EMISSIONS PERFORMANCE TEST PROGRAM

Performed For
Michigan South Central Power Agency

Performed At
Coldwater Peaking Plant
Engine Group (FGGEN1-3)
Emission Units: EUGEN1, EUGEN2, and EUGEN3
Coldwater, Michigan

Test Dates
August 4 through 6, 2015

Report No.
TRC Environmental Corporation Report 238252A

Report Submittal Date
September 14, 2015

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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).

Anthony Sakellariou
Project Manager

September 14, 2015
Date

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

Jeffrey W. Burdette
TRC Air Measurements Technical Director

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed a particulate and gaseous emission compliance test program on the Engine Group (FGGEN1-3) at the Coldwater Peaking Plant of Michigan South Central Power Agency (MSCPA) in Coldwater, Michigan on August 4 through 6, 2015. The tests were authorized by and performed for MSCPA.

The purpose of this test program was to determine particulate matter (PM), nitrogen oxides (NOx), and carbon monoxide (CO) emission rates during normal operating conditions. The results of the test program will be used in order to determine compliance with the emission limits in the Michigan Department of Environmental Quality (MDEQ) Permit to Install (PTI) 80-14. The test program was conducted according to the TRC Test Protocol 238252, dated July 1, 2015.

1.1 Project Contact Information

Participants		
Test Facility	Coldwater Peaking Plant 250 North Filmore Road Coldwater, Michigan 49036	Mr. Matt Burk Michigan South Central Power Agency Director of Environmental Compliance 517-542-2346 Ext. 370 (phone) burkm@mscpa.net
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Mr. Greg Rock Field Team Leader 312-533-2042 (phone) 312-533-2070 (fax) grock@trcsolutions.com

The tests were conducted by Rome Rothgeb, Skylar Rothgeb and Greg Rock of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) can be located in the appendix to this report.

1.2 Facility Description

The Coldwater Peaking Plant operates three 6,023 horsepower natural gas-fueled engines with associated 4,348 kilowatts generators for electrical generation during peak (grid) demand periods. The total nominal capacity is approximately 13.0 MWe. Each engine has a selective catalytic reduction (SCR) for NOx control and an oxidation catalyst for CO control.

2.0 SUMMARY OF RESULTS

The results of this test program are summarized in the table below. Detailed individual run results are presented in Section 6.0.

Parameter	Units	Engine 1	Engine 2	Engine 3	Emission Limit
Filterable Particulate	gr/dscf	---	0.0001	---	---
	lb/hr	---	0.01	---	---
Condensable Particulate	gr/dscf	---	0.0002	---	---
	lb/hr	---	0.02	---	---
Total Particulate (PM2.5/PM10)	gr/dscf	---	0.0003	---	---
	lb/hr	---	0.03	---	0.3 pph
NO_x	ppmvd	13.4	13.8	14.2	---
	lb/MMBtu	0.029	0.030	0.030	0.0368
CO	ppmvd	1.4	0.9	1.4	---
	g/hp-hr	0.005	0.003	0.005	0.04
	ppmvd at 15% O2	0.8	0.5	0.8	270

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

Unit ID/ Sample Location	Parameter Measured	Test Method	No. of Runs	Run Duration
EUGN1, EUGEN2, EUGEN3	Volumetric Flow rate	USEPA 1-4	3	30 min
	NOx	USEPA 7E	3	60 min
	CO	USEPA 10	3	60 min
EUGEN2	PM	USEPA 5 and 202	3	120 min

3.0 DISCUSSION OF RESULTS

No problems were encountered with the testing equipment during the test program. Source operation appeared normal during the entire test program. No 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.

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 Method 7E specifications.

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 Filterable PM Determination by USEPA Method 5

This method is applicable for the determination of PM emissions from stationary sources. USEPA Methods 2-4 were performed concurrently with, and as an integral part of, these determinations.

Flue gas was withdrawn isokinetically from the source at traverse points determined per USEPA Method 1, and PM was collected in the nozzle, probe liner, and on a glass fiber filter. The probe liner and filter were maintained at a temperature of 120 ± 14°C (248 ± 25°F) or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. The PM mass, which included any material that condensed at or above the filtration temperature, was determined gravimetrically after the removal of uncombined water.

4.6 Condensable PM Determination by USEPA Method 202 (As Revised December, 2010)

This method is applicable for the determination of condensable particulate matter (CPM) from stationary sources. CPM is measured in the emissions after removal from the stack and after passing through a filter.

The CPM was collected in dry impingers after filterable particulate material had been collected on filters maintained above 30°C (85°F) using Method 5 or 17 (Appendix A, 40CFR60) or 201A (Appendix M, 40CFR51) type sampling train. The sample train included a Method 23 type condenser capable of cooling the stack gas to less than 85°F, followed by a water dropout impinger. One modified Greenburg Smith impinger and a CPM filter followed the water dropout impinger. The impinger contents were immediately purged after the run with nitrogen (N2) to remove dissolved sulfur dioxide. The impinger solution was then extracted with hexane, and the CPM filter was extracted with water and hexane.

The organic and aqueous fractions were then taken to dryness and the residues weighed. A correction, if necessary, was made for any ammonia present due to laboratory analysis procedures. The total of all fractions represented the CPM.

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

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PARTICULATE TEST RESULTS SUMMARY

Company: MSCPA
Plant: Coldwater, MI
Unit: Engine 2
Location: Stack

Test Run Number	1	2	3	Average
Source Condition	Normal	Normal	Normal	
Date	8/4/2015	8/4/2015	8/4/2015	
Start Time	8:51	11:36	14:27	
End Time	10:57	13:43	16:32	
Sample Duration (min):	120.0	120.0	120.0	120.0
Average Gas Temp (^{o}F):	138.4	136.8	136.9	137.4
Fractional Gas Moisture Content:	0.12	0.11	0.13	0.12
Gas CO_2 Content (%vol):	6.1	6.1	6.2	6.1
Gas O_2 Content (%vol):	10.7	10.8	10.8	10.8
Excess Air (%):	95.0	97.0	97.2	96.4
Gas Wet MW (lb/lbmole-mole):	28.08	28.11	27.96	28.05
Average Gas Vel (ft/sec):	63.74	63.71	64.02	63.82
Measured Volumetric Flow Rate				
Q (actual ft^3/min):	15,205	15,199	15,272	15,226
Q_{std} (std ft^3/min):	12,836	12,901	12,960	12,899
$Q_{std(dry)}$ (dry std ft^3/min):	11,350	11,439	11,305	11,364
Sample Volume (dry std ft^3):	79.168	80.134	81.270	80.191
Sample Volume (std. m^3):	2.242	2.269	2.301	2.271
PM Collected (mg):				
Filterable	0.00	0.54	0.91	0.48
Condensable:	0.30	1.50	0.90	0.90
Total:	0.30	2.04	1.81	1.38
PM Concentration (gr/dscf):				
Filterable	0.0000	0.0001	0.0002	0.0001
Condensable:	0.0001	0.0003	0.0002	0.0002
Total:	0.0001	0.0004	0.0003	0.0003
PM Emission Rate (lb/hr based on measured volumetric flow rate):				
Filterable:	0.00	0.01	0.02	0.01
Condensable:	0.01	0.03	0.02	0.02
Total:	0.01	0.04	0.03	0.03
Isokinetic Variance	98.0	98.4	101.0	99.1

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Gaseous Test Results Summary – Engine 1 and 2

Project Number:	238252	Start Date:	8/6/15
Customer:	MSCPA	End Date:	8/6/15
Unit Identification:	Engine 2 and 1	Facility:	Coldwater, MI
Sample Location:	Stack	Recorded by:	G. Rock
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	Normal Base load	Fd Factor:	8710

Reference Method Results, As Measured Moisture Basis							
Run #	Date	Start Time	End Time	NOx ppmvd	CO ppmvd	CO_2 % v/v dry	O_2 % v/v dry
1 - Engine 2	8/6/15	7:55	8:54	12.9	0.9	6.2	10.8
2 - Engine 2	8/6/15	9:25	10:24	14.2	0.9	6.2	10.7
3 - Engine 2	8/6/15	11:10	12:09	14.3	1.0	6.2	10.8
Average				**13.8**	**0.9**	**6.2**	**10.8**
1 - Engine 1	8/6/15	13:00	13:59	12.3	1.3	6.2	10.8
2 - Engine 1	8/6/15	14:35	15:34	14.1	1.4	6.2	10.7
3 - Engine 1	8/6/15	16:10	17:09	13.9	1.4	6.1	10.8
Average				**13.4**	**1.4**	**6.2**	**10.8**

Emission Rate Calculation Summary					
Run #	NOx lb/MMBtu	CO lb/MMBtu	NOx lb/hr	CO lb/hr	Flow DSCFM
1 - Engine 2	0.028	0.001	1.04	0.04	11,283
2 - Engine 2	0.031	0.001	1.15	0.04	11,293
3 - Engine 2	0.031	0.001	1.16	0.05	11,396
Average	**0.030**	**0.001**	**1.12**	**0.04**	**11,324**
1 - Engine 1	0.026	0.002	1.02	0.07	11,550
2 - Engine 1	0.030	0.002	1.16	0.07	11,559
3 - Engine 1	0.030	0.002	1.16	0.07	11,585
Average	**0.029**	**0.002**	**1.11**	**0.07**	**11,564**

Results Corrected to a Reference O_2 Concentration		Emission Rate Test Calculation Summary g/HP-hr Determined Using lb/hr and horsepower-hour			
Run #	CO ppmvd corrected to 15% Oxygen	BHP HP-hr	CO g/HP-hr	-	-
1 - Engine 2	0.5	6023	0.003	-	-
2 - Engine 2	0.5		0.003	-	-
3 - Engine 2	0.6		0.004	-	-
Average	**0.5**		**0.003**	-	-
1 - Engine 1	0.8	6023	0.005	-	-
2 - Engine 1	0.8		0.005	-	-
3 - Engine 1	0.8		0.005	-	-
Average	**0.8**		**0.005**	-	-

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Gaseous Test Results Summary – Engine 3

Project Number:	238252	Start Date:	8/5/15
Customer:	MSCPA	End Date:	8/5/15
Unit Identification:	Engine 3	Facility:	Coldwater, MI
Sample Location:	Stack	Recorded by:	G. Rock
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	Normal Base load	Fd Factor:	8710

Reference Method Results, As Measured Moisture Basis

Run #	Date	Start Time	End Time	NOx ppmvd	CO ppmvd	CO_2 % v/v dry	O_2 % v/v dry
1	8/5/15	14:45	15:44	14.3	1.4	6.1	10.8
2	8/5/15	16:15	17:14	14.1	1.3	6.1	10.8
3	8/5/15	17:45	18:44	14.2	1.4	6.2	10.8
Average				**14.2**	**1.4**	**6.1**	**10.8**

Emission Rate Calculation Summary

Run #	NOx lb/MMBtu	CO lb/MMBtu	NOX lb/hr	CO lb/hr	Flow DSCFM
1	0.031	0.002	1.17	0.07	11,446
2	0.030	0.002	1.17	0.07	11,537
3	0.031	0.002	1.18	0.07	11,538
Average	**0.030**	**0.002**	**1.17**	**0.07**	**11,507**

Results Corrected to a Reference O_2 Concentration		**Emission Rate Test Calculation Summary g/HP-hr Determined Using lb/hr and horsepower-hour**			
Run #	CO ppmvd corrected to 15% Oxygen	BHP HP-hr	CO g/HP-hr	-	-
1	0.8	6023	0.005	-	-
2	0.8		0.005	-	-
3	0.8		0.005	-	-
Average	**0.8**		**0.005**	-	-