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COMPLIANCE SOURCE TESTING

Performed At The
Arbor Hills Energy LLC
Arbor Hills Facility
Solar Taurus Gas Turbine and Typhoon Unit 2
Northville, Michigan

Test Dates
September 5 and 6, 2014

Report No.
TRC Environmental Corporation Report 221757A

Report Submittal Date
October 15, 2014

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Report Certification

I certify that to the best of my knowledge:

- Testing data and all corresponding information have been checked for accuracy and completeness.
- Sampling and analysis have been conducted in accordance with the approved protocol and applicable reference methods (as applicable).
- All deviations, method modifications, or sampling and analytical anomalies are summarized in the appropriate report narrative(s).

Scott Miller
Project Director

October 15, 2014
Date

TRC was operating in conformance with the requirements of ASTM D7036-04 during this test program.

Jeffrey W. Burdette
TRC Air Measurements Technical Director

COMPLIANCE SOURCE TESTING

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed a compliance Source Testing program to determine emissions at the Solar Taurus Gas Turbine and Typhoon Turbine Unit 2 of Arbor Hills Energy LLC in Northville, Michigan on September 5 and 6, 2014. The tests were authorized by Arbor Hills Energy LLC.

The purpose of this test program was to determine oxides of nitrogen (NO_x) emission rates of the Solar Taurus Gas Turbine, and oxides of nitrogen (NO_x), carbon monoxide, hydrogen chloride and hexane emission rates of the Typhoon Turbine Unit 2 during normal operating conditions. The purpose of the testing is to verify that the emission levels meet the applicable Michigan permit limits.

1.1 Project Contact Information

Participants		
Test Facility	Arbor Hills Energy LLC 10690 W. Six Mile Road Northville, Michigan 48167	Mr. Andrew Zalenski Environmental Manager 716-439-1004 ext. 118 (phone) azalenski@fortistar.com
Test Coordinator	Arbor Hills Energy LLC 5087 Junction Road Lockport, New York 14094	
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Mr. Ben Cacao Field Team Leader 630-280-9068 (cell phone) 312-533-2070 (fax) bcacao@trcsolutions.com

Benigno Cacao and Ryan Novosel of TRC conducted the testing. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) can be located in the appendix to this report.

2.0 SUMMARY OF RESULTS

The results of this test program are summarized in the table below. Detailed individual run results are presented in Section 6.0.

Parameter	Units	Solar Gas Turbine	Emission Limit
NO_x	ppmvd	20.1	---
	lb/hr	5.31	9.02
	ton/month	1.91	3.29
	ppmvd @ 15% O2	24.7	96.0
	lb/MMBtu	0.099	---

Parameter	Units	Typhoon Turbine Unit 2	Emission Limit
NO_x	ppmvd	24.2	---
	lb/hr	4.64	8.8
	ton/month	1.67	2.75
	ppmvd @ 15% O2	20.6	---
	lb/MMBtu	0.083	---
CO	ppmvd	110.1	---
	lb/hr	12.83	13.1
	ton/month	4.62	4.76
	ppmvd @ 15% O2	93.5	---
	lb/MMBtu	0.229	---
Hexane	ppmvd	0.70	---
	lb/hr	0.25	---
	ton/month	0.090	---
	ppmvd @ 3% O2	1.801	---
HCl	ppmvw	1.10	---
	lb/hr	0.19	1.9
	ton/month	0.07	0.68

The table below summarizes the test methods performed, as well as the number and duration of each at each test location:

Unit ID/ Sample Location	Parameter Measured	Test Method	No. of Runs	Run Duration
Solar Taurus Gas Turbine	NOx	USEPA Method 7E	3	60 min
	O2/CO2	USEPA Method 3A	3	60 min
	Volumetric Flow	USEPA Method 1, 2, & 4	3	---
Typhoon Turbine Unit 2	NOx	USEPA Method 7E	3	60 min
	O2/CO2	USEPA Method 3A	3	60 min
	CO	USEPA Method 10	3	60 min
	HCl	USEPA Method 26	3	60 min-
	Hexane	USEPA Method 25A	3	60 min
	Volumetric Flow	USEPA Method 1, 2, & 4	3	---

3.0 DISCUSSION OF RESULTS

No problems were encountered with the testing equipment during the test program. Source operation appeared normal during the entire test program. Unit operating data was recorded by plant personnel and appended to the report.

4.0 SAMPLING AND ANALYSIS 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.

4.1 Determination of Sample Point Locations by USEPA Method 1

This method is applicable to gas streams flowing in ducts, stacks, and flues and is designed to aid in the representative measurement of pollutant emissions and/or total volumetric flow rates from stationary sources. In order to qualify as an acceptable sample location, it must be located at a position at least two stack or duct equivalent diameters downstream and a half equivalent diameter upstream from any flow disturbance.

The cross-section of the measurement site was divided into a number of equal areas, and the traverse points were then located in the center of these areas. The minimum number of points were determined from either Figure 1-1 (particulate) or Figure 1-2 (non-particulate) of USEPA Method 1.

4.2 Volumetric Flow Rate Determination by USEPA Method 2

This method is applicable for the determination of the average velocity and the volumetric flow rate of a gas stream.

The gas velocity head (ΔP) and temperature were measured at traverse points defined by USEPA Method 1. The velocity head was measured with a Type S (Stausscheibe or reverse type) pitot tube and oil-filled manometer; and the gas temperature was measured with a Type K thermocouple. The average gas velocity in the flue was calculated based on: the gas density (as determined by USEPA Methods 3 and 4); the flue gas pressure; the average of the square roots of the velocity heads at each traverse point, and the average flue gas temperature.

4.3 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.

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.

4.3.1 CO_2 Determination by USEPA Method 3A

This method is applicable for the determination of CO_2 concentrations in controlled and uncontrolled emissions from stationary sources only when

specified within the regulations. The CO_2 analyzer was equipped with a non-dispersive infrared (IR) detector.

4.3.2 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.

4.3.3 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 utilized a photomultiplier tube to measure the linear and proportional luminescence caused by the reaction of nitric oxide and ozone.

4.3.4 CO Determination by USEPA Method 10

This method is applicable for the determination of CO concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The non-dispersive infrared analyzer (NDIR) CO analyzer was equipped with an internal gas correlation filter wheel, which eliminates potential detector interference. As such, use of an interference removal trap was not required.

4.4 Moisture Determination by USEPA Method 4

This method is applicable for the determination of the moisture content of stack gas.

A gas sample was extracted at a constant rate from the source. Moisture was removed from the sample stream by a series of pre-weighed impingers immersed in an ice bath. A minimum of 21 dry standard cubic feet of flue gas was collected during each sample run.

4.5 Total Organic Concentration Determination by USEPA Method 25A

This method is applicable for the determination of total gaseous organic concentration of vapors consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons). The concentration is expressed in terms of propane (or other appropriate organic calibration gas) or in terms of Hexane.

A gas sample was extracted from the source through a heated sample line and glass fiber filter to a flame ionization analyzer (FIA). If necessary, a source-specific response factor was developed for the FIA.

4.6 Hydrogen Halide and Halogen Determination by USEPA Method 26

This method is applicable for determining emissions of hydrogen halides (HCl, HBr, and HF) and halogens (Cl_2 and Br_2) from stationary sources when specified by the applicable subpart.

An integrated sample was extracted at a constant rate from the source. The sample flowed through a heated probe and filter, and solutions of dilute sulfuric acid and dilute sodium hydroxide. The filter collected particulate matter including halide salts but was not recovered or analyzed. The liquid solutions were analyzed via ion chromatography (IC).

4.7 Determination of F-Factors by USEPA Method 19

This method is applicable for the determination of the pollutant emission rate using oxygen (O_2) or carbon dioxide (CO_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 calculated from fuel analyses using the equations in Section 12.3.3.1 of Method 19.

5.0 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:

- Louisiana Environmental Lab Accreditation Program (LELAP) accreditation;
- Interim accreditation from the Stack Testing Accreditation Council (STAC) that our operations conform with the requirements of ASTM D 7036-04

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.

6.0 TEST RESULTS SUMMARIES

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Test Results Summary

Project Number:	221757	Start Date:	9/6/14
Customer:	Fortistar	End Date:	9/6/14
Unit Identification:	Solar Taurus Gas Turbine	Facility:	Arbor Hills Energy - Northville, MI
Sample Location:	Stack	Recorded by:	Ben Cacao
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	Normal	Fd Factor:	9505

Reference Method Results, As Measured Moisture Basis						
Run #	Date	Start Time	End Time	NOx ppmvd	CO2 % v/v dry	O2 % v/v dry
1	9/6/14	8:50	9:49	19.6	4.2	16.1
2	9/6/14	10:05	11:04	19.9	4.2	16.1
3	9/6/14	11:21	12:20	20.9	4.3	16.1
Average				**20.1**	**4.3**	**16.1**

Emission Rate Calculation Summary				
Run #	NOx lb/MMBtu	NOx lb/hr	NOx ton/month	Flow DSCFM
1	0.096	5.20	1.87	37,111
2	0.099	5.23	1.88	36,774
3	0.103	5.51	1.98	36,835
Average	**0.099**	**5.31**	**1.91**	**36,907**

Results Corrected to a Reference O_2 Concentration			
Run #	NO_X ppmvd corrected to 15% Oxygen	-	-
1	24.0	-	-
2	24.6	-	-
3	25.5	-	-
Average	**24.7**	-	-

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Test Results Summary

Project Number:	221757	Start Date:	9/5/14
Customer:	Fortistar	End Date:	9/5/14
Unit Identification:	Typhoon Turbine Unit 2	Facility:	Arbor Hills Energy - Northville, MI
Sample Location:	North Stack	Recorded by:	Ben Cacao
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	Normal	Fd Factor:	9504

Reference Method Results, As Measured Moisture Basis

Run #	Date	Start Time	End Time	NOx ppmvd	CO ppmvd	CO2 % v/v dry	O2 % v/v dry
1	9/5/14	15:30	16:29	24.7	107.3	6.2	13.9
2	9/5/14	16:55	17:54	23.1	114.7	5.9	14.1
3	9/5/14	18:23	19:22	24.9	108.5	6.3	13.8
Average				**24.2**	**110.1**	**6.1**	**13.9**

Emission Rate Calculation Summary

Run #	NOx lb/MMBtu	CO lb/MMBtu	NOx lb/hr	CO lb/hr	NOx ton/month	CO ton/month	Flow DSCFM
1	0.083	0.220	4.74	12.51	1.71	4.50	26,720
2	0.081	0.245	4.41	13.34	1.59	4.80	26,665
3	0.084	0.222	4.77	12.64	1.72	4.55	26,729
Average	**0.083**	**0.229**	**4.64**	**12.83**	**1.67**	**4.62**	**26,705**

Results Corrected to a Reference O_2 Concentration

Run #	NO_X ppmvd corrected to 15% Oxygen	-	CO ppmvd corrected to 15% Oxygen
1	20.7	-	89.9
2	20.1	-	99.9
3	20.8	-	90.7
Average	**20.6**	**-**	**93.5**

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Test Results Summary

Project Number:	221757	Test Date(s):	09/05/14
Customer:	Fortistar	Facility:	Arbor Hills Energy - Northville, MI
Unit Identification:	Typhoon Turbine U2 - North Stack	Recorded by:	Ben Cacao

Location	Stack			
Test Run No.	1	2	3	Average
Test Date	9/5/2014	9/5/2014	9/5/2014	
Test Time - Start	15:30	16:55	18:23	
Test Time - End	16:29	17:54	19:22	
THC (ppmvw as Methane)	3.65	4.05	3.65	3.78
Moisture Content (%)	9.8	9.8	9.8	9.8
NMHC (ppmvd as Methane)	4.05	4.49	4.05	4.19
NMHC (ppmvd as Hexane)	0.67	0.75	0.67	0.70
Volumetric Flow Rate (dscfm)	26,720	26,665	26,729	26,705
NMHC (lb/hr as Hexane)	**0.24**	**0.27**	**0.24**	**0.25**
NMHC (ton/month as Hexane)	**0.09**	**0.10**	**0.09**	**0.09**
NMHC (Hexane @ 3% O2)	**1.715**	**1.979**	**1.710**	**1.801**
O_2 (% dry)	13.86	14.13	13.84	13.94

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HYDROGEN HALIDE AND HALOGEN TEST RESULTS SUMMARY (METHOD 26)

Company: Fortistar
Plant: Arbor Hills - Northville, MI
Unit: Typhoon Turbine Unit 2
Location: North Stack

Test Run Number	1	2	3	Average
Source Condition	Normal	Normal	Normal	
Date	9/5/14	9/5/14	9/5/14	
Start Time	15:30	16:55	18:23	
End Time	16:30	17:55	19:23	
Sample Duration (min):	60.0	60.0	60.0	60.0
Gas CO_2 Content (%v/v dry):	6.2	5.9	6.3	6.1
Gas O_2 Content (%v/v dry):	13.9	14.1	13.8	13.9
Gas Dry MW, M_d (lb/lb-mole):	29.55	29.52	29.55	29.54
Barometric Pressure, P_{bar} ("Hg)	28.90	28.90	28.90	28.90
Flue Pressure, P_s ("Hg)	28.85	28.85	28.85	28.85
Meter Volume, $V_{m(std)}$ (dscf):	3.752	3.792	3.829	3.791
Fractional Moisture Content, B_{ws}:	0.098	0.097	0.096	0.097
Volumetric Flow Rate, $Q_{std(dry)}$ (dscfm):	26,720	26,665	26,729	26,705
Hydrogen Chloride (HCl)				
HCl Net Mass Collected (mg):	0.21	0.19	0.20	0.20 ADL
HCl Concentration (lb/dscf):	1.23E-07	1.12E-07	1.12E-07	1.16E-07 ADL
HCl Concentration (ppmvd):	1.30	1.18	1.19	1.22 ADL
HCl Concentration (ppmvw):	1.17	1.07	1.07	1.10 ADL
HCl Emission Rate (lb/hr):	**0.20**	**0.18**	**0.18**	**0.19** ADL
HCl Emission Rate (ton/month):	**0.07**	**0.06**	**0.06**	**0.07** ADL

ADL - all analytical values used to calculate and report an in-stack emissions value are greater than the laboratory's reported detection level(s)