ADVANCED INDUSTRIAL RESOURCES

BOILER MACT COMPLIANCE TEST REPORT
NO. 11 BOILER
(HYDROGEN CHLORIDE)
AT
ESCANABA PAPER COMPANY
ESCANABA, MICHIGAN
PROJECT ID: KR- 9368

PREPARED FOR:

VERSO

Escanaba Paper Company

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Test Date:

NOVEMBER 10-12, 2015

ADVANCED INDUSTRIAL RESOURCES

REPORT CERTIFICATION SHEET

Having conducted the Technical Review of this report, I hereby certify the data, information, results, and calculations in this report to be accurate and true according to the methods and procedures used.

January 5, 2015
Date

Derek Stephens
Technical Director
Advanced Industrial Resources

Having written and prepared this report, I hereby certify that the data, information and results in this report to be correct and all inclusive of the necessary information required for a complete third-party review of the testing event.

January 5, 2015
Date

Steven Haigh
Report Preparation Director
Advanced Industrial Resources

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Having supervised all aspects of the field testing, I hereby certify the equipment preparation, field sample collection procedures, and all equipment calibrations were conducted in accordance to the applicable methodologies.

November 16, 2015
Date

Greg Essig
Field Project Supervisor
Advanced Industrial Resources

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1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

The Verso Corporation operates The Escanaba Paper Company (EPC) pulp and paper mill in Escanaba, Michigan. Processes at the facility include the No. 11 Boiler. The facility is operated under the Michigan Department of Environmental Quality (MDEQ) issued Renewable Operating Permit (ROP) Number MI-ROP-A0884-2008a. The No. 11 Boiler is also subject to the operational and emission limits established under 40 CFR 63 Subpart DDDDD – *NESHAP for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters*.

This document describes the test report for establishing compliance with the applicable hydrogen chloride (HCl) emissions limit set-forth in the referenced NESHAP guidance as well as establishing source and control device operational limitations and ranges, as applicable. Compliance for particulate matter, mercury, and carbon monoxide was demonstrated in an initial *Boiler MACT* test event conducted in September 2015.

The test was conducted on the No. 11 Boiler exhaust stack to quantify the emissions of hydrogen chloride.

The field sampling portion of the test program was conducted on November 10-12, 2015, in accordance with the site-specific Test Plan submitted to the MDEQ. All test methods and procedures were performed by Advanced Industrial Resources, Inc. (*AIR*) in accordance with approved USEPA Methods (i.e., 40 CFR 60 Appendix A Methods 1, 2, 3A, 4 and 26A).

1.2 KEY PERSONNEL

The key personnel who coordinated the test program and their telephone numbers are:

Paula LaFleur, Escanaba Paper Company	906-233-2603
Todd Schmidt, Escanaba Paper Company	906-233-2929
Derek Stephens, *QSTI I-IV*, Advanced Industrial Resources	404-843-2100
Scott Wilson, Advanced Industrial Resources	800-224-5007

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS & CONTROL EQUIPMENT DESCRIPTION

Escanaba Paper Company operates a pulp and paper mill in Escanaba, Michigan. Processes at the facility include the No. 11 Boiler.

The No. 11 Boiler (EU11B68), installed 1981, modified 1986, is an ABB Combustion Engineering combination fuel boiler rated for 750,000 pounds of steam per hour (approximately 1040 million BTU per hour heat input) that provides steam for mill processes and steam turbine-generators for producing electricity. The No. 11 Boiler burns natural gas and solid fuels, which include pulverized coal, wood residue, wastewater treatment plant residuals, Tire-Derived Fuel (TDF), and non-hazardous secondary material (NHSM) engineered fuel pellets. Emissions from the No. 11 Boiler are controlled by an over-fired air system (OAF), multi-clone, and electrostatic precipitator. Opacity is monitored by a COMS which meets the design, installation, performance and certification requirements of Performance Specification 1 under Appendix B of 40 CFR 60 and the quality assurance requirements of Procedure 2 under Appendix F to 40 CFR 60. The COMS also meets the requirements of 63.7525. The boiler utilizes an oxygen trim system to maintain optimum air to fuel ratios. For purposes of Boiler MACT compliance, the No. 11 Boiler is in the *hybrid suspension/grate burners designed to burn wet biomass/bio-based solid* subcategory. The Table 2-1 summarizes the applicable Boiler MACT emissions limits and operating parameters associated with No. 11 Boiler.

Table 2-1
Boiler No. 11 Summary of Applicable Emissions Limits and Operating Parameter

Pollutant	Emissions Limit	Control Device	Operating Parameter
Filterable PM	0.44 lb/MMBtu heat input	Multi-Cyclone, Dry ESP	Opacity
CO	2,800 ppmvd @ 3% O_2 [(a),(b)]	N/A	Oxygen Trim System Set Point
Hg	5.7E-06 lb/MMBtu heat input	Multi-Cyclone, Dry ESP	Hg input loading to boiler
HCl	2.2E-02 lb/MMBtu heat input	N/A	HCl input loading to boiler
All	N/A	N/A	Operating Load (as steam flow)

(a) Emissions limits for filterable PM and CO are for boilers under the subcategory of ***hybrid suspension/grate burners designed to burn wet biomass/bio-based solids.***
(b) Parts per million by volume, dry basis, corrected to 3% oxygen concentration.
(c) Per U.S. EPA's proposed reconsideration of Boiler MACT for major sources (80 FR 3090), the CO emissions limit is 3,500 ppmvd @ 3% O_2. The SSMP will be modified as needed based on amendments to Subpart DDDDD, if any, due to the proposed rule.

The applicable operating limits and compliance methodology for each parameter are summarized below in Table 2-2. Operating limits have been set through Initial Performance Testing and may be modified based on subsequent testing.

Table 2-2
Boiler No. 11 Summary of Operating Limits

Parameter	Compliance Methodology[(a)]	Operating Limit[(b)]
Opacity[(c)]	Conduct initial and annual performance testing for filterable PM. Maintain opacity to less than or equal to 10% (daily block average)	≤10%
Oxygen Content[(b)(c)]	Conduct initial and annual performance testing for CO. Operate the oxygen trim system set no lower than the lowest hourly average oxygen concentration measured during the most recent CO performance test.	1.9%
Operating Load – PM, CO, Hg (Sept. 15)[(c)], HCl (Nov. 15)	Conduct initial and annual performance testing for filterable PM, CO, Hg, and HCl. Maintain the operating load such that the 30-day rolling average steam flow rate does not exceed 110% of the highest hourly average operating load recorded during the most recent performance test.	703 KPPH (max. avg. steam flow); 773 KPPH (110% of max. avg. steam flow)

(a) Per Boiler MACT, if your performance tests for a given pollutant for at least two (2) consecutive years show that your emissions are at or below 75% of the emissions limit for the pollutant, and if there are no changes in the operation of the individual boiler or air pollution control equipment that could increase emissions, performance test frequency for the pollutant may be decreased to once every three (3) years.
(b) Boiler MACT does not specifically address oxygen trim system range requirements. EPC has assigned the set point based on September 2015 performance testing.
(c) Operating load, PM, Hg, & CO Boiler MACT compliance established in September 2015 testing.

2.2 SAMPLING LOCATION

The sampling location on the No. 11 Boiler exhaust is located at greater than 8.0 equivalent diameters downstream from the nearest upstream flow disturbance and at least 2.0 equivalent diameters upstream from the stack exhaust. The exhaust stack has a circular cross-section with an internal diameter of 168.0 inches. The stack has four sampling ports oriented on a 90 degree horizontal plane perpendicular to the exhaust flow direction. A schematic diagram of the sampling location is presented in Appendix D. Twenty-four (24) sampling points (six points per port (x4)) were used for USEPA Methods 2, 3A, 4 and 26A sampling, in accordance with USEPA Method 1 requirements.

3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

3.1 OBJECTIVES

The purpose of the testing was to establish compliance with the applicable hydrogen chloride (HCl) emissions limit set-forth in the referenced NESHAP guidance as well as to establish source and control device operational limitations and ranges. Testing was conducted under three (3) separate operating conditions including firing various ratios of coal, bark, and gas.

3.2 FIELD TEST CHANGES, PROBLEMS, OR ITEMS OF NOTE

The testing was conducted in accordance with the Site-Specific Test Protocol submitted to the MDEQ. No problems were encountered during testing that required deviation from the planned test protocol.

Items of note include the following:

1) As previously described, testing was conducted under three (3) separate operating conditions. The results of all three (3) test conditions are included in this test report. However, only the data and results for Condition #2 (i.e. Runs 4-6) have been entered into the ERT data package associated with this test event.

3.3 PRESENTATION OF TEST RESULTS

HCl emission rates are summarized and compared to the applicable emissions standard in Table 3-1 Concentrations and mass rates are presented in Appendix A. Reduced and tabulated data from the field-testing is included in Appendix B. The calculations and nomenclature used to reduce the data are presented in Appendix C. Actual raw field data sheets are presented in Appendix D. Laboratory reports and custody records are presented in Appendix E.

TABLE 3-1: Measured and Allowable Emissions - No. 11 Boiler

Source	Condition	Measured and Allowable Emissions				% of Allowable
		Pollutant	Average Measured	Allowable	Units	
No. 11 Power Boiler	**#1**	HCl	2.6E-02	2.2E-02	lb / MMBtu	**119%**
	#2[1]	HCl	1.2E-02	2.2E-02	lb / MMBtu	**55%**
	#3	HCl	1.8E-02	2.2E-02	lb / MMBtu	**81%**

1) Condition 2 Runs 4-6 used to demonstrate compliance with Boiler MACT HCl emission standard as these runs had maximum HCl loading conditions while also demonstrating compliance with the HCl limit. Runs 4-6 are used in ERT data package and are labeled as Runs 1-3 therein, respectively.

3.4 PROCESS OPERATION DATA

All essential process and control device monitoring equipment was operating and data was being recorded throughout the test periods. Data collected is presented in Appendix G and includes heat input rates per fuel type, applicable CEMS and COMS data, control device operating parameters and steam production rates.

3.5 CMS PERFORMANCE EVALUATIONS

3.5.1 Monitoring Equipment

The Escanaba Paper Company is required by 40 CFR 63.7525 and 40 CFR 63.8(e) to conduct performance evaluations on the continuous monitoring system (CMS) equipment used to demonstrate compliance with the operating limits in Table 2-2.

The CMS equipment, including performance and equipment specifications and data collection, is detailed in Tables 3-1.

Table 3-1
Boiler No. 11 Performance and Equipment Specifications

Equipment	Type	Sample Interface	Parametric Signal Analyzer	Manufacturer Specified Accuracy	Monitor Range/ Output	Data Collection and Reduction Systems
Opacity Meter	Sick Optics OMD41 Opacity Monitor	Light transmission = transmitter/ receiver unit and reflector unit on precipitator outlet duct to stack	0-80%, 4-20 mA signal	±2% full scale	System span 0-80%/ 4-20 mA (max range 100%)	Data is collected in a DCS system. VIM software is used to reduce and manage the data from the DCS system.
Center Oxygen Meter	Rosemount 3000/3008 Probe Oxygen Sensor	Zirconia electrochemi-cal cell positioned in the boiler	0-10%, 4-20 mA signal	0.1% of oxygen or 3% of reading (whichever is greater)	Calibrated range: 0-10% O_2 4-20 mA (max range 25% O_2)	Data is collected in a DCS system. VIM software is used to reduce and manage the data from the DCS system.
East and West Oxygen Meters	Yokogawa ZR22G200 SCETQEA Oxygen Sensors	Zirconia electrochemi-cal cell positioned in the boiler	0-10%, 4-20 mA signal	Zero and span drift <2% of range maximum	Calibrated range: 0-10% O_2/ 4-20 mA (max range 25% O_2)	Data is collected in a DCS system. VIM and PI software are used to reduce and manage the data from the DCS system.
Steam Flow Meter	Rosemount MDL3051 S1CD3A3F 12A1AB3 D2E5L4M 5	Coplanar differential pressure in steam line to distribution header	1-331" H_2O, 4-20 mA, 0-900 KPPH	0.025% of span	0-331" H_2O, 4-20 mA, 0-900 KPPH	Data is collected in a DCS system. VIM software is used to reduce and manage the data from the DCS system.

3.5.2 Evaluation Program Objective

The purpose of the CMS performance evaluation is to validate the continuous monitoring system data as required by 40 CFR 63.8(e)(3)(i) and 40 CFR 63.7525. Performance specifications typically include all the procedures for determining whether a particular CMS is capable of providing reliable measurements. In the absence of performance specifications, the monitors specified in 40 CFR 63.7525 are required to be installed, calibrated, certified, operated and maintained in accordance with the manufacturer's specifications. Consequently, the CMS performance evaluations consisted of the following the manufacturer calibration procedures and any other procedure(s) to document that the monitors meet the performance audit calibration acceptance criteria as specified in Tables 3-2.

Table 3-2
Boiler No. 11 CMS Calibration Frequency and Calibration Acceptance Criteria

Measurement Type	Instrument Type	Calibration Frequency	Calibration Acceptance Criteria
Opacity Meter	Sick Optics OMD41 Opacity Monitor	Daily (Zero and Span)	≤ 4% Opacity
		Quarterly (Performance Audit)	Zero Compensation: ≤ 4% Opacity
			Audit Zero: ≤ 1% Opacity
			Audit Calibration Error: ≤ 3% Opacity
			Optical Alignment: Light beam outside of acceptable alignment area
		Annual (Zero Alignment)	≤ 2% Opacity
Center Oxygen Meter	Rosemount 3000/3008 Probe Oxygen Sensor	Annual (Performance Audit)	Minimum tolerance of +/- 0.2% O_2
East and West Oxygen Meters	Yokogawa ZR22G200SCETQEA Oxygen Sensors	Annual (Performance Audit)	Minimum tolerance of +/- 0.2% O_2
Steam Flow Meter	Rosemount MDL3051S1CD3A3F12 A1AB3D2E5L4M5	Performance Evaluation During Scheduled Boiler Outage	Flow sensor with minimum tolerance of 2% of flow rate

3.5.3 Performance Evaluation Schedule

For equipment other than COMS, the CMS performance evaluations consisted of equipment calibration checks in the weeks prior to the performance testing. Because steam flow and scrubber differential pressure transmitters require removal from the process for calibration, these calibration checks are scheduled to coincide with the most recent scheduled annual boiler outage.

As previously mentioned, the COMS equipment meets the performance evaluations requirements of Performance Specification 1 under Appendix B of 40 CFR 60 and the quality control and assurance requirements of Procedure 3 under Appendix F to 40 CFR 60. Quality assurance and quality control procedures, including calibrations and audits, are conducted according the frequencies specified in Procedure 3.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Emission rate testing was performed on the No. 11 Power Boiler exhaust in accordance with 40 *CFR* 60 Appendix A. Specifically:

- EPA Method 1 was used for the qualification of the location of sampling ports and for the determination of the number and positions of stack traverse points, as applicable to sample traverses for Method 2.

- EPA Method 2 was employed for the determination of the stack gas velocity and volumetric flow rate during stack sampling using the Type "S" Pitot tube.

- EPA Method 3A was used for the calculation of the density and dry molecular weight of the effluent stack gas as well as to determine the oxygen and carbon dioxide concentrations using a calibrated instrumental analyzer.

- EPA Method 4 was used for the determination of moisture content.

- EPA Method 19 was to determine the heat input of the boiler and was used to report the applicable emissions in the units of lbs/MMBtu.

- EPA Method 26A was used for the determination of hydrogen chloride emissions.

All samples were stored upright in a closed sample box until final laboratory analysis. In order to limit the chain of custody, only essential *AIR* personnel are permitted access to these samples.

5.0 QUALITY ASSURANCE ACTIVITIES

The quality assurance/quality control (QA/QC) measures associated with the sampling and analysis procedures given in the noted EPA reference methodologies, in Subparts A of 40 *CFR* 60 and 40 *CFR 63*, and in the *EPA QA/QC Handbook*, Volume III (EPA 600/R-94/038c) were employed, as applicable. Such measures included, but were not limited to, the procedures detailed below.

5.1 PROBE NOZZLE DIAMETER CHECKS

Probe nozzles were calibrated before field testing by measuring the internal diameter of the nozzle entrance orifice along three different diameters. Each diameter was measured to the nearest 0.001 inch, and all measurements were averaged. The diameters were within the limit of acceptable variation of 0.004".

5.2 PITOT TUBE FACE PLANE ALIGNMENT CHECK

Before field testing, each Type S Pitot tube was examined in order to verify that the face planes of the tube were properly aligned, per Method 2 of 40 *CFR* 60, Appendix A. The external tubing diameter and base-to-face plane distances were measured in order to verify the use of 0.84 as the baseline (isolated) Pitot coefficient. At that time the entire probe assembly (i.e., the sampling probe, nozzle, thermocouple, and Pitot tube) was inspected in order to verify that its components met the interference-free alignment specifications given in EPA Method 2. Because the specifications were met, then the baseline Pitot coefficient was used for the entire probe assembly.

After field testing, the face plane alignment of each Pitot tube was checked. No damage to the tube orifices was noted.

5.3 METERING SYSTEM CALIBRATION

Every three months each dry gas meter (DGM) console is calibrated at five orifice settings according to Method 5 of 40 *CFR* 60, Appendix A. From the calibration data, calculations of the values of Y_m and $\Delta H_@$ are made, and an average of each set of values is obtained. The limit of total variation of Y_m values is ± 0.02, and the limit for $\Delta H_@$ values is ± 0.20.

After field testing, the calibration of the DGM console was checked by performing three calibration runs at a single intermediate orifice setting that is representative of the range used during field-testing. Each DGM was within the limit of acceptable relative variation from Y_m of 5.0%.

5.4 TEMPERATURE GAUGE CALIBRATION

After field testing, the temperature measuring instruments on each sampling train was calibrated against standardized mercury-in-glass reference thermometers. Each indicated temperature was within the limit of acceptable variation between the absolute reference temperature and the absolute indicated temperature of 1.5%.

5.5 GAS ANALYZER CALIBRATION

5.5.1 CALIBRATION GAS CONCENTRATION VERIFICATION

AIR obtained a certificate from the gas manufacturer and confirmed that the documentation included all information required by the Environmental Protection Agency Traceability Protocol No. 1. AIR confirmed that the manufacturer certification was complete and current and that calibration gases certifications had not expired. This documentation was available on-site for inspection during testing and is presented in Appendix E.

5.5.2 MEASUREMENT SYSTEM PREPARATION

AIR assembled, prepared, and preconditioned each measurement system by following the manufacturer's written instructions for preparing and preconditioning each gas analyzer and, as applicable, the other system components. *AIR* made all necessary adjustments to calibrate the analyzers and the data recorders and to achieve the correct sampling rate.

5.5.3 ANALYZER CALIBRATION ERROR

After sampling system and analyzer assembly, preparation and calibration, AIR conducted a 3-point analyzer calibration error test before the first run. AIR introduced the low-, mid-, and high-level calibration gases sequentially in direct calibration mode. During the test, AIR made no adjustments to the system except to maintain the correct flow rate. AIR recorded the analyzer's response to each calibration gas and calculated the system calibration error. At each calibration gas level (low, mid, and high) the calibration error was within ± 2.0 percent or 0.5 ppm of the calibration span.

5.5.4 INITIAL SYSTEM BIAS AND CALIBRATION ERROR CHECKS

Before sampling began, AIR determined that the high-level calibration gas best approximated the emissions and used it as the upscale gas. AIR introduced the upscale gas at the probe upstream of all sample conditioning components in system calibration mode. The time it took for the measured concentration to increase to a value that is within 95 percent of the certified gas concentration was recorded. AIR continued to observe the gas concentration reading until it reached a final, stable value and recorded the value.

Next, AIR introduced the low-level gas in system calibration mode and recorded the time required for the concentration response to decrease to a value that was within 5.0 percent of the certified low-range gas concentration.

AIR continued to observe the low-level gas reading until it reached a final, stable value and recorded the result. AIR operated the measurement system at the normal sampling rate during all system bias checks and made only the adjustments necessary to achieve proper calibration gas flow rates at the analyzer. From this data, AIR determined the initial system bias was less than 5% of the calibration span for the low- and high- level gases.

5.5.5 MEASUREMENT SYSTEM RESPONSE TIME

AIR calculated the measurement system response time from the data collected during the Initial System Bias Check.

5.6 INSTRUMENT INTERFENCE RESPONSE

AIR obtained instrument vendor data that demonstrates the interference performance specification is not exceeded as defined in EPA Method 7E Section 13.4. Documentation is provided in Appendix D.

5.7 DATA REDUCTION CHECKS

AIR ran an independent check (using a validated computer program) of the calculations with predetermined data before the field test, and the *AIR* Team Leader conducted spot checks on-site to assure that data was being recorded accurately. After the test, *AIR* checked the data input to assure that the raw data had been transferred to the computer accurately.

5.8 EXTERNAL QUALITY ASSURANCE

5.8.1 TEST PROTOCOL EVALUATION

A Site-Specific Test Protocol (SSTP) was submitted to MDEQ in advance of testing, which provided regulatory personnel the opportunity to review and comment upon the test and quality assurance procedures used in conducting this testing.

5.8.2 ON-SITE TEST EVALUATION

A test schedule was submitted with the Site-Specific Test Protocol and MDEQ personnel were notified of all changes in the schedule. No tests were performed earlier than stated in the original schedule. Therefore, regulatory personnel were afforded the opportunity for on-site evaluation of all test procedures.

6.0 DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) process is generally a seven-step iterative planning approach to ensure development of sampling designs for data collection activities that support decision making. The seven steps are as follows: (1) defining the problem; (2) stating decisions and alternative actions; (3) identifying inputs into the decision; (4) defining the study boundaries; (5) defining statistical parameters, specifying action levels, and developing action logic; (6) specifying acceptable error limits; and (7) selecting resource-effective sampling and analysis plan to meet the performance criteria. The first five steps are primarily focused on identifying qualitative criteria such as the type of data needed and defining how the data will be used. The sixth step defines quantitative criteria and the seventh step is used to develop a data collection design. In regards to emissions sampling, these steps have already been identified for typical monitoring parameters.

Monitoring methods presented in 40 *CFR* 60 Appendix A indicate the following regarding DQOs: Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods. At a minimum, each method provides the following types of information: summary of method; equipment and supplies; reagents and standards; sample collection, preservation, storage, and transportation; quality control; calibration and standardization; analytical procedures, data analysis and calculations; and alternative procedures. These test methods have been designed and tested according to DQOs for emissions testing and analysis. These test methods have been specified and were followed in accordance with the Site-Specific Test Protocol submitted to MDNRE to ensure that DQOs were met for this project.