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CONTINUOUS EMISSIONS MONITORING SYSTEM RELATIVE ACCURACY TEST AUDIT DETERMINATION

Performed At
USG-Otsego Paper, Inc.
USG-Otsego Facility
EUTURBINE1 (North – Unit 24)
EUTURBINE2 (South – Unit 25)
Otsego, Michigan

Test Dates
April 19 and 20, 2018

Report No.
TRC Environmental Corporation Report 295739A

Report Submittal Date
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CONTINUOUS EMISSIONS MONITORING SYSTEM
RELATIVE ACCURACY TEST AUDIT DETERMINATION

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed an oxides of nitrogen (NO_x) and oxygen (O_2) relative accuracy test audit (RATA) determination of the continuous emission monitoring system (CEMS) associated with the natural gas fired combustion turbines EUTURBINE1 (North-Unit 24) and EUTURBINE2 (South-Unit 25) on April 19 and 20, 2018 at the USG-Otsego Paper, Inc. facility located in Otsego, Michigan. The tests were authorized by and performed for USG-Otsego Paper, Inc.

This test program was performed to demonstrate compliance with Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) No. MI-ROP-A0023-2013 and the CAIR Ozone Nitrogen Oxide Budget Permit No. MI-NOO-55799-2013 in Appendix 9 of the ROP. The test program was conducted according to the TRC Test Protocol 295739 dated March 14, 2018.

1.1 Project Contact Information

Participants		
Test Facility	USG-Otsego Paper, Inc. USG-Otsego Facility 320 N. Farmer Street Otsego, Michigan 49078	Franklin Knowles Environmental Compliance Supervisor 269-384-6351 (phone) fknowles@usg.com
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Chris Miller Field Team Leader 312-533-2042 (phone) cmiller@trcsolutions.com
State Representative	MDEQ – Air Quality Division Constitution Hall 525 West Allegan Street Lansing, Michigan 48909	David Patterson Environmental Quality Analyst Technical Programs Unit 517-284-6782 (phone) pattersond2@michigan.gov

The tests were coordinated through Franklin Knowles, Environmental Compliance Supervisor, of Otsego Paper and conducted by Christopher Purches and Chris Miller of TRC. David Patterson of Michigan Department of Environmental Quality (MDEQ) observed the testing. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) can be found in the appendix to this report.

2.0 FACILITY DESCRIPTION

Otsego Paper, Inc is a subsidiary of the United States Gypsum Company. The facility manufactures gypsum paper.

The Otsego Paper facility produces electricity from two (2) Mars T-15000 gas turbines, designated as EUTURBINE1 and EUTURBINE2, with a maximum heat input rate of 141.5 million British thermal unit per hour (MMBtu/hr) at low temperature operating conditions as measured on a higher heating value (HHV) basis. Energy is generated at the combustion turbine by drawing in ambient air by means of burning fuel and expanding the hot combustion gases in the turbine. The hot exhaust gases of each turbine are directed to a multi-pressure ABCO heat recovery steam generator (HR5G). There are also natural gas-fired duct burners associated with each HRSG and coupled to a turbine, designated as EUDUCTBURNER1 and EUDUCTBURNER2, respectively.

The facility has one paper machine, No. 1 Paper Machine (EUPAPERMACHINE1), used to produce paper from 100 percent recycle stock and corrugated material. The paper machine has three fourdriniers and is capable of producing a triple ply sheet.

Plant capacity for base load operations is 11 megawatts (MW) for each turbine and 160,000 pounds per hour (lb/hr) of steam for each HRSG.

EUTURBINE1 and EUTURBINE2 each have a maximum heat input rate of 141.5 MMBtu/hr at low temperature operating conditions.

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3.0 SUMMARY OF RESULTS

3.1 CEMS RATA Test Matrix

Parameter	Reference Methods (RM)	No. of Test Runs	Test Run Length (min)
NO_X	7E, 3A	10	21
O_2	3A	10	21

3.2 CEMS RATA Results

EUTURBINE1 (Unit 24)

Load (MW)	Parameter	Units	Performance Specifications (40CFR75)		CEMS Performance	
			Semi-Annual	Annual	Relative Accuracy	Bias Adjustment Factor
~7.5	NO_X	lb/MMBtu	7.5% < RA ≤ 10.0%	RA ≤ 7.5%	1.03 %	1.000

Load (MW)	Parameter	Units	Performance Specifications (40CFR60)		CEMS Performance
			Specification No.	Acceptance Criteria	Relative Accuracy
~7.5	NO_X	ppmvd @ 15% O_2	2	RA ≤ 20%	0.76 %
	O_2	%	3	RA ≤ 1.0% difference for %O_2	0.28 %

EUTURBINE2 (Unit 25)

Load (MW)	Parameter	Units	Performance Specifications (40CFR75)		CEMS Performance	
			Semi-Annual	Annual	Relative Accuracy	Bias Adjustment Factor
~10.1	NO_X	lb/MMBtu	7.5% < RA ≤ 10.0%	RA ≤ 7.5%	3.73 %	1.000

Load (MW)	Parameter	Units	Performance Specifications (40CFR60)		CEMS Performance
			Specification No.	Acceptance Criteria	Relative Accuracy
~10.1	NO_X	ppmvd @ 15% O_2	2	RA ≤ 20%	3.68 %
	O_2	%	3	RA ≤ 1.0% difference for %O_2	0.13 %

Based on the above summary of results, the facility CEMS passed the RATA. The complete test results from this program are tabulated in Section 7.0

4.0 DISCUSSION OF RESULTS

The data acquisition and handling system (DAHS) computer printout for the same time periods as TRC's reference method (RM) testing was used to determine the relative accuracy (RA) of the CEMS. The watches of the test crew were synchronized with the facility's CEM system prior to the commencement of and during each test run. A total of ten (10) RATA runs, each 21-minutes in duration, were performed at each turbine unit location while operating greater than 50% of maximum load. The CEMS RATA data, comprised of twenty-one (21) minutes of data points for each test run, was provided to TRC by the facility.

Source operation appeared normal during the entire test program. Each turbine was operated near base load during the RATA.

Data collected from the O_2 and NO_x analyzers were averaged for each test run. A standard fuel factor of 8,710 dscf/MMBtu was used to calculate the NO_x emission rates on a pound per million Btu basis (lb/MMBtu) following the guidelines of USEPA Method 19.

5.0 TEST 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.

5.1 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 40CFR75 Appendix A, Section 6.5.6. Sampling was performed at three points (16.7%, 50%, and 83.3%) across one diameter of each turbine exhaust stack.

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 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.

5.1.1 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.

5.1.2 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 used a photomultiplier tube to measure the light emitted from the chemiluminescent decomposition of NO_2. A NO_x converter efficiency test was performed on site. The results show the NO_x analyzer passed. Results are appended.

5.1.3 Determination of F-Factors by USEPA Method 19

This method is applicable for the determination of the pollutant emission rate using oxygen (O_2) concentrations and the appropriate F factor (the ratio of combustion gas volumes to heat inputs) and the pollutant concentration. The appropriate F-Factor was selected from Table 19-2 of Method 19.

6.0 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.

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RATA Type: **Nitrogen Oxides (NO_X), lb/MMBtu**
Regulation: **40CFR75**
RM Used: **3A, 7E**

Customer:	USG-Otsego Paper	Project #:	295739
Unit ID:	EUTURBINE 1 (North)	CEM Model:	Horiba/CMA-EC622
Sample Loc:	Stack	CEM Serial #:	41678240071

Use? 1 = Y 0 = N	Test Run	Date	Start Time	End Time	RM NO_X lb/MMBtu	CEM NO_X lb/MMBtu	(RM-CEM) Difference (di)	Unit Load (MW)
0	1	4/19/18	7:10	7:30	0.054	0.056	-0.002	7.517
1	2	4/19/18	8:00	8:20	0.054	0.055	-0.001	7.517
1	3	4/19/18	8:43	9:03	0.055	0.055	0.000	7.516
1	4	4/19/18	9:28	9:48	0.055	0.055	0.000	7.516
1	5	4/19/18	10:10	10:30	0.054	0.055	-0.001	7.515
1	6	4/19/18	10:50	11:10	0.054	0.054	0.000	7.517
1	7	4/19/18	11:34	11:54	0.054	0.054	0.000	7.515
1	8	4/19/18	12:16	12:36	0.054	0.054	0.000	7.515
1	9	4/19/18	12:58	13:18	0.054	0.054	0.000	7.516
1	10	4/19/18	13:40	14:00	0.054	0.054	0.000	7.515

n	9	
t(0.025)	2.306	
Mean RM Value	0.054	RM avg
Mean CEM Value	0.054	CEM avg
Mean Difference	-0.0002	d avg
Standard Deviation	0.000	sd
Confidence Coefficient	0.000	CC
RA based on RM	1.03	%
Bias Adjustment Factor	1.000	BAF

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RATA Type: **Nitrogen Oxides (NO_X), ppmvd at** **15% Oxygen**
Regulation: **40CFR60**
RM Used: **7E**

Customer:	USG-Otsego Paper	Project #:	295739
Unit ID:	EUTURBINE 1 (North)	CEM Model:	Horiba/CMA-EC622
Sample Loc:	Stack	CEM Serial #:	41678240071

Use? 1 = Y 0 = N	Test Run	Date	Start Time	End Time	RM NO_X ppmvd at 15% Oxygen	CEM NO_X ppmvd at 15% Oxygen	(RM-CEM) Difference (di)	Unit Load (MW)
0	1	4/19/18	7:10	7:30	14.7	15.2	-0.500	7.517
1	2	4/19/18	8:00	8:20	14.8	14.8	0.000	7.517
1	3	4/19/18	8:43	9:03	14.8	14.9	-0.100	7.516
1	4	4/19/18	9:28	9:48	14.9	15.0	-0.100	7.516
1	5	4/19/18	10:10	10:30	14.6	14.8	-0.200	7.515
1	6	4/19/18	10:50	11:10	14.6	14.7	-0.100	7.517
1	7	4/19/18	11:34	11:54	14.7	14.7	0.000	7.515
1	8	4/19/18	12:16	12:36	14.6	14.6	0.000	7.515
1	9	4/19/18	12:58	13:18	14.6	14.6	0.000	7.516
1	10	4/19/18	13:40	14:00	14.6	14.6	0.000	7.515

n	9	
t(0.975)	2.306	
Mean RM Value	14.689	RM avg
Mean CEM Value	14.744	CEM avg
Mean Difference	-0.056	d avg
Sum of Differences^2	0.070	di^2
Standard Deviation	0.073	sd
Confidence Coefficient	0.056	CC
RA based on RM	0.76	%

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RATA Type: **Oxygen (O_2), % by volume**
Regulation: **40CFR60**
RM Used: **3A**

Customer:	USG-Otsego Paper	Project #:	295739
Unit ID:	EUTURBINE 1 (North)	CEM Model:	Horiba/CMA-EC622
Sample Loc:	Stack	CEM Serial #:	41678240071

Use? 1 = Y 0 = N	Test Run	Date	Start Time	End Time	RM O_2 % v/v dry	CEM O_2 % v/v dry	(RM-CEM) Difference (di)	Unit Load (MW)
1	1	4/19/18	7:10	7:30	15.9	16.1	-0.200	7.517
1	2	4/19/18	8:00	8:20	16.0	16.2	-0.200	7.517
1	3	4/19/18	8:43	9:03	16.0	16.2	-0.200	7.516
1	4	4/19/18	9:28	9:48	15.9	16.2	-0.300	7.516
1	5	4/19/18	10:10	10:30	15.9	16.3	-0.400	7.515
1	6	4/19/18	10:50	11:10	15.9	16.2	-0.300	7.517
0	7	4/19/18	11:34	11:54	15.9	16.3	-0.400	7.515
1	8	4/19/18	12:16	12:36	15.9	16.2	-0.300	7.515
1	9	4/19/18	12:58	13:18	15.9	16.2	-0.300	7.516
1	10	4/19/18	13:40	14:00	15.9	16.2	-0.300	7.515

n	9	
t(0.975)	2.306	
Mean RM Value	15.922	RM avg
Mean CEM Value	16.200	CEM avg
Mean Difference	-0.278	d avg
Standard Deviation	0.067	sd
Confidence Coefficient	0.051	CC
RA (Absolute Mean Difference)	0.28	% vol diff.

RATA Type: **Nitrogen Oxides (NO_X), lb/MMBtu**
Regulation: **40CFR75**
RM Used: **3A, 7E**

Customer:	USG-Otsego Paper	Project #:	295739
Unit ID:	EUTURBINE 2 (South)	CEM Model:	Horiba/CMA-EC622
Sample Loc:	Stack	CEM Serial #:	41678240073

Use? 1 = Y 0 = N	Test Run	Date	Start Time	End Time	RM NO_X lb/MMBtu	CEM NO_X lb/MMBtu	(RM-CEM) Difference (di)	Unit Load (MW)
1	1	4/20/18	7:05	7:25	0.040	0.040	0.000	10.362
1	2	4/20/18	7:47	8:07	0.040	0.041	-0.001	10.202
1	3	4/20/18	8:28	8:48	0.040	0.041	-0.001	10.246
1	4	4/20/18	9:08	9:28	0.041	0.042	-0.001	10.175
1	5	4/20/18	9:53	10:13	0.042	0.043	-0.001	10.143
1	6	4/20/18	10:34	10:54	0.043	0.044	-0.001	10.096
1	7	4/20/18	11:13	11:33	0.045	0.047	-0.002	10.260
1	8	4/20/18	11:55	12:15	0.045	0.047	-0.002	10.238
1	9	4/20/18	12:35	12:55	0.044	0.045	-0.001	9.871
0	10	4/20/18	13:18	13:38	0.043	0.045	-0.002	9.808

n	9	
t(0.025)	2.306	
Mean RM Value	0.042	RM avg
Mean CEM Value	0.043	CEM avg
Mean Difference	-0.0011	d avg
Standard Deviation	0.001	sd
Confidence Coefficient	0.000	CC
RA based on RM	3.73	%
Bias Adjustment Factor	1.000	BAF

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RATA Type: **Nitrogen Oxides (NO_X), ppmvd at** **15% Oxygen**
Regulation: **40CFR60**
RM Used: **7E**

Customer:	USG-Otsego Paper	Project #:	295739
Unit ID:	EUTURBINE 2 (South)	CEM Model:	Horiba/CMA-EC622
Sample Loc:	Stack	CEM Serial #:	41678240073

Use? 1 = Y 0 = N	Test Run	Date	Start Time	End Time	RM NO_X ppmvd at 15% Oxygen	CEM NO_X ppmvd at 15% Oxygen	(RM-CEM) Difference (di)	Unit Load (MW)
1	1	4/20/18	7:05	7:25	10.8	10.8	0.000	10.362
1	2	4/20/18	7:47	8:07	10.8	11.1	-0.300	10.202
1	3	4/20/18	8:28	8:48	10.8	11.1	-0.300	10.246
1	4	4/20/18	9:08	9:28	11.3	11.5	-0.200	10.175
1	5	4/20/18	9:53	10:13	11.4	11.8	-0.400	10.143
1	6	4/20/18	10:34	10:54	11.7	11.9	-0.200	10.096
1	7	4/20/18	11:13	11:33	12.3	12.6	-0.300	10.260
1	8	4/20/18	11:55	12:15	12.3	12.8	-0.500	10.238
1	9	4/20/18	12:35	12:55	11.8	12.3	-0.500	9.871
0	10	4/20/18	13:18	13:38	11.7	12.3	-0.600	9.808

n	9	
t(0.975)	2.306	
Mean RM Value	11.467	RM avg
Mean CEM Value	11.767	CEM avg
Mean Difference	-0.300	d avg
Sum of Differences^2	1.010	di^2
Standard Deviation	0.158	sd
Confidence Coefficient	0.122	CC
RA based on RM	3.68	%

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RATA Type: **Oxygen (O_2), % by volume**
Regulation: **40CFR60**
RM Used: **3A**

Customer:	USG-Otsego Paper	Project #:	295739
Unit ID:	EUTURBINE 2 (South)	CEM Model:	Horiba/CMA-EC622
Sample Loc:	Stack	CEM Serial #:	41678240073

Use? 1 = Y 0 = N	Test Run	Date	Start Time	End Time	RM O_2 % v/v dry	CEM O_2 % v/v dry	(RM-CEM) Difference (di)	Unit Load (MW)
1	1	4/20/18	7:05	7:25	14.8	14.9	-0.100	10.362
1	2	4/20/18	7:47	8:07	14.8	15.0	-0.200	10.202
1	3	4/20/18	8:28	8:48	14.9	15.0	-0.100	10.246
1	4	4/20/18	9:08	9:28	14.9	15.0	-0.100	10.175
1	5	4/20/18	9:53	10:13	14.9	15.1	-0.200	10.143
1	6	4/20/18	10:34	10:54	15.0	15.1	-0.100	10.096
1	7	4/20/18	11:13	11:33	15.0	15.1	-0.100	10.260
1	8	4/20/18	11:55	12:15	14.9	15.0	-0.100	10.238
1	9	4/20/18	12:35	12:55	14.9	15.1	-0.200	9.871
0	10	4/20/18	13:18	13:38	14.9	15.1	-0.200	9.808

n	9	
t(0.975)	2.306	
Mean RM Value	14.900	RM avg
Mean CEM Value	15.033	CEM avg
Mean Difference	-0.133	d avg
Standard Deviation	0.050	sd
Confidence Coefficient	0.038	CC
RA (Absolute Mean Difference)	0.13	% vol diff.