Air Emission Testing of Boiler Nos. 2, 3, 5, and 6

Nexteer Automotive

3900 Holland Road
Saginaw, Michigan
State Registration No. A6175

Prepared for

Nexteer Automotive

Saginaw, Michigan

Bureau Veritas Project No. 11015-000146.00

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Executive Summary

Nexteer Automotive retained Bureau Veritas North America, Inc. to test air emissions from four sources at its facility in Saginaw, Michigan. The testing was performed in order to satisfy testing requirements and evaluate compliance with emission limits in Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI -ROP-A6175-2014a (Boiler No. 2) and MDEQ Permit-to-Install (PTI) PTI 175-14 (Boiler Nos. 3, 5, and 6).

The sources tested are the following boilers:

- **Boiler No. 2 (EUBR02)** 77-million-British-thermal-unit-per-hour (mmBtu/hr)-heat-input, natural-gas-fired boiler that supplies 60,000 pounds per hour (lb/hr) process steam.
- **Boiler No. 3 (EUBR03)** 150-mmBtu/hr-heat-input, natural-gas-fired boiler that supplies 125,000 lb/hr of process steam.
- **Boiler No. 5 (EUBR05)** 180-mmBtu/hr-heat-input, natural-gas-fired boiler that supplies 150,000 lb/hr of process steam.
- **Boiler No. 6 (EUBR06)** 180-mmBtu/hr-heat-input, natural-gas-fired boiler that supplies 150,000 lb/hr of process steam.

The ROP and PTI require testing to evaluate compliance with emission limits. Boiler No. 5 and Boiler No. 6 have recently been converted from coal-fired boilers to gas-fired boilers; therefore, testing was required within 180 days after initial startup of the boilers.

The air emission testing at the outlet of the boilers followed United States Environmental Protection Agency (USEPA) Methods 1, 2, 3A, 4, 7E, 10, 19, and 205, and State of Michigan Part 10 Rules. Testing consisted of three 60-minute test runs at the exhaust of:

- Boiler No. 2 (EUBR02) to measure O_2, CO_2, and NO_x concentrations and mass emission rates on December 2, 2015. CO was not measured because the permit for this boiler does not include a limit for CO.
- Boiler Nos. 3, 5, and 6 (EUBR03, EUBR05, and EUBR06) to measure O_2, CO_2, CO, and NO_x concentrations and mass emission rates on November 30, 2015, and December 1, 2015.

The air emission testing was conducted as described in the Intent-to-Test plan, which was submitted to MDEQ on September 1, 2015. Detailed results are presented in Tables 1 through 4 after the Tables Tab of this report. The results of the testing are summarized in the following tables. The results of this test program indicate Boiler Nos. 2, 3, 5, and 6 at the Nexteer Automotive facility are operating in compliance with permit emission limits.

Boiler No. 2 Emission Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	53,020	52,960	52,720	52,900	—
Fuel Consumption	scf/hr	47,000	46,000	46,000	46,333	—
O_2 Concentration‡	%	6.4	6.3	6.2	6.3	—
CO_2 Concentration‡	%	8.4	8.4	8.5	8.4	—
NO_x Mass Emission Rate	lb NO_x/mmscf of natural gas	127	127	127	127	210

O_2 = oxygen
CO_2= carbon dioxide
NO_x = nitrogen oxides
‡ corrected for analyzer drift
scf/hr = standard cubic foot per hour
mmscf = million standard cubic foot
Note: The permit limit for Boiler No. 2 is expressed in units different from the other boilers.

Boiler No. 3 Emission Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	110,780	112,380	113,480	112,213	—
Fuel Consumption	scf/hr	121,000	119,000	118,000	119,333	—
O_2 Concentration‡	%	3.4	2.9	2.9	3.1	—
CO_2 Concentration‡	%	10.3	10.5	10.4	10.4	—
CO Mass Emission Rate	lb/mmBtu	0.0000098	Not detected	Not detected	0.0000098	0.10
	lb/hr	0.0018	Not detected	Not detected	0.0018	15.0
NO_x Mass Emission Rate	lb/mmBtu	0.087	0.088	0.088	0.088	0.12
	lb/hr	16.2	16.3	16.0	16.2	18.0

O_2 = oxygen
CO_2= carbon dioxide
CO = carbon monoxide
NO_x = nitrogen oxides
‡ corrected for analyzer drift
lb/hr = pound per hour
scf/hr = standard cubic foot per hour
lb/mmBtu = pound per million British thermal unit

Boiler No. 5 Emission Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	146,683	144,427	148,428	146,513	—
Fuel Consumption	scf/hr	137,000	131,000	135,000	134,333	—
O_2 Concentration‡	%	3.3	3.2	3.2	3.2	—
CO_2 Concentration‡	%	10.2	10.2	10.3	10.2	—
CO Mass Emission Rate	lb/mmBtu	Not detected	Not detected	Not detected	Not detected	0.10
	lb/hr	Not detected	Not detected	Not detected	Not detected	18.0
NO_x Mass Emission Rate	lb/mmBtu	0.076	0.076	0.075	0.076	0.12
	lb/hr	16.4	16.5	14.5	15.8	21.6

O_2 = oxygen
CO_2 = carbon dioxide
CO = carbon monoxide
NO_x = nitrogen oxides
‡ corrected for analyzer drift
lb/hr = pound per hour
scf/hr = standard cubic foot per hour
lb/mmBtu = pound per million British thermal unit

Boiler No. 6 Emission Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	143,425	143,854	144,168	143,816	—
Fuel Consumption	scf/hr	135,000	137,000	132,000	134,667	—
O_2 Concentration‡	%	2.6	2.6	2.6	2.6	—
CO_2 Concentration‡	%	10.5	10.6	10.5	10.5	—
CO Mass Emission Rate	lb/mmBtu	Not detected	Not detected	Not detected	Not detected	0.10
	lb/hr	Not detected	Not detected	Not detected	Not detected	18.0
NO_x Mass Emission Rate	lb/mmBtu	0.077	0.077	0.077	0.077	0.12
	lb/hr	11.3	12.3	13.2	12.2	21.6

O_2 = oxygen
CO_2 = carbon dioxide
CO = carbon monoxide
NO_x = nitrogen oxides
‡ corrected for analyzer drift
lb/hr = pound per hour
scf/hr = standard cubic foot per hour
lb/mmBtu = pound per million British thermal unit

1.0 Introduction

1.1 Summary of Test Program

Nexteer Automotive retained Bureau Veritas North America, Inc. to test air emissions from four sources at its facility in Saginaw, Michigan. Nexteer Automotive is a designer and manufacturer of steering columns, shafts, integral steering gears, rack and pinion steering gears, power steering pumps, advanced steering systems and complete steering modules with anti-theft features for various vehicle manufacturers.

The testing was performed in order to satisfy testing requirements and evaluate compliance with emission limits in Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI -ROP-A6175-2014a (Boiler No. 2) and MDEQ Permit-to-Install (PTI) PTI 175-14 for Boiler Nos. 2, 3, 5, and 6 (Boiler Nos. 3, 5, and 6).

Air emission testing consisted of measuring the following parameters:

- Flue gas velocity, molecular weight, and moisture content
- Concentration of oxygen (O_2)
- Concentration of carbon dioxide (CO_2)
- Concentration of carbon monoxide (CO) except for Boiler No. 2. The permit for Boiler No. 2 does not have a limit for CO.
- Concentration of nitrogen oxides (NO_x)

The sources tested are the following four boilers:

- **Boiler No. 2 (EUBR02)** 77-million-British-thermal-unit-per-hour (mmBtu/hr) heat-input, natural-gas-fired boiler that supplies 60,000 pound per hour (lb/hr) process steam.
- **Boiler No. 3 (EUBR03)** 150-mmBtu/hr-heat-input, natural-gas-fired boiler that supplies 125,000 lb/hr of process steam.
- **Boiler No. 5 (EUBR05)** 180-mmBtu/hr-heat-input, natural-gas-fired boiler that supplies 150,000 lb/hr of process steam.
- **Boiler No. 6 (EUBR06)** 180-mmBtu/hr-heat-input, natural-gas-fired boiler that supplies 150,000 lb/hr of process steam.

The ROP and PTI require testing to evaluate compliance with emission limits. Boiler No. 5 and Boiler No. 6 have recently been converted from coal-fired boilers to gas-fired boilers; therefore, testing was required within 180 days after initial startup of the boilers.

The air emission testing was conducted November 30 through December 2, 2015, as described in the Intent-to-Test plan, which was submitted to MDEQ on September 1, 2015. The testing is summarized in Table 1-1.

Table 1-1
Sources Tested, Parameters, and Test Date

Source	Test Parameter	Test Date
Boiler No. 2 (EUBR02)	O_2, CO_2, and NO_x	December 2, 2015
Boiler No. 3 (EUBR03)	O_2, CO_2, CO, and NO_x	December 1, 2015
Boiler No. 5 (EUBR05)	O_2, CO_2, CO, and NO_x	November 30, 2015
Boiler No. 6 (EUBR06)	O_2, CO_2, CO, and NO_x	November 30, 2015

O_2 = oxygen
CO_2 = carbon dioxide
CO = carbon monoxide
NO_x = nitrogen oxides

1.2 Key Personnel

Key personnel involved in this test program are listed in Table 1-2. Mr. Brian Young, Senior Project Manager with Bureau Veritas, directed the compliance testing program. Mr. Dominic DeCarlo, Facilities and Environmental Engineer, provided process coordination and arranged for facility operating parameters to be recorded.

Portions of the testing were witnessed by Mr. Thomas Gasloli and Mr. Ben Witkopp, Environmental Quality Analysts with MDEQ.

Table 1-2
Key Personnel

Nexteer Automotive	
Dominic DeCarlo Facilities and Environmental Engineer **Nexteer Automotive** 3900 Holland Road Saginaw, Michigan 48601 Telephone: 989.757.5987 Facsimile: 989.757.4044 dominic.decarlo@nexteer.com	Kimberly Bostek Supervisor, Environmental Engineer **Nexteer Automotive** 3900 Holland Road Saginaw, Michigan 48601 Telephone: 989.757.4504 Facsimile: 989.757.4044 kimberly.bostek@ nexteer.com
Michigan Department of Environmental Quality	
Ben Witkopp **Michigan Department of Environmental Quality** Air Quality Division - Saginaw Bay District 401 Ketchum Street, Suite B Bay City, Michigan 48708 Telephone: 989.894.6219 Facsimile: 989.891.9237 witkoppb@michigan.gov	Thomas Gasloli **Michigan Department of Environmental Quality** Air Quality Division – Lansing District Office Constitution Hall 525 West Allegan Street, 2th Floor South Lansing, Michigan 30241 Telephone: 517.284.6778 Email: gaslolit@michigan.gov
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2.0 Source and Sampling Locations

2.1 Process Description

Nexteer Automotive is a designer and manufacturer of steering columns, shafts, integral steering gears, rack and pinion steering gears, power steering pumps, advanced steering systems and complete steering modules with anti-theft features for various vehicle manufacturers. Operations are conducted in six buildings and a powerhouse. The testing was performed on boilers in the powerhouse.

Four gas-fired boilers (Boiler Nos. 2, 3, 5, and 6), which can generate 485,000 pounds of steam per hour (lb/hr) distributed to various buildings. Emissions are generated through the combustion of natural gas and combustion gases are vented through stacks exiting the roof of the powerhouse.

Nexteer Automotive operates the boilers on a load-demand basis throughout the year because the steam is used for both process heating and building heat. Generally, steam is provided by a minimum of one boiler (during the summer months), with a maximum of three boilers operating a balanced steam load (during the winter months). During the testing, the boilers operated at 80 to 100% capacity.

Natural gas supplied by Consumers Energy is combusted in Boiler Nos. 2, 3, 5, and 6. Nexteer Automotive personnel recorded operating parameters during the emission testing. The recorded operating parameters are included in Appendix E and summarized in Table 2-1.

The ratings of the boiler are:

- **Boiler No. 2 (EUBR02)** 77 mmBtu/hr heat input and 60,000 lb/hr process steam.
- **Boiler No. 3 (EUBR03)** 150 mmBtu/hr heat input and 125,000 lb/hr of process steam.
- **Boiler No. 5 (EUBR05)** 180 mmBtu/hr heat input and 150,000 lb/hr of process steam.
- **Boiler No. 6 (EUBR06)** 180 mmBtu/hr heat input and 150,000 lb/hr of process steam.

Table 2-1
Summary of Process Operating Parameters

Source	Date	Run	Natural Gas Use (Mcf/hr)	Steam Output (lb/hr)	Boiler O_2 %
Boiler No. 2 (EUBR02)	Dec. 2, 2015	1	47	53,020	5.8
		2	46	52,960	5.8
		3	46	52,720	5.7
		Average	**46**	**52,900**	**5.7**
Boiler No. 3 (EUBR03)	Dec. 1, 2015	1	121	110,780	2.8
		2	119	112,380	2.4
		3	118	113,480	2.4
		Average	**119**	**112,213**	**2.5**
Boiler No. 5 (EUBR05)	Nov. 30, 2015	1	137	146,683	2.6
		2	131	144,427	2.6
		3	135	148,428	2.6
		Average	**134**	**148,428**	**2.6**
Boiler No. 6 (EUBR06)	Nov. 30, 2015	1	135	143,425	2.0
		2	137	143,854	2.0
		3	132	144,168	1.9
		Average	**135**	**143,816**	**2.0**

Mcf/hr = thousand cubic feet per hour
lb/hr = pound per hour

2.2 Control Equipment

The use of low nitrogen oxide (NO_x) burners installed in Boiler Nos. 2, 3, 5, and 6 reduce NO_x emissions. Low NOx burners reduce emissions by staging the combustion process, thereby delaying ignition and lowering the combustion temperature. The lower combustion temperature reduces thermal NOx formation.

Low NOx burners generally result in NOx emission reductions of 40 to 85% relative to uncontrolled emission levels.

Process and control equipment data recorded during testing are included in Appendix E. Table 2-1 summarizes the process and control equipment data.

2.3 Flue Gas Sampling Locations

Descriptions of the flue gas sampling locations are presented in Sections 2.3.1 through 2.3.4.

2.3.1 Boiler No. 2 (EUBR02) Exhaust

The Boiler No. 2 (EUBR02) exhaust stack is 48.25 inches in diameter and has two 4-inch-diameter sampling ports. Eight traverse points were used to measure stack gas velocity. The ports are located:

- 20 feet (5 duct diameters) from the nearest downstream disturbance.
- 12 feet (3 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible via a ladder and a platform on the stack.

Figure 2-1 depicts the Boiler No. 2 (EUBR02) exhaust sampling location. Figure 1 in the Appendix depicts the sampling ports and traverse point locations.

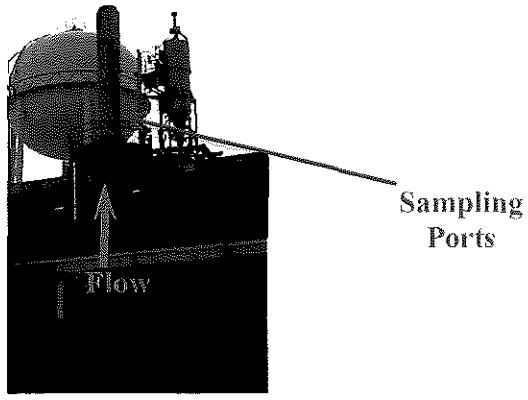

Figure 2-1. Boiler No. 2 (EUBR02) Exhaust Stack

2.3.2 Boiler No. 3 (EUBR03) Exhaust

The Boiler No. 3 (EUBR03) exhaust stack is 66 inches in diameter and has two 4-inch-diameter sampling ports. Eight traverse points were used to measure stack gas velocity. The ports are located:

- 10 feet (2 duct diameters) from the nearest downstream disturbance.
- 15 feet (3 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible via a ladder and a platform on the stack.

Figure 2-2 depicts the Boiler No. 3 (EUBR03) exhaust sampling location. Figure 2 in the Appendix depicts the sampling ports and traverse point locations.

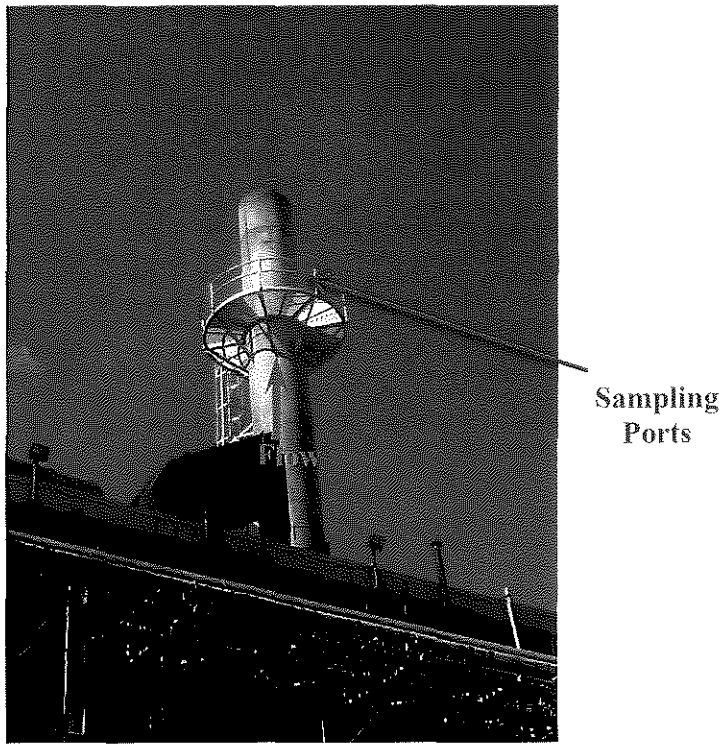

Figure 2-2. Boiler No. 3 (EUBR03) Exhaust Stack

2.3.3 Boiler No. 5 (EUBR05) Exhaust

The Boiler No. 5 (EUBR05) exhaust stack is 60 inches in diameter and has two 4-inch-diameter sampling ports. Eight traverse points were used to measure stack gas velocity. The ports are located:

- 10 feet (2 duct diameters) from the nearest downstream disturbance.
- 20 feet (4 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible via a ladder and a platform on the stack.

Figure 2-3 depicts the Boiler No. 5 (EUBR05) exhaust sampling location. Figure 3 in the Appendix depicts the sampling ports and traverse point locations.

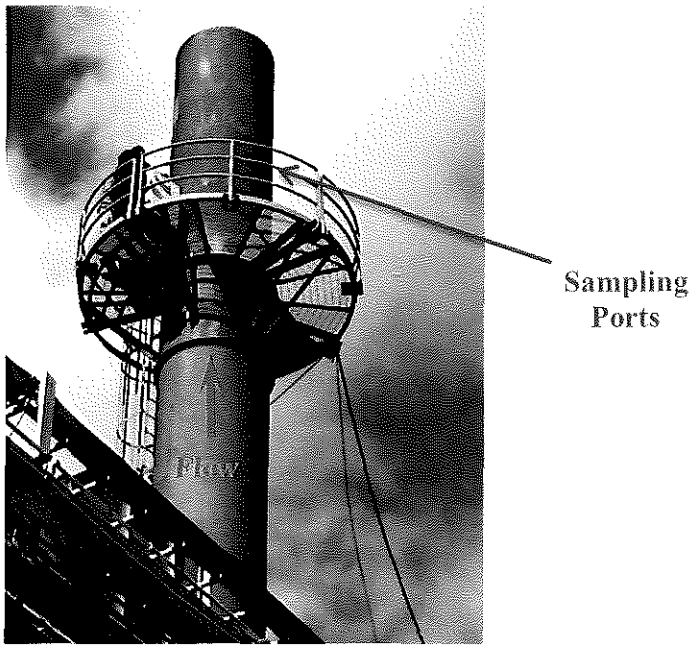

Figure 2-3. Boiler No. 5 (EUBR05) Exhaust Stack

2.3.4 Boiler No. 6 (EUBR06) Exhaust

The Boiler No. 6 (EUBR06) exhaust stack is 60 inches in diameter and has two 4-inch-diameter sampling ports. Eight traverse points were used to measure stack gas velocity. The ports are located:

- 10 feet (2 duct diameters) from the nearest downstream disturbance.

- 20 feet (4 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible via a ladder and a platform on the stack.

Figure 2-4 depicts the Boiler No. 6 (EUBR06) exhaust sampling location. Figure 3 in the Appendix depicts the sampling ports and traverse point locations.

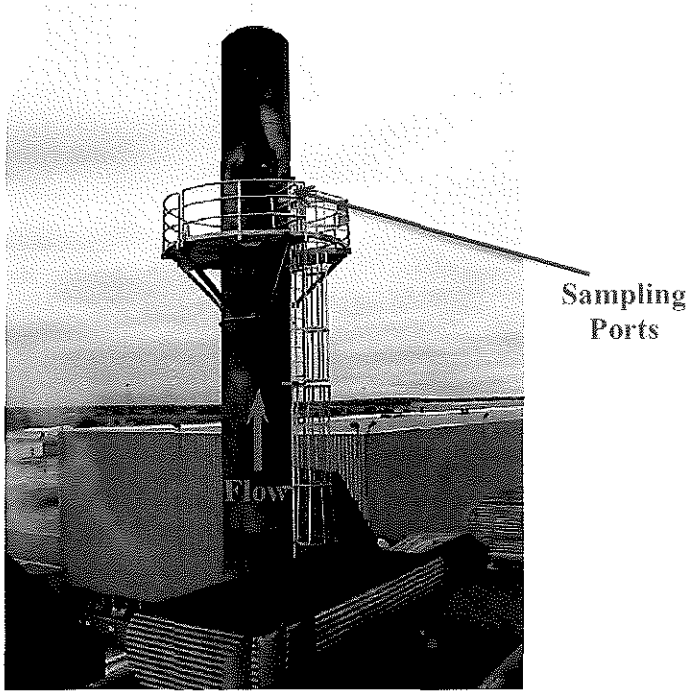

Figure 2-4. Boiler No. 6 (EUBR06) Exhaust Stack

2.4 Process Sampling Locations

Process sampling was not required during this test program. A process sample is a sample that is analyzed for operational parameters, such as calorific value of a fuel (e.g., diesel, natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).

3.0 Summary and Discussion of Results

3.1 Objective and Test Matrix

The objective of the testing was to satisfy testing requirements and evaluate compliance with emission limits in MDEQ ROP MI -ROP-A6175-2014a (Boiler No. 2) and MDEQ PTI PTI 175-14 (Boiler Nos. 3, 5, and 6). The specific objectives of the testing were to measure O_2, CO_2, CO, and NO_x concentrations and mass emission rates.

The permit for Boiler No. 2 does not have an emission limit for CO, only NO_x; therefore, CO was not measured for this boiler.

The permit limit for Boiler No. 2 is expressed in pounds of NO_x per million standard cubic feet of natural gas (lb/mmscf). The limits for the other boilers are in pounds per million Btu (lb/mmBtu) and pounds per hour (lb/hr) for NO_x and CO.

Table 3-1 summarizes the sampling and analytical matrix.

3.2 Field Test Changes and Issues

Communication between Nexteer Automotive, Bureau Veritas, and MDEQ allowed the testing to be completed without field test changes.

3.3 Summary of Results

The results of the testing, compared to the applicable emission limits, are summarized in Tables 3-2 through 3-5. Detailed results are presented in Tables 1 through 4 after the Table Tab of this report. Graphs of the measured O_2, CO_2, CO, and/or NO_x concentrations are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.

The results of this test program indicate Boiler Nos. 2, 3, 5, and 6 at the Nexteer Automotive facility are operating in compliance with permit limits listed in the tables.

Table 3-1
Test Matrix

Sampling Location	Test Date	Test Run	Start Tine	Stop Tine	Sample/Type of Pollutant	Sampling Method	No. of Test Runs and Duration	Analytical Method	Analytical Laboratory
Boiler No. 2 (EUBR02)	Dec. 2	1	8:00	9:00	O_2, CO_2, NO_x	1, 2, 3A, 4, 7E, 19, and 205	Three 60-minute runs	Field measurement Paramagnetic Chemiluminescence Gravimetric Infrared	Bureau Veritas
		2	9:15	10:15					
		3	10:30	11:30					
Boiler No. 3 (EUBR03)	Dec. 1	1	8:15	9:15	O_2, CO_2, CO, NO_x	1, 2, 3A, 4, 7E, 10, 19, and 205	Three 60-minute runs	Field measurement Instrument infrared analysis Paramagnetic Chemiluminescence Gravimetric Infrared	Bureau Veritas
		2	9:30	10:30					
		3	10:45	11:45					
Boiler No. 5 (EUBR05)	Nov. 30	1	12:30	13:30	O_2, CO_2, CO, NO_x	1, 2, 3A, 4, 7E, 10, 19, and 205	Three 60-minute runs	Field measurement Instrument infrared analysis Paramagnetic Chemiluminescence Gravimetric Infrared	Bureau Veritas
		2	13:45	14:45					
		3	15:00	16:00					
Boiler No. 6 (EUBR06)	Nov. 30	1	8:00	9:00	O_2, CO_2, CO, NO_x	1, 2, 3A, 4, 7E, 10, 19, and 205	Three 60-minute runs	Field measurement Instrument infrared analysis Paramagnetic Chemiluminescence Gravimetric Infrared	Bureau Veritas
		2	9:30	10:30					
		3	10:45	11:45					

Table 3-2
Summary of Boiler No. 2 Air Emission Test Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	53,020	52,960	52,720	52,900	—
Fuel Consumption	scf/hr	47,000	46,000	46,000	46,333	—
O_2 Concentration‡	%	6.4	6.3	6.2	6.3	—
CO_2 Concentration‡	%	8.4	8.4	8.5	8.4	—
NO_x Mass Emission Rate	lb NO_x/mmscf of natural gas	127	127	127	127	210

O_2 = oxygen
CO_2 = carbon dioxide
NO_x = nitrogen oxides
‡ corrected for analyzer drift
scf/hr = standard cubic foot per hour
mmscf = million standard cubic foot
Note: The permit limit for Boiler No. 2 is expressed in units different from the other boilers.

Table 3-3
Summary of Boiler No. 3 Air Emission Test Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	110,780	112,380	113,480	112,213	—
Fuel Consumption	scf/hr	121,000	119,000	118,000	119,333	—
O_2 Concentration‡	%	3.4	2.9	2.9	3.1	—
CO_2 Concentration‡	%	10.3	10.5	10.4	10.4	—
CO Mass Emission Rate	lb/mmBtu	0.0000098	Not detected	Not detected	0.0000098	0.10
	lb/hr	0.0018	Not detected	Not detected	0.0018	15.0
NO_x Mass Emission Rate	lb/mmBtu	0.087	0.088	0.088	0.088	0.12
	lb/hr	16.2	16.3	16.0	16.2	18.0

O_2 = oxygen
CO_2 = carbon dioxide
CO = carbon monoxide
NO_x = nitrogen oxides
‡: corrected for analyzer drift
lb/hr = pound per hour
scf/hr = standard cubic foot per hour
lb/mmBtu = pound per million British thermal unit

Table 3-4
Summary of Boiler No. 5 Air Emission Test Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	146,683	144,427	148,428	146,513	—
Fuel Consumption	scf/hr	137,000	131,000	135,000	134,333	—
O_2 Concentration‡	%	3.3	3.2	3.2	3.2	—
CO_2 Concentration‡	%	10.2	10.2	10.3	10.2	—
CO Mass Emission Rate	lb/mmBtu	Not detected	Not detected	Not detected	Not detected	0.10
	lb/hr	Not detected	Not detected	Not detected	Not detected	18.0
NO_x Mass Emission Rate	lb/mmBtu	0.076	0.076	0.075	0.076	0.12
	lb/hr	16.4	16.5	14.5	15.8	21.6

O_2 = oxygen
CO_2 = carbon dioxide
CO = carbon monoxide
NO_x = nitrogen oxides
‡ corrected for analyzer drift
lb/hr = pound per hour
scf/hr = standard cubic foot per hour
lb/mmBtu = pound per million British thermal unit

Table 3-5
Summary of Boiler No. 6 Air Emission Test Results

Parameter	Units	Run 1	Run 2	Run 3	Average	Permit Limit
Testing Condition (Steam Production)	lb/hr	143,425	143,854	144,168	143,816	—
Fuel Consumption	scf/hr	135,000	137,000	132,000	134,667	—
O_2 Concentration‡	%	2.6	2.6	2.6	2.6	—
CO_2 Concentration‡	%	10.5	10.6	10.5	10.5	—
CO Mass Emission Rate	lb/mmBtu	Not detected	Not detected	Not detected	Not detected	0.10
	lb/hr	Not detected	Not detected	Not detected	Not detected	18.0
NO_x Mass Emission Rate	lb/mmBtu	0.077	0.077	0.077	0.077	0.12
	lb/hr	11.3	12.3	13.2	12.2	21.6

O_2 = oxygen
CO_2 = carbon dioxide
CO = carbon monoxide
NO_x = nitrogen oxides
‡ corrected for analyzer drift
lb/hr = pound per hour
scf/hr = standard cubic foot per hour
lb/mmBtu = pound per million British thermal unit

4.0 Sampling and Analytical Procedures

4.1 Test Methods

Bureau Veritas measured emissions in accordance with the procedures specified in the USEPA Standards of Performance for New Stationary Sources and State of Michigan Part 10 Rules Intermittent Testing and Sampling. Bureau Veritas used methods presented in Table 4-1.

Table 4-1
Sampling Methods

Parameter	Source				USEPA Reference Method	
	EUBR02	EUBR03	EUBR05	EUBR06	Method	Title
Sampling ports and traverse points	●	●	●	●	1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	●	●	●	●	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight, carbon dioxide and oxygen	●	●	●	●	3A	Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)
Moisture content	●	●	●	●	4	Determination of Moisture Content in Stack Gases
Nitrogen oxides	●	●	●	●	7E	Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)
Carbon monoxide		●	●	●	10	Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)
Emission rate (lb/mmBtu)	●	●	●	●	19	Determination of Sulfur Dioxide Removal Efficiency, and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates
Gas dilution	●	●	●	●	205	Verification of Gas Dilution Systems for Field Instrument Calibrations†

● Indicates a test parameter for each test run.
† For calibration gases.

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

Method 1, "Sample and Velocity Traverses for Stationary Sources," from 40 CFR 60, Appendix A, was used to evaluate the sampling locations and the number of traverse points for the measurement of velocity profiles. Figures 1 through 3 (see Figures Tab) depict the sampling locations and traverse points.

Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrate. An S-type Pitot tube and thermocouple assembly connected to a digital manometer and thermometer was used. Because the dimensions of Bureau Veritas' Pitot tubes meet the requirements outlined in Method 2, Section 10.0, a baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned.

The digital manometer and thermometer are calibrated using calibration standards, which are traceable to National Institute of Standards (NIST). The Pitot tube inspection and calibration sheets are included in Appendix A.

Cyclonic Flow Check. Bureau Veritas evaluated whether cyclonic flow was present at the sampling location.

Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head readings—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack wall when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20°, the flue gas flow is considered to be cyclonic at that sampling location and an alternative location should be used.

The average of the measured traverse point flue gas velocity null angles for each boiler is presented below:

- Boiler No. 2 (EUBR02) approximately 3°
- Boiler No. 3 (EUBR03) approximately 3°
- Boiler No. 5 (EUBR05) approximately 5°
- Boiler No. 6 (EUBR06) approximately 4°

Because the average null angles were less than 20°, the measurements indicate the absence of cyclonic flow. Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.2 Oxygen, Carbon Dioxide, Carbon Monoxide, and Nitrogen Oxides (USEPA Methods 3A, 7E, and 10)

The flue gas oxygen (O_2) and nitrogen oxide (NO_x) concentrations were measured in order to calculate an emission rate in lb NO_x/hr and lb NO_x/mmBtu (pound of NO_x per million British thermal unit). USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure)," was

used to measure the O_2 and carbon dioxide (CO_2) concentrations of the flue gas. USEPA Method 7E, "Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Method)" was used to measure NO_x concentrations. Carbon monoxide concentrations were measured using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources." The sampling trains for USEPA Methods 3A, 7E, and 10 are similar and the flue gas was extracted from the stack through:

- A stainless-steel probe.
- Heated Teflon® sample line to prevent condensation.
- A chilled Teflon condenser with peristaltic pump to remove moisture from the sampled gas stream prior to entering the analyzer.
- Paramagnetic (O_2), chemiluminescence (NO_x), and infrared (CO and CO_2) gas analyzers.

Data were recorded at 1-second intervals on a computer equipped with data acquisition software (DAS). Recorded pollutant concentrations were averaged over the duration of each test run.

Before testing, a 3-point stratification test was conducted by measuring the O_2, CO_2, CO, or NO_x gas concentration at a sampling location 17, 50, and 83% of the stack diameter for at least twice the response time. The results of the 3-point stratification demonstrated that sampling from a single point near the centroid of the duct was appropriate.

An NO/NO_2 conversion check was performed using an approximate 50-ppmv NO_2 calibration gas. The NO concentration was greater than 90% of the introduced NO_2 calibration standard.

A calibration error check was performed by introducing zero-, mid-, and high-level calibration gases directly into the analyzers. The calibration error check was performed to evaluate the analyzers' response within the acceptable ±2% range of the calibration span.

Before each test run, a system-bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers' responses were within ±5% of the calibration span. At the conclusion of each test run, an additional system-bias check was performed to evaluate the percent drift from pre- and post-test system-bias checks. If percent drift was less than 3.0% of span, the test is considered valid.

USEPA Method 19 equations were used to calculate NO_x and CO emission rates in lb NO_x/mmBtu and lb CO/mmBtu.

Figure 4 depicts (Figures Tab) the USEPA Methods 3A, 7E and 10 sampling train. Calibration data along with the USEPA Protocol 1 certification sheets for the calibration gases used are included in Appendix A.

4.1.3 Moisture Content (USEPA Method 4)

The moisture content of the flue gas was measured using USEPA Method 4, "Determination of Moisture Content in Stack Gases." Bureau Veritas' modular USEPA Method 4 stack sampling system consists of:

- A stainless steel probe.
- Tygon® umbilical line connecting the probe to the impingers.
- A set of four Greenburg-Smith (GS) impingers with the configuration shown in Table 4-2 situated in a chilled ice bath.
- A sample line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Table 4-2
USEPA Method 4 Impinger Configuration

Impinger	Type	Contents	Amount
1	Modified	Water	~100 milliliters
2	Greenburg Smith	Water	~100 milliliters
3	Modified	Empty	0 milliliters
4	Modified	Silica desiccant	~300 grams

Before starting a test run, the sampling train was leak-checked by capping the probe tip and applying a vacuum of approximately 15 inches of mercury to the sampling train. The dry-gas meter was monitored for approximately 1 minute to demonstrate that the sample train leak rate was less than 0.02 cubic feet per minute (cfm). The sampling probe was inserted into the sampling port and positioned near the centroid of the stack in preparation for sampling. Flue gas was extracted at a constant rate from the stack, with moisture removed from the sample stream by the chilled impingers.

At the conclusion of the test run, a post-test leak check was conducted and the impinger train was carefully disassembled. The weight of liquid or silica gel in each impinger was measured with a scale capable of measuring ±0.5 gram. The weight of water collected within the impingers and volume of flue gas sampled were used to calculate the moisture content. Figure 5 after the Figures Tab depicts the USEPA Method 4 sampling train.

4.1.4 Carbon Monoxide and Nitrogen Oxide Emission Rate (USEPA Method 19)

USEPA Method 19, "Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates," was used to calculate CO and NO_x emission rates in units specified by the permit. Oxygen concentrations and appropriate F factors (ratios of combustion gas volumes to heat inputs) were used to calculate NO_x emission rates from measured NO_x and O_2 concentrations. Equation 19-1 from the method was used:

$$E = C_d F_d \frac{20.9}{(20.9 - \%O_{2d})}$$

Where:

E	=	Pollutant emission rate (lb/million-Btu)
C_d	=	Pollutant concentration, dry basis (lb/scf)
F_d	=	Volumes of combustion components per unit of heat content (8,710 dscf/mm Btu for natural gas)
$\%O_{2d}$	=	Concentration of oxygen on a dry basis (%)

4.1.5 Gas Dilution (USEPA Method 205)

A gas dilution system was used to introduce known values of calibration gases into the analyzers. The gas dilution system consists of calibrated orifices or mass flow controls and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and was evaluated for accuracy in the field in accordance with USEPA Method 205, "Verification of Gas Dilution Systems for Field Instrument Calibrations."

Before testing, the gas divider dilutions were measured to evaluate that they were within ±2% of predicted values. Three sets of three dilutions of the high-level calibration gas were performed. In addition, a certified mid-level calibration gas was introduced into an analyzer; this calibration gas concentration was within ± 10% of a gas divider dilution concentration.

4.2 Procedures for Obtaining Process Data

Process data were recorded by Nexteer Automotive personnel. Refer to Section 2.1 and 2.2 for discussions of process and control device data and Appendix E for the operating parameters recorded during testing.

4.3 Sampling Identification and Custody

Recovery and analytical procedures were not applicable to this test program.

5.0 QA/QC Activities

Equipment used in this test program passed quality assurance/quality control (QA/QC) procedures. Refer to Appendix A for equipment calibrations and inspection sheets. Field data sheets are presented in Appendix C. Computer-generated data sheets are presented within Appendix D.

5.1 Pretest QA/QC Activities

Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling method and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III, Stationary Source-Specific Methods."

5.2 QA/QC Audits

The results of select sampling and equipment QA/QC audits and the acceptable tolerance are presented in the following sections. Analyzer calibration and gas certification sheets are presented in Appendix A.

5.2.1 Sampling Train QA/QC Audits

The sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. Table 5-1 summarizes the QA/QC audits conducted for the Method 4 sampling train.

Table 5-1
Method 4 Sampling Train QA/QC Audits

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
Boiler No. 2 (EUBR02)					
Sampling train leak check Post–test	0 ft^3 for 1 min at 6 in Hg	0 ft^3 for 1 min at 6 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at ≥ sample vacuum recorded during test	Valid
Sampling vacuum (in Hg)	3	3	3		
Boiler No. 3 (EUBR03)					
Sampling train leak check Post–test	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 6 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at ≥ sample vacuum recorded during test	Valid
Sampling vacuum (in Hg)	3	3	3		
Boiler No. 5 (EUBR05)					
Sampling train leak check Post–test	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 7 in Hg	<0.020 ft^3 for 1 minute at ≥ sample vacuum recorded during test	Valid
Sampling vacuum (in Hg)	3	3	3		
Boiler No. 6 (EUBR06)					
Sampling train leak check Post–test	0.005 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 13 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at ≥ sample vacuum recorded during test	Valid
Sampling vacuum (in Hg)	3	3	3		

5.2.2 Instrument Analyzer QA/QC Audits

The instrument sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. The following table summarizes gas cylinders used during this test program. Refer to Appendix A for additional calibration data.

Table 5-2
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Carbon Dioxide (CO_2) Oxygen (O_2) Nitrogen (N)	Pangaea Gases, LLC	EB0049262	19.89% (CO_2) 20.01% (O_2) Balance (N)	3/6/22
	Airgas	CC68032	11.21% (CO_2) 10.89% (O_2) Balance (N)	2/17/23
		CC307809	11.20% (CO_2) 10.91% (O_2) Balance (N)	2/17/23
		CC13924	19.93% (CO_2) 20.11% (O_2) Balance (N)	2/26/23
Carbon Monoxide (CO) Nitrogen (N)	Airgas	CC148871	45.03 ppm Balance (N)	12/19/22
		XC014125B	81.49 ppm Balance (N)	1/6/23
Nitrogen (N)	Airgas	CC39741	99.9995%	9/25/22
Nitrogen Dioxide (NO_2) Oxygen (O_2) Nitrogen (N)	Airgas	CC500773	50.18 ppm (NO_2) 1,000 ppm (O_2) Balance (N)	11/11/17
Nitric Oxide (NO) Nitrogen Oxides (NO_x) Nitrogen (N)	The American Gas Group	CC275914	45.2 ppm (NO) 45.5 ppm (NO_x) Balance (N)	7/23/17
		CC272120	90.7 ppm (NO) 90.9 ppm (NO_x) Balance (N)	7/10/22

5.2.3 Dry-Gas Meter QA/QC Audits

Table 5-3 summarizes the dry-gas meter calibration checks in comparison to the acceptable USEPA tolerance. Refer to Appendix A for DGM calibrations.

Table 5-3
Dry-gas Meter Calibration QA/QC Audit

Dry-Gas Meter	Pre-test DGM Calibration Factor (Y) (dimensionless)	Post-Test DGM Calibration Factor (Y) (dimensionless)	Difference Between Pre- and Post-test DGM Calibrations	Acceptable Tolerance	Comment
2	0.974 October 12, 2015	0.984 December 17, 2015	0.01	±0.05	Valid

5.2.4 Thermocouple QA/QC Audits

Temperature measurements using thermocouples and digital pyrometers were compared to a reference temperature (i.e., ice water bath, boiling water) before and after testing to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperature within ±1.5% of the reference temperatures and were within USEPA acceptance criteria. Thermocouple calibration sheets are presented in Appendix A.

5.3 QA/QC Checks for Data Reduction and Validation

Bureau Veritas validated the computer spreadsheets onsite. The computer spreadsheets were used to evaluate the accuracy of field calculations. The field data sheets were reviewed to evaluate whether data has been recorded appropriately. The computer data sheets were checked against the field data sheets for accuracy during review of the draft report. Sample calculations were performed to check computer spreadsheet computations.

5.4 QA/QC Problems

Equipment audits and QA/QC procedures demonstrate sample collection accuracy for the test runs.

6.0 Limitations

The information and opinions rendered in this report are exclusively for use by Nexteer Automotive. Bureau Veritas North America, Inc. will not distribute or publish this report without Nexteer Automotive's consent except as required by law or court order. The information and opinions are given in response to a limited assignment and should be implemented only in light of that assignment. Bureau Veritas North America, Inc. accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

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Tables

Table 1
Boiler No. 2 O_2, CO_2, and NO_x Emission Results
Nexteer Automotive
Saginaw, Michigan
Bureau Veritas Project No. 11015-000146.00
Sampling Date: December 2, 2015

Parameter	Units	Run 1	Run 2	Run 3	
Date		**Dec 2, 2015**	**Dec 2, 2015**	**Dec 2, 2015**	**Average**
Steam Production	lb/hr	**53,020**	**52,960**	**52,720**	**52,900**
Start Time	hr:min	8:00	9:15	10:30	
Duration	min	60	60	60	60
Fuel Consumption	scf/hr	47,000	46,000	46,000	46,333
Volumetric Flowrate	dscf/min	13,078	12,400	12,408	12,629
O_2 Concentration (C_{avg})	%	6.4	6.3	6.2	6.3
Pre-test system calibration, zero gas (C_O)	%	0	0.1	0.1	0.1
Post-test system calibration, zero gas (C_O)	%	0.1	0.1	0.1	0.1
Certified low bracket gas concentration (C_{MA})	%	10.91	10.91	10.91	10.91
Pre-test system calibration, low bracket gas (C_M)	%	10.90	10.90	10.80	10.87
Post-test system calibration, low bracket gas (C_M)	%	10.90	10.80	10.90	10.87
Average Corrected O_2 Concentration (C_{gas})†	**%**	**6.4**	**6.3**	**6.2**	6.3
CO_2 Concentration (C_{avg})	%	8.4	8.5	8.5	8.5
Pre-test system calibration, zero gas (C_O)	%	0	0.1	0.1	0
Post-test system calibration, zero gas (C_O)	%	0.1	0.1	0	0
Certified low bracket gas concentration (C_{MA})	%	11.23	11.23	11.23	11.2
Pre-test system calibration, low bracket gas (C_M)	%	11.2	11.3	11.4	11.3
Post-test system calibration, low bracket gas (C_M)	%	11.3	11.4	11.1	11.3
Average Corrected CO_2 Concentration (C_{gas})†	**%**	**8.4**	**8.4**	**8.5**	8.4
NO_x Concentration (C_{avg})	ppmvd	62.7	64.3	64.7	63.9
Pre-test system calibration, zero gas (C_O)	ppmvd	-0.3	-0.1	-0.1	-0.2
Post-test system calibration, zero gas (C_O)	ppmvd	-0.1	-0.1	0.1	0.0
Certified low bracket gas concentration (C_{MA})	ppmvd	90.9	90.9	90.9	90.9
Pre-test system calibration, low bracket gas (C_M)	ppmvd	89.9	89.0	89.1	89.3
Post-test system calibration, low bracket gas (C_M)	ppmvd	89.0	89.1	89.5	89.2
Average Corrected NO_x Concentration (C_{gas})†	**ppmvd**	**63.8**	**65.7**	**65.8**	**65.1**
NO_x Mass Emission Rate	**lb/mmscf gas**	**127**	**127**	**127**	**127**

† corrected for analyzer drift
lb/hr: pound per hour
scf/hr: standard cubic foot per hour
dscf/min: dry standard cubic foot per minute
ppmvd: part per million by dry volume
lb/mmscf: pound per million standard cubic foot

Table 2
Boiler No. 3 O_2, CO_2, CO, and NO_x Emission Results
Nexteer Automotive
Saginaw, Michigan
Bureau Veritas Project No. 11015-000146.00
Sampling Date: December 1, 2015

Parameter	Units	Run 1	Run 2	Run 3	
Date		Dec 1, 2015	Dec 1, 2015	Dec 1, 2015	Average
Steam Production	lb/hr	110,780	112,380	113,480	112,213
Start Time	hr:min	8:15	9:30	10:45	
Duration	min	60	60	60	60
Fuel Consumption	scf/hr	121,000	119,000	118,000	119,333
Volumetric Flowrate	dscf/min	32,054	31,152	30,599	31,268
O_2 Concentration (C_{avg})	%	3.4	2.9	2.9	3.1
Pre-test system calibration, zero gas (C_O)	%	0	0	0	0
Post-test system calibration, zero gas (C_O)	%	0	0	0	0
Certified low bracket gas concentration (C_{MA})	%	10.91	10.91	10.91	10.91
Pre-test system calibration, low bracket gas (C_M)	%	11.00	10.90	10.90	10.93
Post-test system calibration, low bracket gas (C_M)	%	10.90	10.90	10.90	10.90
Average Corrected O_2 Concentration (C_{gas})†	%	**3.4**	**2.9**	**2.9**	3.1
CO_2 Concentration (C_{avg})	%	10.2	10.4	10.4	10.3
Pre-test system calibration, zero gas (C_O)	%	0	0	0	0
Post-test system calibration, zero gas (C_O)	%	0	0	0	0
Certified low bracket gas concentration (C_{MA})	%	11.2	11.2	11.2	11.2
Pre-test system calibration, low bracket gas (C_M)	%	11.1	11.2	11.2	11.2
Post-test system calibration, low bracket gas (C_M)	%	11.2	11.2	11.2	11.2
Average Corrected CO_2 Concentration (C_{gas})†	%	**10.3**	**10.5**	**10.4**	10.4
CO Concentration (C_{avg})	ppmvd	0.3	0	0	0.1
Pre-test system calibration, zero gas (C_O)	ppmvd	0.2	0.4	0.1	0.2
Post-test system calibration, zero gas (C_O)	ppmvd	0.4	0.1	0.1	0.2
Certified low bracket gas concentration (C_{MA})	ppmvd	45.0	45.0	45.0	45.0
Pre-test system calibration, low bracket gas (C_M)	ppmvd	44.7	44.5	44.3	44.5
Post-test system calibration, low bracket gas (C_M)	ppmvd	44.5	44.3	44.2	44.3
Average Corrected CO Concentration (C_{gas})†	**ppmvd**	**0.013**	**-0.21**	**-0.12**	**-0.11**
Note: If the measured CO is zero or the corrected concentration is negative, the concentration and subsequent results are considered "not detected."					
CO Mass Emission Rate	**lb/mmBtu**	**0.0000098**	**-0.00015**	**-0.000091**	**-0.000077**
CO Mass Emission Rate	**lb/hr**	**0.0018**	**-0.028**	**-0.017**	**-0.014**
NO_x Concentration (C_{avg})	ppmvd	69.3	72.0	71.5	70.9
Pre-test system calibration, zero gas (C_O)	ppmvd	0.3	0.5	0.4	0.4
Post-test system calibration, zero gas (C_O)	ppmvd	0.5	0.4	0.3	0.4
Certified low bracket gas concentration (C_{MA})	ppmvd	90.9	90.9	90.9	90.9
Pre-test system calibration, low bracket gas (C_M)	ppmvd	89.9	89.1	89.5	89.5
Post-test system calibration, low bracket gas (C_M)	ppmvd	89.1	89.5	88.8	89.1
Average Corrected NO_x Concentration (C_{gas})†	**ppmvd**	**70.3**	**73.2**	**72.9**	**72.1**
NO_x Mass Emission Rate	**lb/mmBtu**	**0.087**	**0.088**	**0.088**	**0.088**
NO_x Mass Emission Rate	**lb/hr**	**16.2**	**16.3**	**16.0**	**16.2**

† corrected for analyzer drift
lb/hr: pound per hour
scf/hr: standard cubic foot per hour
dscf/min: dry standard cubic foot per minute
ppmvd: part per million by dry volume
lb/mmBtu: pound per million British thermal unit

Table 3
Boiler No. 5 O_2, CO_2, CO, and NO_x Emission Results
Nexteer Automotive
Saginaw, Michigan
Bureau Veritas Project No. 11015-000146.00
Sampling Date: November 30, 2015

Parameter	Units	Run 1	Run 2	Run 3	
Date		Nov 30, 2015	Nov 30, 2015	Nov 30, 2015	Average
Steam Production	lb/hr	146,683	144,427	148,428	146,513
Start Time	hr:min	12:30	13:45	15:00	
Duration	min	60	60	60	60
Fuel Consumption	scf/hr	137,000	131,000	135,000	134,333
Volumetric Flowrate	dscf/min	37,089	37,194	33,125	35,802
O_2 Concentration (C_{avg})	%	3.3	3.2	3.1	3.2
Pre-test system calibration, zero gas (C_O)	%	0.1	0	0	0
Post-test system calibration, zero gas (C_O)	%	0	0	0	0
Certified low bracket gas concentration (C_{MA})	%	10.91	10.91	10.91	11
Pre-test system calibration, low bracket gas (C_M)	%	10.80	10.80	10.80	11
Post-test system calibration, low bracket gas (C_M)	%	10.80	10.80	10.80	11
Average Corrected O_2 Concentration (C_{gas})†	%	3.3	3.2	3.2	3.2
CO_2 Concentration (C_{avg})	%	10.3	10.3	10.4	10.3
Pre-test system calibration, zero gas (C_O)	%	0	0	0	0
Post-test system calibration, zero gas (C_O)	%	0	0	0	0
Certified low bracket gas concentration (C_{MA})	%	11.2	11.2	11.2	11
Pre-test system calibration, low bracket gas (C_M)	%	11.3	11.4	11.3	11
Post-test system calibration, low bracket gas (C_M)	%	11.4	11.3	11.4	11
Average Corrected CO_2 Concentration (C_{gas})†	%	10.2	10.2	10.3	10.2
CO Concentration (C_{avg})	ppmvd	0	0	0	0
Pre-test system calibration, zero gas (C_O)	ppmvd	-0.4	0.2	0.3	0.0
Post-test system calibration, zero gas (C_O)	ppmvd	0.2	0.3	0.2	0.2
Certified low bracket gas concentration (C_{MA})	ppmvd	45.0	45.0	45.0	45.0
Pre-test system calibration, low bracket gas (C_M)	ppmvd	44.0	44.2	44.3	44.2
Post-test system calibration, low bracket gas (C_M)	ppmvd	44.2	44.3	44.1	44.2
Average Corrected CO Concentration (C_{gas})†	ppmvd	0.10	-0.26	-0.27	-0.1
Note: If the measured CO is zero or the corrected concentration is negative, the concentration and subsequent results are considered "not detected."					
CO Mass Emission Rate	lb/mmBtu	0.000076	-0.00019	-0.00020	-0.00011
CO Mass Emission Rate	lb/hr	0.016	-0.042	-0.040	-0.022
NO_x Concentration (C_{avg})	ppmvd	58.4	58.7	58.5	58.6
Pre-test system calibration, zero gas (C_O)	ppmvd	0.7	0.6	0.7	0.7
Post-test system calibration, zero gas (C_O)	ppmvd	0.6	0.7	0.6	0.6
Certified low bracket gas concentration (C_{MA})	ppmvd	45.5	45.5	45.5	45.5
Pre-test system calibration, low bracket gas (C_M)	ppmvd	43.4	43.2	43.7	43.4
Post-test system calibration, low bracket gas (C_M)	ppmvd	43.3	43.7	43.7	43.6
Average Corrected NO_x Concentration (C_{gas})†	ppmvd	61.5	61.8	61.2	61.5
NO_x Mass Emission Rate	lb/mmBtu	0.076	0.076	0.075	0.076
NO_x Mass Emission Rate	lb/hr	16.4	16.5	14.5	15.8

† corrected for analyzer drift
lb/hr: pound per hour
scf/hr: standard cubic foot per hour
dscf/min: dry standard cubic foot per minute
ppmvd: part per million by dry volume
lb/mmBtu: pound per million British thermal unit

Table 4
Boiler No. 6 O_2, CO_2, CO, and NO_x Emission Results
Nexteer Automotive
Saginaw, Michigan
Bureau Veritas Project No. 11015-000146.00
Sampling Date: November 30, 2015

Parameter	Units	Run 1	Run 2	Run 3	
Date		Nov 30, 2015	Nov 30, 2015	Nov 30, 2015	Average
Steam Production	lb/hr	143,425	143,854	144,168	143,816
Start Time	hr:min	8:00	9:30	10:45	
Duration	min	60	60	60	60
Fuel Consumption	scf/hr	135,000	137,000	132,000	134,667
Volumetric Flowrate	dscf/min	24,424	26,410	28,468	26,434
O_2 Concentration (C_{avg})	%	2.7	2.7	2.7	2.7
Pre-test system calibration, zero gas (C_O)	%	0.1	0.1	0.1	0.1
Post-test system calibration, zero gas (C_O)	%	0.1	0.1	0.1	0.1
Certified low bracket gas concentration (C_{MA})	%	10.91	10.91	10.91	10.9
Pre-test system calibration, low bracket gas (C_M)	%	11.00	10.90	10.80	10.9
Post-test system calibration, low bracket gas (C_M)	%	10.90	10.80	10.80	10.8
Average Corrected O_2 Concentration (C_{gas})†	%	2.6	2.6	2.6	2.6
CO_2 Concentration (C_{avg})	%	10.5	10.6	10.6	10.5
Pre-test system calibration, zero gas (C_O)	%	0	0	0	0
Post-test system calibration, zero gas (C_O)	%	0	0	0	0
Certified low bracket gas concentration (C_{MA})	%	11.2	11.2	11.2	11.2
Pre-test system calibration, low bracket gas (C_M)	%	11.3	11.2	11.3	11.3
Post-test system calibration, low bracket gas (C_M)	%	11.2	11.2	11.5	11.3
Average Corrected CO_2 Concentration (C_{gas})†	%	10.5	10.6	10.5	10.5
CO Concentration (C_{avg})	ppmvd	0	0	0	0
Pre-test system calibration, zero gas (C_O)	ppmvd	0.5	-0.4	-0.4	-0.1
Post-test system calibration, zero gas (C_O)	ppmvd	-0.4	-0.4	-0.4	-0.4
Certified low bracket gas concentration (C_{MA})	ppmvd	45.0	45.0	45.0	45.0
Pre-test system calibration, low bracket gas (C_M)	ppmvd	45.0	44.0	44.1	44.4
Post-test system calibration, low bracket gas (C_M)	ppmvd	44.0	44.1	44.0	44.0
Average Corrected CO Concentration (C_{gas})†	ppmvd	-0.051	0.41	0.41	0.3
Note: If the measured CO is zero or the corrected concentration is negative, the concentration and subsequent results are considered "not detected."					
CO Mass Emission Rate	lb/mmBtu	-0.000037	0.00029	0.00029	0.00018
CO Mass Emission Rate	lb/hr	-0.0054	0.047	0.050	0.031
NO_x Concentration (C_{avg})	ppmvd	61.7	61.3	61.2	61.4
Pre-test system calibration, zero gas (C_O)	ppmvd	0.1	0.9	0.7	0.6
Post-test system calibration, zero gas (C_O)	ppmvd	0.9	0.7	0.7	0.8
Certified low bracket gas concentration (C_{MA})	ppmvd	45.5	45.5	45.5	45.5
Pre-test system calibration, low bracket gas (C_M)	ppmvd	44.1	43.3	43.3	43.6
Post-test system calibration, low bracket gas (C_M)	ppmvd	43.3	43.3	43.4	43.3
Average Corrected NO_x Concentration (C_{gas})†	ppmvd	64.4	64.8	64.5	64.6
NO_x Mass Emission Rate	lb/mmBtu	0.077	0.077	0.077	0.077
NO_x Mass Emission Rate	lb/hr	11.3	12.3	13.2	12.2

† corrected for analyzer drift
lb/hr: pound per hour
scf/hr: standard cubic foot per hour
dscf/min: dry standard cubic foot per minute
ppmvd: part per million by dry volume
lb/mmBtu: pound per million British thermal unit