PERFORMANCE TEST PROGRAM

Performed At The
Hillsdale Board of Public Utilities
Unit 5 and Unit 6
Hillsdale, Michigan

Test Date(s)
August 14 and 15, 2019

Report No.
TRC Environmental Corporation Report 341920A

Report Submittal Date
October 7, 2019

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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

Mr. Anthony Sakellariou
Senior Project Manager

October 7, 2019
Date

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

Bruce Randall
TRC Emission Testing Technical Director

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1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed a performance test program on the Unit 5 and Unit 6 at the Hillsdale Board of Public Utilities in Hillsdale, Michigan on August 14 and 15, 2019. The tests were authorized by and performed for Hillsdale Board of Public Utilities.

The purpose of this test program was to determine the percent of carbon monoxide (CO) reduced by the diesel oxidation catalyst (DOC) system installed to control CO emissions during >90% of design capacity operating conditions. The test program was completed in accordance with the methods and specifications for the Reciprocating Internal Combustion Engine (RICE) Maximum Achievable Control Technology (MACT) regulations presented in Title 40, Code of Federal Regulations, Part 63, Subpart ZZZZ, "National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Stationary Reciprocating Internal Combustion Engines". The test program was conducted according to the TRC Test Protocol 341920, dated June 10, 2019.

1.1 Project Contact Information

Participants		
Test Facility	Hillsdale Board of Public Utilities 45 Monroe Street Hillsdale, Michigan 49242 State Registration Number: B7536	Mr. Matt Burk Power Generation Services Lead 517-323-8919 Ext. 135 (phone) mburk@mpower.org
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Mr. Ben Cacao Field Team Leader 630-280-9068 (phone) 312-533-2070 (fax) bcacao@trccompanies.com

The tests were conducted by Bill Harris and Ben Cacao of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual (QI) can be located in the appendix to this report.

Brian Carley and Regina Hines of the Michigan Department of Environmental Quality (MDEQ) observed the testing on August 14, 2019.

1.2 Facility and Process Description

Unit 5 and Unit 6 are subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Stationary Reciprocating Internal Combustion Engines (RICE) requirements for existing non-emergency, non-black start compression ignition (CI) stationary RICE with a site rating of more than 500 brake horsepower (HP) located at a major source of HAP emissions. Unit 5 diesel engine generator uses No. 2 fuel oil and natural gas with an electrical generating capacity of 5613 KW. The fuel oil is from either of two outdoor storage tanks through two day tanks. Unit 6 diesel engine generator uses No. 2 fuel oil and natural gas with an electrical generating capacity of 6000 KW. The fuel oil is from either of two outdoor storage tanks through four dedicated day tanks. Both engines utilize lake water for cooling water.

Each diesel engine generator is equipped with a DCL International Diesel Oxidation Catalyst (DOC) System. The DOC is a single-stage device comprised of one or more substrates coated with catalytic material which promotes oxidation of carbon monoxide, hydrocarbons and particulate matter in the exhaust gas entering the DOC. The DOC was specifically designed to meet the NESHAP RICE requirements for stationary diesel engines.

1.3 Source/Unit Information

The following table identifies the design capacity, make, model number, serial number and date installed of each RICE.

Unit	Emission Unit ID	Engine Information				
		Size (KW)	Manufacturer	Model No.	Serial Number	Installed
Unit 5	EU-ENG-5	5613	Cooper Bessemer	LSV-16-GDT	7126	1/1/1972
Unit 6	EU-ENG-6	6000	Cooper Bessemer	LSVB-20-GDT7167	7167	1/1/1976

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.

Pollutant Tested		Unit 5			Applicable Rule/Regulation
		Inlet	Outlet	Performance Criteria	
CO	ppmvd @ 15% Oxygen	155.8	33.8	23 (Outlet) or	USEPA 40CFR63 subpart ZZZZ - NESHAP for RICE Table 2c (5)
	Reduction (%)	78.3		> 70% Reduction	

Pollutant Tested		Unit 6			Applicable Rule/Regulation
		Inlet	Outlet	Performance Criteria	
CO	ppmvd @ 15% Oxygen	232.7	49.9	23 (Outlet) or	USEPA 40CFR63 subpart ZZZZ - NESHAP for RICE Table 2c (5)
	Reduction (%)	78.6		> 70% Reduction	

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
Unit 5	O_2	USEPA 3A	3	60 min
	CO	USEPA 10	3	60 min
Unit 6	O_2	USEPA 3A	4	60 min
	CO	USEPA 10	4	60 min

3.0 DISCUSSION OF RESULTS

Upon completion of Unit 6 Inlet test run 3, the system response to the zero calibration gas was higher than expected. A check of the sampling system revealed a loose ferrule on the sample line. The ferrule was replaced, and a fourth test run was performed. Runs 1, 2 and 4 have been used for the Unit 6 averaged test results. No other problems were encountered with the testing equipment during the test program.

Source operation appeared normal during the entire test program.

An initial stratification test was conducted on both units (inlet and outlet) in order to determine sampling points according to Section 8.1.2 of Method 7E of 40 CFR part 60, appendix A-4. 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.

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 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.

4.2.1 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.

4.2.2 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.

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

Hillsdale Board of Public Utilities
Hillsdale, MI
August 14, 2019

Unit	Test No.	Inlet CO ppmvd @ 15% O_2	Outlet CO ppmvd @ 15% O_2	Reduction %
5	1	160.4	34.4	78.6
	2	154.4	33.6	78.3
	3	152.5	33.5	78.0
	Average	**155.8**	**33.8**	**78.3**

$$\text{Reduction \%} = \frac{\text{Inlet (CO ppmvd @ 15\% } O_2\text{) - Outlet (CO ppmvd @ 15\% } O_2\text{)}}{\text{Inlet (CO ppmvd @ 15\% O2)}} \times 100$$

Hillsdale Board of Public Utilities
Hillsdale, MI
August 15, 2019

Unit	Test No.	Inlet CO ppmvd @ 15% O_2	Outlet CO ppmvd @ 15% O_2	Reduction %
6	1	232.2	50.0	78.5
	2	232.5	49.5	78.7
	4	233.5	50.3	78.4
	Average	**232.7**	**49.9**	**78.6**

$$\text{Reduction \%} = \frac{\text{Inlet (CO ppmvd @ 15\% } O_2\text{) - Outlet (CO ppmvd @ 15\% } O_2\text{)}}{\text{Inlet (CO ppmvd @ 15\% O2)}} \times 100$$