ADVANCED INDUSTRIAL RESOURCES

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CEMS RELATIVE ACCURACY TEST AUDIT
NO. 8 BOILER, NO. 10 RECOVERY FURNACE, AND
NO. 11 BOILER
VERSO ESCANABA LLC
ESCANABA, MICHIGAN
PROJECT ID: KR-9989

PREPARED FOR:

VERSO

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PREPARED BY:

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Test Dates:

MAY 23-24, 2018

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Verso Escanaba LLC (VE) operates an integrated pulp and paper mill in Escanaba, Michigan. Mill operations include the No. 8 Boiler, No. 10 Recovery Furnace, and No. 11 Boiler which are operating under the Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) Number MI-ROP-A0884-2016.

Relative accuracy test audits (RATAs) are required on each of the CEMS on an annual basis. This Test Report addresses the following required tests:

- NO_x and O_2 CEMS RATA testing on the No. 8 Boiler
- TRS and O_2 CEMS RATA testing on the No. 10 Recovery Furnace
- NO_x and O_2 CEMS RATA testing on the No. 11 Boiler

Testing was conducted on May 23 – 24, 2018, in accordance with the site-specific Test Plan submitted to the MDEQ. All tests were conducted in accordance with the test methods in Title 40 of the Code of Federal Regulations, Part 60 (40 CFR 60) Appendices A and B. Procedures used in and results from this testing are described in this Final Test Report.

1.2 KEY PERSONNEL

The key personnel who coordinated and reviewed this Test Report and their telephone numbers are:

Adam Becker, Verso Escanaba LLC	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

Verso Escanaba LLC (VE) operates an integrated pulp and paper mill in Escanaba, Michigan. Processes at the facility include the No. 8 Boiler, No. 10 Recovery Furnace, and No. 11 Boiler.

The No. 8 Boiler is permitted to burn natural gas and fuel oil to produce steam for the pulping and paper making processes in the mill. The No. 10 Recovery Furnace is permitted to burn black liquor, natural gas, #6 fuel oil, ultra-low sulfur diesel and used oil. The No. 11 Boiler is permitted to burn woodwaste, wastewater sludge, tire-derived fuel (TDF), engineered fuel pellets, natural gas and coal to produce steam for the pulping and paper making processes in the mill.

The facility is required to operate a NO_x/O_2 CEMS on the No. 8 Boiler and No. 11 Boiler and TRS/O2 CEMS on the No. 10 Recovery Furnace.

The No. 8 Boiler NO_x Monitor is a Thermo Electron Instruments (TEI) Model 42I–ANMSPCB (Serial # 1317958371). The O_2 analyzer is a TEI Model 25595003 (Serial # CC111105-5). The system extracts a sample from the process stream and dilutes it at a constant ratio for transport to the analyzer. The captured sample is filtered and passed through a heat exchanger to remove moisture from the sample stream prior to dilution, thereby providing a sample for dry basis measurement. The NO_x analyzer measures oxides of nitrogen by chemiluminescence. The O_2 analyzer uses a fuel cell technology to measure oxygen. The NO_x monitor operates with a span of 0-1,000 PPM and the O_2 operates with a span of 0-25%

The No. 10 Recovery Furnace TRS Monitor is a Thermo Electron Instruments (TEI) Model 43I–ANSCB (Serial #1236656185). The O_2 analyzer is a TEI Model 25595003 (Serial # 1819-OC). The system extracts the sample gas through a sample probe and through a heated Teflon sample line to the gas conditioning system. The moisture is removed from the gas stream and the sample gas is then passed to an SO2 scrubbing system and then to a thermal oxidizer, which operates at approximately 1500°F, where the TRS gases are oxidized to SO2. The gases then pass to the SO2 monitor for analysis. The SO2 analyzer measures sulfur dioxide by UV Fluorescence. The O2 analyzer uses fuel cell technology to measure oxygen. The TRS analyzer operates with a span of 0-30 PPM and the O2 operates with a span of 0-25%.

The No. 11 Boiler NO_x analyzer is a TEI Model 42I-ANMSPCB (Serial # 1308857366). The No. 11 Boiler O_2 analyzer is a TEI Model 25595003 analyzer, serial number 932839437. The system extracts the sample gas through a sample probe and through a heated Teflon sample line to the gas conditioning system. The moisture is removed and the sample gas is then passed to the analyzer. The NO_x analyzer measures oxides of nitrogen by chemiluminescence. The O_2 analyzer uses a fuel cell technology to measure oxygen. The NO_x monitor operates with a span of 0-1,000 PPM and the O_2 operates with a span of 0-25%.

2.2 SAMPLING LOCATION

NOx and O_2 concentrations were sampled from the dedicated stack servicing the No. 8 Boiler. This stack is 161 feet tall with an inside diameter of 84 inches (7 feet). The sampling ports are located 5.6 stack diameters (39 feet) from the last upstream disturbance and 9.0 diameters (63 feet) from the stack discharge. Traverse points were sampled at twenty-four sampling points (six points per each of the four ports).

The No. 11 Boiler sampling point for the NO_x and O_2 probe is located in the duct prior to the stack. The duct has a rectangular cross-section of 66 inches by 300 inches. Testing was performed at the breach from the centrally located port. Previous testing indicated that stratification was not present in the stack, therefore, sampling traverse points were conducted at the proximity of the CEMS.

The No. 10 Recovery Furnace sampling point is located at least 2.0 stack diameters downstream and at least 0.5 stack diameters upstream from any flow disturbances. The stack has an internal diameter of 156.0 inches. The stack has four sampling ports oriented on a 90 degree horizontal plane perpendicular to the exhaust flow direction. Traverse points were sampled simultaneously with the compliance testing, therefore twenty-four sampling points (six points per each of the four ports) were used for sampling, in accordance with Method 1 requirements.

3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

3.1 OBJECTIVES

The purpose of the test program was to determine the relative accuracy of each source's applicable CEM systems and compare the results with the specifications in 40 *CFR* 60 Appendix B.

3.2 FIELD TEST CHANGES AND PROBLEMS

No significant problems were encountered during testing that required deviation from the planned test protocol.

3.3 PRESENTATION OF TEST RESULTS

3.3.1 CEMS RATA RESULTS

Table 3-1 provides the RATA summary for each source tested. Relative accuracy calculation results are presented in Appendix A. Reduced data is presented in Appendix B and raw field data is presented in Appendix D. Facility CEMS data is presented in Appendix F.

Table 3-1

Source	NO_x CEMS (lb/MMBtu) 40 CFR 60 Appendix B Performance Specification 2			O_2 CEMS (vol%, dry) 40 CFR 60 Appendix B Performance Specification 3		
	Relative Accuracy	Limit	RATA Test Result	Average Difference	Limit	RATA Test Result
No. 8 Boiler	1.9%	20%	Passed	0.134	1.0	Passed
No. 11 Boiler	5.0%	20%	Passed	0.618	1.0	Passed
	TRS CEMS 40 CFR 60 Appendix B Performance Specification 5			O_2 CEMS (vol%, dry) 40 CFR 60 Appendix B Performance Specification 3		
	Relative Accuracy	Limit	RATA Test Result	Average Difference	Limit	RATA Test Result
No. 10 Recovery Furnace	7.0%	10%	Passed	0.256	1.0	Passed

3.3.1.1 No. 8 Boiler CEMS NO_x/O_2 RATA Results

On May 24, 2018, the relative accuracy of the No. 8 Boiler NO_x CEMS in the units of lb/MMBtu was determined to be **1.9%** as a percentage of the average reference method, which is less than the 20% limit. Therefore, the NO_x CEMS **passed** the Relative Accuracy Test Audit.

On May 24, 2018, the relative accuracy of the No. 8 Boiler O_2 CEMS was determined to be **0.134 vol%** O_2 as the absolute average difference, which is less than the 1.0 vol% O_2 limit. Therefore, the O_2 CEMS **passed** the Relative Accuracy Test Audit.

3.3.1.2 No. 11 Boiler CEMS NO_x/ O_2 RATA Results

On May 23, 2018, the relative accuracy of the No. 11 Boiler NO_x CEMS in the units of lb/MMBtu was determined to be **5.0%,** which is less than the 20% limit. Therefore, the NO_x CEMS **passed** the Relative Accuracy Test Audit.

On May 23, 2018, the relative accuracy of the No. 11 Boiler O_2 CEMS test was determined to be **0.618 vol% O_2** as the absolute average difference, which is less than the 1.0 vol% O_2 limit. Therefore, the O_2 CEMS **passed** the Relative Accuracy Test Audit.

3.3.1.3 No. 10 Recovery Furnace CEMS TRS /O_2 RATA Results

On May 24, 2018, the relative accuracy of the No. 10 Recovery Furnace TRS CEMS in the units of ppm corrected to 8% O_2 was determined to be **7.0%** as a percentage of the emission standard of 5.0 ppm corrected to 8% O_2, which is less than the 10% limit. Therefore, the TRS CEMS **passed** the Relative Accuracy Test Audit.

On May 24, 2018, the relative accuracy of the No. 10 Recovery Furnace O_2 CEMS was determined to be **0.256 vol%** O_2 as the absolute average difference, which is less than the 1.0 vol% O_2 limit. Therefore, the O_2 CEMS **passed** the Relative Accuracy Test Audit.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Testing on the No. 8 Boiler was conducted according to the methodology in 40 *CFR* 60 Appendices A and B. EPA Method 19 was used to calculate NOx PPM to NOx lb/MMBtu using natural gas as Fd Factor of 8710. Ten (10), separate thirty (30) minute test runs were conducted in accordance with 40 *CFR* 60, Appendix A, Method 7E and Method 3A to determine NO_x and O_2 concentrations simultaneously.

Testing on the No 11 Boiler was conducted according to the methodology in 40 *CFR* 60 Appendices A and B. EPA Method 19 was used to calculate NOx PPM to NOx lb/MMBtu using process data as Fd Factor of 9570. Ten (10), separate thirty (30) minute test runs were conducted in accordance with 40 *CFR* 60, Appendix A, Methods 3A, and 7E to determine O_2, and NO_x concentrations, respectively.

Testing on the No. 10 Recovery Furnace was conducted according to the methodology in 40 *CFR* 60 Appendices A and B. EPA Method 16C was used to calculate the bias correct TRS concentration based on system performance. Nine (9), separate thirty (30) minute test runs were conducted in accordance with 40 *CFR* 60, Appendix A, Methods 3A, and 16C to determine O_2, and TRS concentrations, respectively.

RATA on No. 8 Boiler, No. 10 Recovery Furnace, and No. 11 Boiler were conducted while the operating rates were under normal load conditions.

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 GAS ANALYZER CALIBRATION

5.1.1 CALIBRATION GAS CONCENTRATION VERIFICATION

Calibration gases that were analyzed following the Environmental Protection Agency Traceability Protocol No. 1 were used. Certifications from the gas manufacturers that Protocol No. 1 was followed are presented in Appendix E.

5.1.2 MEASUREMENT SYSTEM PREPARATION

AIR assembled 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.

5.1.3 ANALYZER CALIBRATION ERROR

AIR conducted the analyzer calibration error check by introducing calibration gases to the measurement system upstream of each gas analyzer. After the measurement system had been prepared for use and immediately prior to starting the RATA, *AIR* introduced the zero, high-range, and mid-range gases to the analyzer. During this check, *AIR* made no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Calibration error checks were repeated whenever RATA tests extended over two days.

5.1.4 SAMPLING SYSTEM BIAS CHECK

AIR performed the sampling system bias check by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. Immediately prior to starting each RATA run, a zero gas and the mid-range gas (which most closely approximated the effluent concentrations)

were used for this check. *AIR* introduced the zero calibration gas and recorded the gas concentration displayed by the analyzer. *AIR* then introduced mid-range calibration gas and recorded the gas concentration displayed by the analyzer. During the sampling system bias check, *AIR* operated the system at the normal sampling rate and made no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer.

5.1.5 ZERO AND CALIBRATION DRIFT CHECKS

At the end of each RATA test run and whenever adjustments were necessary for the measurement system, *AIR* repeated the sampling system bias check procedure described in Section 5.1.4.

5.1.6 ANALYZER ERROR, BIAS AND DRIFT CHECK SPECIFICATIONS

Analyzer calibration errors were less than +/-2 percent of the span for the zero, mid-range, and high-range calibration gases. Sampling system bias were less than +/-5 percent of the span for the zero and mid-range calibration gases. Zero drift were less than +/-3 percent of the span over the period between zero drift checks. Calibration drifts were less than +/-3 percent of the span over the period between calibration drift checks.

5.2 NO_2-NO CONVERSION EFFICIENCY

Prior to the test, *AIR* evaluated the NO_2 to NO conversion efficiency of the analyzer. *AIR* introduced an EPA Protocol 1 NO_2 gas from an NO_2 calibration gas cylinder directly to the analyzer. The gas was introduced to the analyzer for a length of time that allowed the NO_2-NO converter within the analyzer to analyze the NO_2 gas to show that the analyzer converter is operating at least at 90% conversion rate. The analyzer used during the testing program successfully met this requirement.

5.3 INSTRUMENT INTERFENCE RESPONSE

AIR obtained instrument vendor data that demonstrates the interference performance specification has not been exceeded as defined in EPA Method 7E Section 8.2.7. Documentation is provided in Appendix D.

5.4 INSTRUMENT RESPONSE TIME

To determine the system response time, prior to testing, *AIR* introduced the upscale calibration gas into the measurement system at the calibration valve assembly, which is located prior to all sample conditioning components. AIR recorded the upscale response time, which is equivalent to the time that was required for the system response output to stabilize at a value that is 95 percent or 0.5 ppm (whichever is less restrictive) of the certified upscale calibration gas value. AIR then quickly switched to the zero calibration gas and recorded the time from the concentration change to the measurement system response equivalent to 95 percent or 0.5 ppm (whichever is less restrictive) of the zero gas. This procedure was repeated three times. A stable value is equivalent to a change of less than 1 percent of span value for 30 seconds or less than 5 percent of the measured average concentration for 2 minutes. The greater of the average upscale or downscale response times was taken as the "response time" for each analyzer.

5.5 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.

5.6 EXTERNAL QUALITY ASSURANCE

5.6.1 TEST PROTOCOL EVALUATION

A Site-Specific Test Protocol was submitted to MDEQ more than 30 days 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.

5.6.2 ON-SITE TEST EVALUATION

A test schedule was submitted with the Site-Specific Test Protocol and MDEQ. 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 a 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 to testing to ensure that DQOs were met for this project.