Methane results were used to evaluate the sample integrity for each bag sample. It was apparent that one bag sample either lost sample or had an issue with sample collection which was Sample 562563-04 for Engine 2 Test 3. The actual Ethane present in the emissions was likely higher than the result determined from the Tedlar® bag analysis. The VOC test result for Engine 2 Test 3 was still less than the emission limit so no further data analysis was required.

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 (SCF)
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.

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.

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 equal areas, and the traverse points were then located in the center of these areas. The minimum number of points were determined from 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 prior to and following each test run.

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.

TRC utilized a VIG Industries, Inc. Model 210 "Methane / Ethane / non-Methane, Non-Ethane and Total Hydrocarbon Analyzer" for Test 1 and Engine 1.

TRC utilized a J.U.M. Engineering HFID Model 109A for the rest of the tests as the VIG Model 210 became inoperable after that first test run.

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

- 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).
- Methane cutter analyzer (such as J.U.M. Engineering HFID Model 109A) (see reference in Table 2 of Subpart JJJJ)

The overall gas sample was extracted from the stack using the same probe and heated sample line used for the Method 3A/7E/10 sampling system. The same sample points were used as for the Method 3A/7E/10 test runs/.

Prior to the electronic chiller used for moisture removal the sample was split and a portion was diverted to the hydrocarbon analyzer using a short, heated sample tube.

The gas sample was heated to greater than 250 ◦F from the probe to the inlet of the hydrocarbon analyzer.

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. Calibration gas certificates are appended.

TRC performed a check to demonstrate proper separation of methane and ethane from the NMEOC residual for the VIG 201 GC/FID instrument. 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, per Method 25A specifications. TRC recorded the Methane, Ethane, and NMEOC residual (VOC) output. The GC/FID measurement was considered wet for the emissions calculations.

TRC used the same calibration gas to calibrate the JUM 109A analyzer. The JUM 109A has two FIDs used to determine Methane, non-Methane, and Total Hydrocarbon. The Methane, Ethane, Propane mixture was used to calibrate the Methane output. Propane in Air calibration gas was used to calibrate the non-Methane output. The total Hydrocarbon output was not utilized for the tests.

To determine Non-Methane Non-Ethane Organic concentrations Tedlar® bag samples were collected and sent to a qualified laboratory to determine the Ethane content of the gas samples.

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.

6.0 TEST RESULTS SUMMARY

Company: Coldwater BOPU

Facility: Coldwater Plant

Source: Engine 1

Qualified Individual(s): Jeffery Daniels

Engine Rated HP: 6023

Test Run No.	1	2	3		
Test Date	10/22/2024	10/23/2024	10/23/2024		
Start Time	8:00:00	8:10:00	9:48:00		
Stop Time	9:00:00	9:10:00	10:48:00		
Duration of Test (hrs)	1.0	1.0	1.0		
Engine Operational Data					
Engine Horsepower (Hp)	5,722	5,800	5,800		
Load Percent, measured / site rated (%)	95.0	96.3	96.3		
O_2 F Factor (DSCF/MMBtu)	8,710	8,710	8,710		
Ambient Conditions					
Barometric Pressure ("Hg)	29.18	28.92	28.97		
Dry Bulb Temperature (°F) :	50	61	65		
Relative Humidity (%):	77.0	72.0	63.0		
Measured Emissions				**Average**	
NOx (ppmv, dry)	16.17	13.75	13.32	14.42	
CO (ppmv, dry)	2.79	2.97	3.02	2.92	
O_2 (% volume, dry)	10.96	11.05	11.05	11.02	
CO_2 (% volume, dry)	5.42	5.38	5.39	5.40	
VOC (ppmv as Propane, wet)	1.62	1.06	0.50	1.06	
VOC (ppmv as Propane, dry)	1.80	1.19	0.56	1.18	
Flue Gas Moisture, B_{ws}	0.101	0.108	0.109	0.106	
Calculated Emissions					**Permit Limits**
NOx (ppmvd @ 15% O_2)	9.6	8.2	8.0	8.6	--
CO (ppmvd @ 15% O_2)	1.7	1.8	1.8	1.7	270
VOC (ppmvd @ 15% O_2)	1.1	0.7	0.3	0.7	--
Stack Volumetric Flow Rate					
via EPA Method 2 (DSCFH)	760,000	763,398	761,008	761,469	
Calculated Mass Emission Rates					
NOx (lbs/hr)	1.47	1.25	1.21	1.31	--
CO (lbs/hr)	0.15	0.16	0.17	0.16	--
VOC (lbs/hr)	0.16	0.10	0.05	0.10	--
NOx (lb/MMBtu)	0.0354	0.0303	0.0294	0.0317	0.0368
CO (lb/MMBtu)	0.00	0.00	0.00	0.00	--
VOC (lb/MMBtu)	0.004	0.003	0.001	0.002	0.056
NOx (g/hp-hr)	0.12	0.10	0.09	0.10	--
CO (g/hp-hr)	0.01	0.01	0.01	0.01	0.04
VOC (g/hp-hr)	0.01	0.01	0.00	0.01	--

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Company:	**Coldwater BOPU**
Facility:	**Coldwater Plant**
Source:	**Engine 2**
Qualified Individual(s):	**Jeffery Daniels**
Engine Rated HP:	**6023**

Test Run No.	**1**	**2**	**3**		
Test Date	10/23/2024	10/23/2024	10/23/2024		
Start Time	11:25	12:55	14:38		
Stop Time	12:25	13:55	15:38		
Duration of Test (hrs)	1.0	1.0	1.0		
Engine Operational Data					
Engine Horsepower (Hp)	5,851	5,849	5,855		
Load Percent, measured / site rated (%)	97.1	97.1	97.2		
O_2 F Factor (DSCF/MMBtu)	8,710	8,710	8,710		
Ambient Conditions					
Barometric Pressure ("Hg)	28.98	29.02	29.03		
Dry Bulb Temperature (°F) :	52	46	44		
Relative Humidity (%):	70.0	54.0	52.0		
Measured Emissions				**Average**	
NOx (ppmv, dry)	13.82	14.37	14.43	14.21	
CO (ppmv, dry)	2.03	2.01	1.92	1.99	
O_2 (% volume, dry)	10.93	10.94	10.96	10.94	
CO_2 (% volume, dry)	5.45	5.43	5.42	5.43	
VOC (ppmv as Propane, wet)	3.26	21.74	14.63	13.21	
VOC (ppmv as Propane, dry)	3.67	24.40	16.39	14.82	
Flue Gas Moisture, B_{ws}	0.111	0.109	0.107	0.109	
Calculated Emissions					**Permit Limits**
NOx (ppmvd @ 15% O_2)	8.2	8.5	8.6	8.4	--
CO (ppmvd @ 15% O_2)	1.2	1.2	1.1	1.2	270
VOC (ppmvd @ 15% O_2)	2.17	14.46	9.72	8.79	--
Stack Volumetric Flow Rate					
via EPA Method 2 (DSCFH)	757,654	765,186	773,239	765,360	
Calculated Mass Emission Rates					
NOx (lbs/hr)	1.25	1.31	1.33	1.30	--
CO (lbs/hr)	0.11	0.11	0.11	0.11	--
VOC (lbs/hr)	0.32	2.14	1.45	1.30	--
NOx (lb/MMBtu)	0.0301	0.0314	0.0315	0.0310	0.0368
CO (lb/MMBtu)	0.003	0.003	0.003	0.003	--
VOC (lb/MMBtu)	0.008	0.051	0.034	0.031	0.056
NOx (g/hp-hr)	0.10	0.10	0.10	0.10	--
CO (g/hp-hr)	0.01	0.01	0.01	0.01	0.04
VOC (g/hp-hr)	0.02	0.17	0.11	0.10	--

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Company:	**Coldwater BOPU**
Facility:	**Coldwater Plant**
Source:	**Engine 3**
Qualified Individual(s):	**Jeffery Daniels**
Engine Rated HP:	**6023**

Test Run No.	**1**	**2**	**3**		
Test Date	10/23/2024	10/23/2024	10/23/2024		
Start Time	16:28	18:15	20:05		
Stop Time	17:28	19:15	21:04		
Duration of Test (hrs)	1.0	1.0	1.0		
Engine Operational Data					
Engine Horsepower (Hp)	5,788	5,793	5,794		
Load Percent, measured / site rated (%)	96.1	96.2	96.2		
O_2 F Factor (DSCF/MMBtu)	8,710	8,710	8,710		
Ambient Conditions					
Barometric Pressure ("Hg)	29.09	29.13	29.17		
Dry Bulb Temperature (°F) :	43	42	41		
Relative Humidity (%):	55.0	64.0	74.0		
Measured Emissions				**Average**	
NOx (ppmv, dry)	11.93	15.59	12.34	13.29	
CO (ppmv, dry)	3.09	3.11	3.07	3.09	
O_2 (% volume, dry)	11.07	11.06	11.11	11.08	
CO_2 (% volume, dry)	5.38	5.38	5.38	5.38	
VOC (ppmv as Propane, wet)	2.21	2.64	1.58	2.14	
VOC (ppmv as Propane, dry)	2.46	2.94	1.77	2.39	
Flue Gas Moisture, B_{ws}	0.10	0.10	0.11	0.10	
Calculated Emissions					**Permit Limits**
NOx (ppmvd @ 15% O_2)	7.2	9.3	7.4	8.0	
CO (ppmvd @ 15% O_2)	1.9	1.9	1.9	1.9	270
VOC (ppmvd @ 15% O_2)	1.5	1.8	1.1	1.4	
Stack Volumetric Flow Rate					
via EPA Method 2 (DSCFH)	775,551	762,827	775,645	771,341	
via EPA Method 2 (DSCMH)	21,961	21,601	21,964	21,842	
Calculated Mass Emission Rates					
NOx (lbs/hr)	1.11	1.42	1.14	1.22	
CO (lbs/hr)	0.17	0.17	0.17	0.17	
NOx (lb/MMBtu)	0.0264	0.0344	0.0274	0.0294	0.0368
CO (lb/MMBtu)	0.00	0.00	0.00	0.00	
VOC (lb/MMBtu)	0.005	0.006	0.004	0.005	0.056
NOx (g/hp-hr)	0.09	0.11	0.09	0.10	
CO (g/hp-hr)	0.01	0.01	0.01	0.01	0.04
VOC (g/hp-hr)	0.02	0.02	0.01	0.02	

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