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FORTISTAR METHANE GROUP

EMISSIONS COMPLIANCE REPORT

For

O_2, SO_2 and NO_x From Stack Testing of
Solar Centaur Landfill Gas Combustion Turbine- Model T-4500 (3,500 kW)

At:

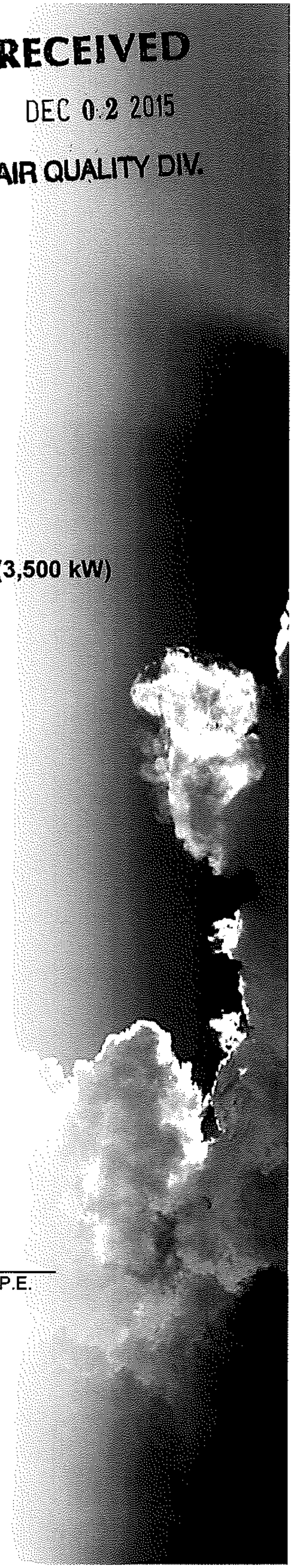
C&C Energy, LLC
19401 15 Mile Road
Marshall, Michigan 40968

Prepared by:

M3V, LLC

11925 E. 65th Street
Indianapolis, IN 46236

Test Date: September 24, 2015



Prepared by:	Reviewed by:
Marius Peter	*Valerian Simianu*
Marius Peter – Environmental Engineer	Valerian Simianu, Ph.D., P.E.

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name C&C Energy LLC County Calhoun

Source Address 19401 15 Mile Road City Marshall

AQD Source ID (SRN) P0222 ROP No. MI-ROP-P0222-2012a ROP Section No. ______

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From ______ To ______

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Compliance Emissions Test Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Anthony J. Falbo	Senior Vice President - Operations	(949) 355-5261
Name of Responsible Official (print or type)	Title	Phone Number

[signature] 11/23/2015

Signature of Responsible Official Date

* Photocopy this form as needed. EQP 5736 (Rev 11-04)

EXECUTIVE SUMMARY

C&C Energy, LLC operates a landfill gas to energy and electrical generation facility in Marshall, Michigan. The facility operates under the terms and conditions of the Permit to Install No. MI-ROP-P0222-2012a issued in May 23, 2013 by the Michigan Department of Environmental Quality (MDEQ). The permit requires C&C ENERGY to perform O_2, SO_2 and NO_x testing of Solar Centaur Landfill Gas Turbine, utilizing methods as approved by the MDEQ to document compliance with the permit requirements and with Subpart KKKK of the NSPS regulations.

The testing performed on September 24, 2015 demonstrates that the SOLAR CENTAUR Model T-4500 Landfill Gas Turbine is emitting SO_2 and NO_x below the permit limits as reflected in the Tables below.

C&C ENERGY retained M3V, LLC (*M3V*) to complete the 2015 emission measurements program. The measurement program was completed following the O_2, SO_2 and NO_x Compliance Test Protocol submitted to MDEQ on July 20, 2015. Tom Gasloli, representative of Michigan Department of Environmental Quality was present on site during the test. The emission measurements were conducted following the *EPA's Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, Reference Methods (RMs), 3A, 6C, 7E and 19* from the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods.*

The following personnel were involved with the testing program:

M3V, LLC	Valerian Simianu, Ph.D., P.E.
M3V, LLC	Marius Peter
M3V, LLC	Karl Mastalski
C&C ENERGY	Andrew Zalenski
MDEQ	Tom Gasloli

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Table 1-1 presents a summary of results for the O_2, SO_2 and NO_x test program.

Table 1-1 - Summary of Test Results – SOLAR CENTAUR Turbine based on F Factor

F factor	O_2 %	SO_2 lb/MMBTU	NO_X ppm @ 15%O2	NO_X Lb/MWh	SCFM
Run 1	16.18	0.1012	31.74	2.33	28,516.94
Run 2	16.24	0.1034	32.94	2.54	29,569.47
Run 3	16.29	0.1055	33.17	2.42	28,453.43
Average	**16.24**	**0.1034**	**32.62**	**2.43**	**28,846.62**
2013 Permit Limit	--	0.15	96	5.5	--
Subpart KKKK		0.15			

* Permittee chose to demonstrate compliance with lb/MMBTU limit for SO_2 and ppm NOx concentration.

Table 1-2 - Summary of Test Results – SOLAR CENTAUR Turbine based on Flow Measurements via Method 2.

Flow rates	O_2 %	SO_2 lb/MMBTU	NO_x lb/MWhr	NO_X ppm @ 15%O2	SCFM
Run 1	16.18	0.1147	2.11	31.74	25,850.00
Run 2	16.24	0.1150	2.23	32.94	25,943.00
Run 3	16.29	0.1194	2.14	33.17	25,144.00
Average	**16.24**	**0.1164**	***2.16***	**32.62**	**25,645.67**
2011 Permit Limit	--	0.15	5.5	96	--
Subpart KKKK		0.15			

Table 1-3 - Summary of Test Results – SOLAR CENTAUR Turbine based on Landfill Gas Analysis (Total reduces sulfur analysis)

Landfill gas analysis	O_2 %	SO_2 lb/MMBTU	SCFM
Run 1	16.18	0.1475	25,850.00
Run 2	16.24	0.1551	25,943.00
Run 3	16.29	0.1470	25,144.00
Average	**16.24**	**0.1499**	**25,645.67**
2011 Permit Limit	--	0.15	--
Subpart KKKK		0.15	

1.0 INTRODUCTION

C&C ENERGY, LLC owns and operates a landfill gas-to-energy facility located in Marshall, Michigan. The C&C ENERGY facility operates under the terms and conditions of the Permit Number MI-ROP-P0222-2012A issued in May 23, 2013 by the Michigan Department of Environmental Quality (MDEQ). The permit requires C&C ENERGY to demonstrate compliance with the requirements of the following table:

Source	Permit requirement	Pollutant		Permit limit	
			Lb/MWhr	ppm @ 15%O2	Lb/MMBTU
Solar Centaur Model T-4500 Gas Turbine EUTURBINE4-S3	EU-TURBINE Emission Limits	SO_2	0.9 or	–	0.15
		NO_x	5.5	96	--

To demonstrate compliance, C&C ENERGY retained *M3V* to test the O_2, SO_2 and NO_x emissions. The testing performed on September 24, 2015 and showed that C&C ENERGY is in compliance with the SO_2 and NO_x emissions permit requirements.

Dr. Valerian C. Simianu, *M3V*'s Vice-President of Operations, was the designated Project Manager for this test program. Dr. Simianu can be contacted at 317-723-3839. Maintenance Manager at C&C ENERGY assisted with the testing and production coordination. Testing was observed by Tom Gasloli, Technical Programs Unit, Air Testing Inspector from the Michigan Department of Environmental Quality.

The testing program was following the protocol submitted to MDEQ prior to the test. The following table provides a summary of the methodologies utilized for the testing program.

Table 1.1 - Summary of Test Program - SOLAR CENTAUR Gas Turbine
Gas Recovery Systems, Marshall, Michigan

Sample / Measurement Location	No. of Runs	Analyte / Parameter	Sample / Measurement Method	Sample Run Time	Analytical Method
Outlet	3	Volumetric Flow Rate	Method 2 and 19	N/A	Pitot Tube and calculation
	3	O_2/CO_2	Method 3A	NA	IR analysis
	3	Moisture	Method 4 and 19	60 minutes	Gravimetric and calculation
	3	NO_x	Method 7E	60 minutes	Instrumental Analyzer
	3	SO_2	Method 6C	60 minutes	Instrumental Analyzer

The measurement program was completed following the typical SO_2, CO_2 and NO_x methodology methods and with the applicable regulations set forth by the EPA's *Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A,* and the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods.*

Section 2.0 of this report presents a discussion of the results. The process operation information is summarized in Section 3.0. The analytical and sampling methods are discussed in Section 4.0. The test methodology is discussed in Section 5.0. A concise description of the quality assurance/quality control (QA/QC) procedures implemented is provided in Section 6.0. Appendix A of this document includes a summary of the emissions testing program with supporting data.

2.0 SUMMARY OF RESULTS

The SO_2, O_2 and NO_x test program was conducted for the SOLAR CENTAUR Model T-4500 (GT1) gas turbine. Field measurements were conducted to obtain representative stack O_2, SO_2 and NO_x emissions results. Results show that C&C ENERGY is in compliance with the permit emission requirements.

The measurement procedures used to complete the test program are accepted EPA RM procedures and defined in *40 CFR 60, Appendix A.*

2.1 PROCESS OPERATION

C&C ENERGY owns and operates a landfill gas to power generating station located in Marshall, Michigan facility. The landfill gas is being captured from the adjacent landfills and directed to the plant's engines or turbine-generators for power generation.

During the testing, the power generating process was run under normal conditions. The SOLAR CENTAUR Turbine is rated at 3,500 KW.

2.2 MEASUREMENTS RESULTS

Table 2.1 provides a detailed summary of the emissions testing program with supporting data included in Appendix A through C.

Table 2.1 – O_2, SO_2 and NO_x Emissions Measurements Results
Solar Centaur - Marshall, Michigan

	SOLAR CENTAUR Gas Turbine			
PARAMETERS, using F factor	**Run 1**	**Run 2**	**Run 3**	**Average**
Date	9/24/2015	9/24/2015	9/24/2015	9/24/2015
O_2 (% dry)	16.18	16.24	16.29	16.24
NO_x (lbs/hr)	6.50	6.99	6.78	6.76
NO_x (ppm)	25.39	26.02	25.92	25.78
NO_x (lb/MWhr)@ 15% O2	31.74	32.94	33.17	32.62
NO_x (lb/mmbtu)	0.1259	0.1306	0.1315	0.1294
SO_2 (lbs/hr)	5.21	5.53	5.43	5.39
SO_2 (ppm)	14.67	14.82	14.96	14.82
SO_2 (lb/MWhr)@ 15% O2	1.87	2.01	1.94	1.94
SO_2 (lb/mmbtu)	0.1012	0.1034	0.1055	0.1034
SCFM	28516.94	29569.47	28453.43	28846.62
BTU/SCFT	532.27	540.35	535.3	535.97

Table 2.2 – O_2, SO_2 and NO_x Emissions Measurements Results
Solar Centaur - Marshall, Michigan

PARAMETERS, using flow measurements	SOLAR CENTAUR Gas Turbine			
	Run 1	Run 2	Run 3	Average
Date	9/24/2015	9/24/2015	9/24/2015	9/24/2015
O_2 (% dry)	16.18	16.24	16.29	16.24
NO_x (lbs/hr)	5.89	6.14	5.99	6.00
NO_x (ppm)	25.39	26.02	25.92	25.78
NO_x (lb/MWhr)@ 15% O2	2.11	2.23	2.14	2.16
NO_x (lb/mmbtu)	0.1430	0.1454	0.1490	0.1458
SO_2 (lbs/hr)	4.72	4.85	4.80	4.79
SO_2 (ppm)	14.67	14.82	14.96	14.82
SO_2 (lb/MWhr)@ 15% O2	18.34	18.76	19.15	18.75
SO_2 (lb/mmbtu)	0.1147	0.1150	0.1194	0.1164
SCFM	25850	25943	25144	25645.67
BTU/SCFT	532.27	540.35	535.3	535.97

Based on the throughput measured during the test the turbine operated at 2,782 KW/hr.

SO2 compliance demonstration based on landfill gas analysis:

PARAMETERS, using landfill gas analysis	SOLAR CENTAUR Gas Turbine			
	Run 1	Run 2	Run 3	Average
Date	9/24/2015	9/24/2015	9/24/2015	9/24/2015
H2S (ppm)	481.80	481.80	481.80	481.80
H2S (lb/ft3)	0.0000415392	0.0000415392	0.0000415392	0.0000415392
Landfill Gas flow rate (SCFTH)	79620	83700	79320	80880
Heat input (MMBTU/hr)	41.187	42.197	40.178	42.197
SO_2 (lbs/hr)	6.225	6.544	6.202	6.324
SO_2 (lb/mmbtu)	0.1475	0.1550	0.1469	0.1499

3.0 TEST METHODOLOGY

The testing program was performed according to the following accepted and approved EPA RMs as contained in the EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods*, and the *40 CFR 60, Appendix A*. Any deviations from the standard RM procedures are detailed in this chapter. The general procedures followed to complete this measurement evaluation included:

RM 1	"Sample and Velocity Traverses for Stationary Sources",
RM 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)",
RM 3A	"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)",
RM 4	"Determination of Moisture Content in Stack Gases",
RM 6C	"Determination of Sulfur Dioxide Concentrations in Emissions",
RM 7E	"Determination of Nitrogen Oxides Emissions from Stationary Sources", and
RM 19	"Determination of Sulfur Dioxide, Nitrogen Oxides via F factor".

3.1 SUPPORT MEASUREMENTS FOR STACK PARAMETERS

RMs 1 through 4, 6C, 7E and 19 were performed to provide support data for emission rate calculations. Ideally, measurements should be performed at least eight stack diameters downstream and two diameters upstream from any flow disturbance. RM 1, selection of sample points for velocity traverses, was conducted prior to the initiation of each set of measurements. Gas Volumetric Flow Rate was determined during each run from the stoichiometric gas usage following method 19.

3.1.1 Selection of Traverse Points

RM 1, "Sample and Velocity Traverses for Stationary Sources," was followed for the selection of measurement points at each stack test location. The number of traverse points were determined based on the test port location and was necessary to attain representative volumetric flow rate measurements. This was performed by taking the cross-sectional area of the effluent stack at the measurement location and dividing it into equal areas. Traverse points were located at the center of each of the equal areas. No stratification of concentrations was observed in the stack and previous stack tests demonstrated no stratification.

3.1.2 Flow Rate Determination

The volumetric flow rate at each stack test location was measured using Gas Volumetric Flow Rate was determined during each run from the stoichiometric gas usage following method 19. The values were recorded during the test on field data forms and the volumetric flow rate was calculated. The values are attached in the Appendix B.

In addition to velocity pressures, gas temperatures were measured and recorded concurrently with all the differential pressure data. The temperature was measured with a Type-K thermocouple attached to a digital temperature indicator. Temperature readings were recorded from the display of the calibrated digital temperature indicator.

The average stack gas velocity was calculated using the effluent molecular weight, average measured velocity head (differential pressure), and average measured gas temperature via F factor as recommended by Method 19. The flow rate results are presented in terms of dscfm.

3.1.3 Determination of O_2 and CO_2 Concentrations

RM 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)", was conducted to determine the diluent O_2 and CO_2 concentration of the effluent. Oxygen and CO_2 concentrations (%) were determined by CEM using a Servomex Model 1400B Paramagnetic O_2 analyzer and Infrared (IR) CO_2 analyzer. The instrument range for both the O_2 and CO_2 instruments is 0 to 25 percent of the full-scale.

RM 3A analyzer calibration requirements include three point calibrations using EPA Protocol 1 gas standards and stringent instrument drift requirements. Calibrations were completed at 80-100 percent of the span value, 40-60 percent of the span value, and zero percent of the span value (ultra-pure nitrogen for both analyzers).

The O_2 and CO_2 analyzers were subjected to a zero and two up-scale calibration gases prior to and upon completion of each set of emission measurements. The gas standards were certified and traceable to EPA Protocol 1 specifications that require that the gas concentration be within ±1 percent of the documented value. The response of the analyzers compared to each certified calibration standard must be within ±2 percent of the analyzer span value for each component as required by the method.

To calibrate the instruments, the gas standards were introduced directly to the monitors at the sample inlet located on the back of each instrument. The amount of bias for O_2 and CO_2 CEMS was also determined. This was accomplished by introducing zero and one span gas to the CEMS at the point in which the sample probe and heated sample filter are connected. The response of the analyzers to the direct zero and span gases (bias check) must be less than ±5 percent of the span value for each component as required by the method. The bias calibration check was performed prior to and upon completion of each sample run.

The magnitude of calibration drift was also calculated. Calibration drift is the difference in the initial (pre-test) bias calibration response and the final (post-test) bias calibration response for the same gas standard. The calibration drift was within ±3 percent of the span over each sample run for each O_2 and CO_2 gas standard as required by the method.

3.1.4 Moisture Content Determination

The effluent moisture content at each oxidizer stack location was determined using RM 4, "Determination of Moisture Content in Stack Gases". The determination of moisture content was accomplished using a condenser and pump assembly connected between a sample probe and metering system.

Throughout each sample run, a known volume of gas (measured by a dry gas meter) was passed through the condenser assembly. Upon completion of each sample run, the total amount of condensate collected was gravimetrically measured and the net gain calculated. The total moisture gain, volume of gas extracted, and measured meter temperature data were used to calculate the actual moisture content of the effluent.

3.1.5 Determination of Sulfur Dioxide and Nitrogen Oxide Emissions

RMs 7E and 6C are both instrumental analysis methods used for the NO_x and SO_2 determination. Stack gas was withdrawn through a heated line and the emissions were analyzed on site using an analyzer with specific detectors. Details of the instrumentation are presented in Appendix B.

3.2 CALCULATIONS AND NOMENCLATURE

The following section presents the calculations for determining flow rate, molecular weight, and moisture content. In addition, calculations for the determination of pollutant and diluent concentrations and pollutant mass emission rates are provided. The nomenclature for each calculation is also defined.

Calculations

Stack Pressure (in. Hg):

$$P_s = P_b + \frac{P_g}{13.6}$$

Molecular Weight (lb/lb-mole, dry):

$$M_d = (0.44 \times \%\,CO_2) + (0.32 \times \%\,O_2) + (0.28 \times (100 - \%\,CO_2 - \%\,O_2))$$

Molecular Weight (lb/lb-mole, wet):

$$M_w = M_d \times (1 - B_{ws}) + (18 \times B_{ws})$$

Velocity (fps):

$$V_s = 85.49 \times C_p \times \sqrt{\Delta p}_{\,avg} \times \sqrt{\frac{T_s}{P_s \times M_w}}$$

Flow Rate (acfm):

$$acfm = V_s \times A_s \times 60$$

Flow Rate (dscfm):

$$dscfm = acfm \times 17.64 \times \left(\frac{100 - \%\,H_2O}{100}\right) \times \left(\frac{P_s}{T_s}\right)$$

Dry Standard Sample Gas Volume (dscf):

$$V_{m(std)} = V_m \times Y_d \times \left(\frac{T_{std}}{T_m}\right) \times \left(\frac{P_b}{P_{std}}\right)$$

Corrected Concentration (ppmv/%):

$$C_{corr.} = (C' - C_o) \times \left(\frac{C_{ma}}{C_m - C_o} \right)$$

CO Emission Rate (lb/hr):

$$E = \frac{C_{corr.} \times MW \times dscfm \times 60}{385 \times 1{,}000{,}000}$$

PM, PM10 Emission Rate (lb/hr):

$$E = \frac{C_{corr.} \times MW \times wscfm \times 60}{385 \times 1{,}000{,}000}$$

Volume of Water Vapor Condensed (scf):

$$V_{wc\,(std)} = 0.04707 \times MG$$

Wet Bulb Partial Pressure (in. H_2O):

$$PP = -0.062025 + (0.0067552 \times T_{s(wet)}) - (1.1141e-4 \times T_{s(wet)}^{\;2}) + (1.4489e-6 \times T_{s(wet)}^{\;3})$$

Wet Bulb Humidity Ratio (dimensionless):

$$HR_{(wet)} = 0.622 \times \left(\frac{PP}{(P_s \times 0.49) - PP} \right)$$

Wet Bulb Enthalpy of Vaporization (Btu/lb):

$$H_{v(wet)} = 1{,}094 - (0.56734 \times T_{s(wet)})$$

Dry Bulb Enthalpy (Btu/lb):

$$H_{(dry)} = 1{,}062 + (0.43216 \times T_{s(dry)})$$

Wet Bulb Enthalpy of Liquidation (Btu/lb):

$$H_{l(wet)} = -31.927 + (0.99925 \times T_{s(wet)})$$

Dry Bulb Humidity Ratio (dimensionless):

$$HR_{(dry)} = \frac{(0.24 \times (T_{s(wet)} - T_{s(dry)})) + (HR_{(wet)} \times H_{v(wet)})}{(H_{(dry)} - H_{l(wet)})}$$

Percent Water (wet bulb/ dry bulb method):

$$\% H_2O = \left(\frac{HR_{(dry)}}{HR_{(dry)} + 1} \right) \times 100$$

Fractional Moisture (dimensionless):

$$B_{ws} = \frac{V_{wc\,(std)}}{V_{wc\,(std)} + V_{m(std)}}$$

Moisture Content of Gas (%):

$$H_2O\,\% = B_{ws} \times 100\,\sigma$$

dscf\MMBTU = 10E6 *((3.64*%H2) + (1.53*%C) + (.14*%N2) - (0.46*%02))/BTU/lb

DSCFM = Gas Fd factor * MMBTU/min * 20.9 / (20.9-%02)

Nomenclature

A_s	Cross Sectional Area of the Stack (Square Feet)
C_p	Pitot Tube Coefficient, Dimensionless (0.84 for Type-S)
B_{ws}	Water Vapor in Gas Stream (proportional by volume)
MW	Molecular Weight of Pollutant (C_3 = 36)
M_d	Molecular Weight of Stack Gas, dry basis (lb/lb-mole)
M_w	Molecular Weight of Stack Gas, wet basis (lb/lb-mole)
P_b	Uncorrected Barometric Pressure (in. Hg)
P_g	Static Pressure of Stack Gas (in. WC)
P_s	Absolute Pressure of Stack Gas (in. Hg)
T_s	Stack Gas Temperature (°R)
V_s	Average Gas Velocity (feet per second)
ΔP	Velocity Head of Gas (in. WC)
acfm	Flow Rate (Actual Cubic Feet Per Minute)
dscfm	Flow Rate (Dry Standard Cubic Feet Per Minute)
$\%CO_2$	Carbon Dioxide, Dry Basis (%)
$\%O_2$	Oxygen, Dry Basis (%)
$\%H_2O$	Moisture Content of Gas (%)
P_{std}	Standard Absolute Pressure (29.92 in. Hg)
T_m	Average DGM Absolute Temperature (°R)
T_{std}	Standard Absolute Temperature (528 °R)
V_m	Dry Gas Volume as Measured by the DGM (dcf)
$V_{m(std)}$	Dry Gas Volume Corrected to Standard Conditions (dscf)
Y_d	DGM Calibration Factor
$V_{wc(std)}$	Volume of Water Vapor Condensed Corrected to Standard Conditions (scf)
E	Emission Rate (lb/hr)
$C_{corr.}$	Corrected Effluent Gas Concentration, dry basis (ppmv/%)
C'	Average gas concentration indicated by gas analyzer, dry basis (ppmv/%)
C_o	Average of initial and final system calibration bias check responses for the zero gas (ppmv/%)
C_m	Average initial and final system calibration bias check responses for the upscale calibration gas (ppmv/%)
C_{ma}	Actual concentration of the upscale calibration gas (ppmv/%)
scf	Standard Cubic Feet
MG	Mass Gain (ml)
PP	Wet Bulb Partial Pressure (in. H_2O)
$HR_{(wet)}$	Wet Bulb Humidity Ratio (dimensionless)
$H_{v(wet)}$	Wet Bulb Enthalpy of Vaporization (Btu/lb)
$H_{(dry)}$	Dry Bulb Enthalpy (Btu/lb)
$H_{l(wet)}$	Wet Bulb Enthalpy of Liquidation (Btu/lb)
$HR_{(dry)}$	Dry Bulb Humidity Ratio (dimensionless)
CE	Captured PM, PM10 and mass basis (%)

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The overall objective of *M3V*'s Quality Assurance/Quality Control (QA/QC) program is to ensure the collection of valid and acceptable data from all environmental measurement projects. Acceptable data is defined in terms of accuracy, precision, completeness, and representativeness.

Quality control activities were carried out during routine project operations to ensure that the data produced were within established limits of accuracy and precision. Quality assurance activities were carried out externally and independent of routine project endeavors to document data quality.

Each air measurement program entails numerous activities, during which critical QA/QC measures must be incorporated to achieve overall project data quality objectives. Specific QA measures were implemented during each of the following phases of field and laboratory operations:

- Pre-sampling activities;
- Sample collection; and
- Data reduction, validation, and reporting.

General QA/QC measures and objectives incorporated into all source measurement programs include the following:

- Continually monitor the precision and accuracy of the data being generated for all environmental measurements.
- Implement measures designed to control the precision and accuracy of all data generated for individual sources.
- Maintain permanent records of equipment calibrations that include traceability and certification.

4.1 PRESAMPLING ACTIVITIES AND QA MEASURES

Pre-sampling activities included equipment maintenance and calibration. All monitoring equipment is uniquely identified and subjected to continuous preventative maintenance measures at *M3V's* office. Records of instrument maintenance and calibration are kept in historical files and continually updated. All instrument analyzers and applicable sampling system components were calibrated prior to and after all field measurement programs according to stringent guidelines set forth in the *Quality Assurance Handbook for Air Pollution*

Measurement Systems, Volume III, Stationary Source Specific Methods and the *40 CFR 60, Appendix A.*

4.2 FIELD PROGRAM

Field sampling and measurement procedures used in all source measurement programs were approved by the EPA or applicable local agency prior to sample initiation. All primary emission testing procedures are referenced in the EPA *40 CFR 60, Appendix A*, and the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods.*

All field test personnel involved with this test program are experienced and trained in field sampling methods and procedures. Each field person was assigned key responsibilities in phases of sample collection, sample recovery, chain-of-custody, and transportation of samples. Basic responsibilities for field personnel included, but were not limited to:

> Record Keeping - Field Personnel recorded all pertinent parameters and relevant observations on the appropriate field data forms.
>
> Safety Requirements - Field personnel were familiar with all company safety regulations and were provided with all the necessary safety equipment.
>
> Sample Handling - Field personnel were trained in the proper procedures for handling samples including: use of sample containers, sample preservation, identification, storage of collected samples, and chains-of-custody.
>
> Instrumentation - Specific field personnel were trained in the proper operation, calibration, troubleshooting, and maintenance of the instrumentation intended for this program. This included the use of pumps, control console(s), samplers, and instrumentation.
>
> Quality Control - The field personnel were trained in all aspects of quality control that related directly to the specific reference method test procedures, sample handling, analysis, and reporting.

A member of the *M3V* field team was designated as Field Manager and was responsible for coordinating testing activities with C&C Energy and answering questions concerning test methodology and quality control. The Field Manager was also responsible for delegating work assignments to the members of the test crew, making sure all QA/QC procedures were carried out, and documenting all field activities in a bound log book.

4.2.1 Sample Documentation

All field data collected for each selected reference method test procedure was documented on field data forms specifically designed for each particular method using recommended formats as described in 40 CFR 60, Appendix A, the EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods. Each form, specific to each particular sample run, includes information as to the source tested, date and time of sample collection, analyst(s) performing the test, and all data necessary for test validation. Each field data sheet was completed by the responsible technician at the time of the test and checked by the Field Manager for accuracy and completeness after each test series. The originals of all raw field data sheets are maintained in project files at *M3V*'s Indianapolis office.

4.3 DATA REDUCTION, VALIDATION, AND REPORTING

M3V has implemented specific measures to ensure that reliable data were generated as a result of the sampling and analytical activities of the field program. The objective of this phase of *M3V's* QA/QC program is to follow the proper collection of representative and quality assured field and analytical data with approved data reduction methods and equations.

All calculations were performed using quality assured spreadsheets incorporating standard accepted equations, as required by the applicable pollutant specific sampling methodology. Data reduction was performed by qualified engineers or data analysts, familiar with standard engineering practices and approved methods.