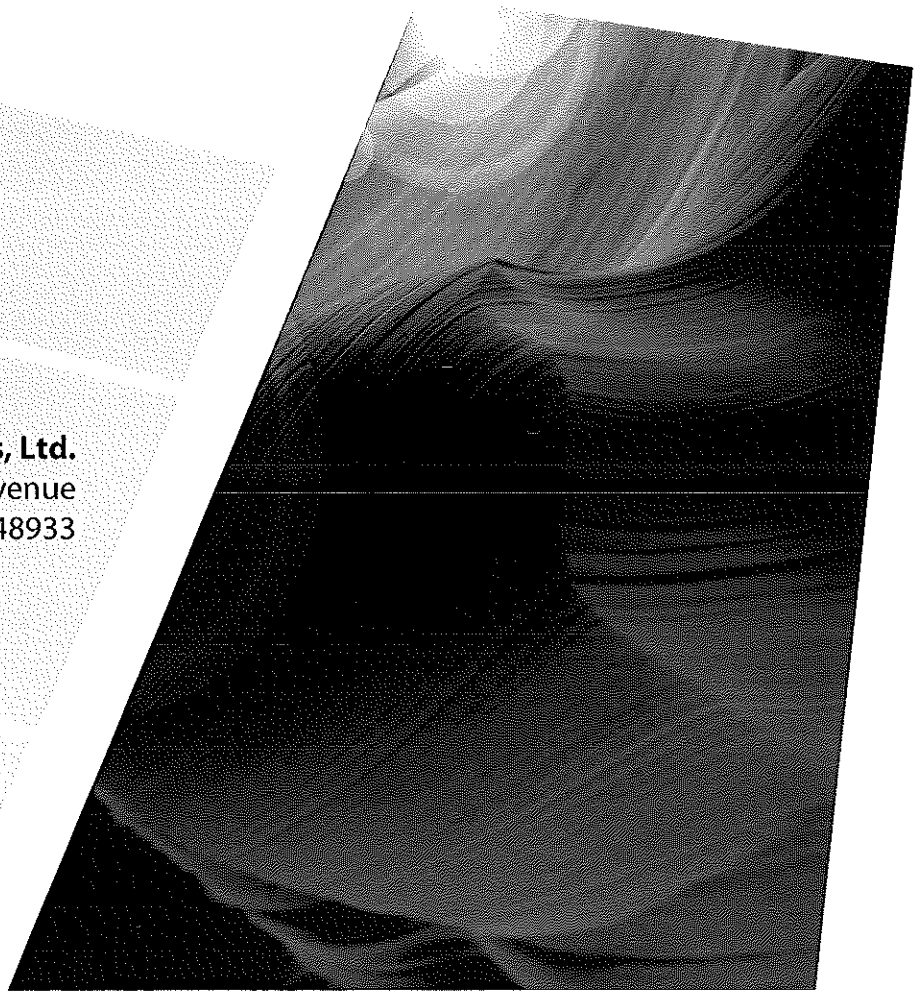
Report

Emissions Test
EU-RGSBBOILER
Test Date: January 29, 2014

Northern Michigan University
Ripley Heating Plant
Marquette, Michigan

NTH Project No. 73-130679-01
March 11, 2014



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1.0 INTRODUCTION

NTH Consultants, Ltd. (NTH) was contracted by Northern Michigan University (NMU) to perform emissions testing on the biomass boiler designated as EU-RGSBBOILER in Michigan Department of Environmental Quality (MDEQ) Permit to Install (PTI) No. 29-11. The boiler is located at the NMU Ripley Heating Plant in Marquette, Michigan.

1.1 Purpose of Test

The purpose of the testing is to comply with Michigan Department of Environmental Quality (MDEQ) Permit to Install (PTI) Number 29-11 and the Federal Standards of Performance for New Stationary Sources (NSPS) codified in 40 CFR Part 60 Subparts A and Dc.

1.2 Test Date Requirement

This test program was performed on January 29, 2014.

1.3 Project Contact Information

Affiliation	Address	Contact
Facility Representative	Northern Michigan University 1401 Presque Isle Ave. Marquette, MI 49855	Ms. Gisele Duehring (906) 227-2158 gduehrin@nmu.edu
Test Company Representative	NTH Consultants, Ltd. 1430 Monroe Avenue NW, Suite 180 Grand Rapids, Michigan 49505	Ms. Lori Myott (517) 242-2692 lmyott@nthconsultants.com
State Representative	MDEQ 120 West Chaplin St. Cadillac, Michigan 79601	Mr. Rob Dickman (231) 876-4412 dickmanr@michigan.gov

This test program was performed by Kyle Daneff and Tyler Hanna of NTH. Ms. Gisele Duehring of NMU coordinated the test events.

1.4 Summary of Results

The emissions test results are summarized in Table 1-1. Detailed results are found in calculations located in Appendix B.

Summary Table 1-1
EU-RGSBBOILER Emissions

PM (Filterable)	Pollutant		
	Measured	Limit	Unit
Run 1	0.065	0.03	lb/MMBtu
Run 2	0.029	0.03	lb/MMBtu
Run3	0.039	0.03	lb/MMBtu
Average	0.044	0.03	lb/MMBtu

2.0 PROCESS DESCRIPTION

EU-RGSBBOILER is a 59 million British thermal units per hour (MMBtu/hr) reciprocating grate stoker fired biomass boiler with over-fire air combustion using biomass as the sole fuel, including start-up. The boiler is a combination water tube/fire tube design and is equipped with a multiclone and dry electrostatic precipitator for the control of particulate matter emissions. The boiler produces steam for use on campus and to generate electricity. The nominal generator electrical output rating is less than 1 MW. The steam output design capacity is 42,000 pounds per hour.

3.0 REFERENCE METHODOLOGIES

The following U.S. EPA approved test methods and procedures were used, in accordance with specifications stipulated in Appendix A to 40 CFR Part 60. Opacity data was collected during the test by NMU's Continuous Monitoring System (COMS).

- **Method 1:** Sampling and Velocity Traverses for Stationary Sources
- **Method 2:** Determination of Stack Gas Velocity and Volumetric Flow Rate (Type "S" Pitot Tube)
- **Method 3A:** Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure).
- **Method 4:** Determination of Moisture Content in Stack Gases
- **Method 5:** Determination of Particulate Matter from Stationary Sources

3.1 Traverse Points

The number of traverse points for each source was determined in accordance with U.S. EPA Method 1. The diameter of EU-RGSBBOILER is 42 inches. A total of twenty-four (24) measurement points were selected for the exhaust flow rate determinations. Two (2) sample ports were utilized for the testing, which resulted in the use of twelve (12) traverse points for each port, as depicted in Figure 1.

3.2 Velocity and Temperature

Exhaust gas velocity and temperature measurements were determined using U.S. EPA Method 2. The pressure differential (delta P) was measured at each traverse point using a calibrated Type S Pitot tube connected to an appropriately sized inclined water column manometer. Exhaust gas temperatures were recorded with a calibrated chromel-alumel (Type"K") thermocouple attached directly to the Pitot tube.

The procedure described in Section 2.4 of Method 1 has been historically employed at each test site to ensure the absence of cyclonic flow. This procedure, known as the Nulling Technique, was employed by positioning the S-Type Pitot tube at each traverse point so that the face openings were perpendicular to the stack cross-sectional plane or at the "0° reference" point. Differential pressure measurements were noted at each traverse point. If the observed delta P was zero, the cyclonic angle was recorded as 0°. If the delta P was not zero, the Pitot tube was rotated up to a ± 90 ° angle until a zero, or null, reading was obtained. Each cyclonic angle was measured with a leveled protractor, reported to the nearest degree, and then averaged. In order for a test site to be considered non-cyclonic, the average must be less than 20 degrees. The cyclonic flow test measurements are included in Appendix E.

3.3 Molecular Weight

The exhaust gas composition was determined using U.S. EPA Reference Method 3A. The oxygen and carbon dioxide concentrations were used to determine exhaust gas composition and molecular weight.

3.4 Moisture

The exhaust gas moisture content was determined in accordance with U.S. EPA Method 4 in conjunction with the Method 5 Sampling Train. All impingers were weighed before and after each run to determine the moisture content of the exhaust gas.

3.5 Particulate Matter

Filterable particulate matter (PM) concentrations were determined following the guidelines of U.S. EPA Method 5. The sample apparatus consisted of a glass nozzle, a heated glass lined probe, a heated 83 mm glass fiber filter, four chilled impingers, and a metering console. The PM sample was collected in the nozzle, probe, and filter. At the conclusion of each test run, the filter was removed from the filter holder, visually inspected and placed into a petri dish. The front half of the filter holder was rinsed with acetone into a separate sample bottle. Acetone blanks were collected during the PM testing.

At the laboratory, Method 5 analytical procedures were used to analyze the samples for PM. The acetone rinses were evaporated and desiccated to dryness and the residue weighed to determine the amount of PM collected. The filters were also desiccated to remove uncombined water and then weighed.

4.0 QUALITY ASSURANCE

Each promulgated U.S. EPA reference method described above is accompanied by a statement indicating that to obtain reliable results, persons using these methods should have a thorough knowledge of the techniques associated with each. To that end, NTH attempts to minimize any factors in the field that could increase error by implementing a quality assurance program into every testing activity segment.

The pitot tubes and thermocouples used to measure the exhaust gas during this test program were calibrated according to the procedures outlined in the *Quality Assurance Handbook for Air Pollution*

Measurement Systems: Volume III, Stationary Source-Specific Methods, Method 2, *Type S Pitot Tube Inspection,* and Calibration Procedure 2E *Temperature Sensor.*

5.0 SUMMARY OF RESULTS

No operational problems were encountered during the test program. Test results are tabulated and can be found appended. Process data including opacity data measured by the COMS was collected and can be found in Appendix C, handwritten data in Appendix D, and quality assurance/quality control information in Appendix E.