

**Derenzo and Associates, Inc.**

*Environmental Consultants*

February 13, 2012.

Mr. Syed Arif, P.E.  
Emission Monitoring Section Administrator  
Florida Department of Environmental Protection  
Bureau of Air Regulation  
2600 Blair Stone Rd.  
Mail Station 5510  
Tallahassee, FL 32301

RECEIVED

FEB 20 2012

DIVISION OF AIR  
RESOURCE MANAGEMENT

Subject: Stack Test Protocol for the Verification of Carbon Monoxide, Nitrogen Oxides, Non-Methane Hydrocarbons and Opacity Emissions from a Landfill Gas-Fueled Internal Combustion Engine.

Dear Mr. Arif:

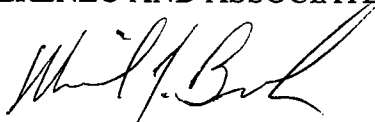
Derenzo and Associates, Inc. is forwarding the enclosed test plan for the verification of Nitrogen Oxides, Carbon Monoxide, Volatile Organic Compounds Emissions and Opacity Determinations from one of four (4) CAT Model No. G3520C 2,233 brake-horsepower landfill gas-fueled engines at the Seminole Energy, LLC facility in Geneva, Florida. The landfill gas-to-energy plant is located at the Osceola Road Solid Waste Management facility in Seminole County.

Testing is being conducted as required by Florida Department of Environmental Protection Permit 1170084-009-AC on March 22, 2012 by Derenzo and Associates' Air Quality Services Landfill Gas Division.

Contact information is provided in the enclosed Stack Test Protocol documentation, should you have any questions or require additional information.

Sincerely,

DERENZO AND ASSOCIATES, INC.



Michael Brack  
Field Services Manager

c: Mr. Richard DiGia- Senior Vice President-Chief Operating Officer, Seminole Energy, LLC  
Mr. Michael Laframboise – Vice President of Operations, Landfill Energy Systems  
Ms. Wanda Parker-Garvin- Environmental Manager, FDEP  
Mr. Tom Waters - Solid Waste Management Seminole County Central Transfer Station

Enclosures

**STACK TEST PROTOCOL**

Report Title: Stack Test Protocol for the Verification of Carbon Monoxide, Nitrogen Oxides, Volatile Organic Compounds Emissions and Opacity Determinations from a Landfill Gas-Fueled Internal Combustion Engine

Submittal Date: February 13, 2012

Test Date(s): March 22, 2012

<b>Facility Information</b>	
Name:	Seminole Energy, LLC – Osceola Road Solid Waste Management Facility
Street Address:	1930 E. Osceola Road
City, County:	Geneva, Seminole
Phone:	407-349-9428

<b>Facility Permit Information</b>			
DEP File No.:	1170084-009-AC	Permit No.:	PSD-FL-376B

<b>Testing Contractor</b>	
Company:	Derenzo and Associates, Inc.
Mailing Address:	39395 Schoolcraft Rd. Livonia, MI 48150
Phone:	(734) 464-3880
Project No.:	1201046

**STACK TEST PROTOCOL  
FOR  
AIR POLLUTANT EMISSIONS  
FROM ONE  
IC ENGINE - GENERATOR SET  
OPERATED BY  
SEMINOLE ENERGY, L.L.C.**

**SCHEDULED TEST DATE: March 22, 2012**

Seminole Energy, L.L.C. (Seminole Energy), operates four (4) Caterpillar (CAT) Model No. G3520C, 2,233 brake horsepower landfill gas fired internal combustion (IC), spark ignited engines for the generation of up to a total of 6.4 megawatts (nominal rating) of electricity.

Installation and operation of the IC engines are permitted by the Florida Department of Environmental Protection (DEP), Air Operation Permit 1170084-009-AC. Permit No. PSD-FL-376B issued to the Osceola Road Solid Waste Management facility requires that annual performance tests be completed on one (1) of the four (4) IC engines to verify the emission rates of carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), volatile organic compounds (VOC) and perform opacity observations.

The compliance test will consist of three (3) one-hour test periods, in which CO, NO<sub>x</sub>, VOC, oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) concentrations, and moisture content will be determined for the selected IC engine exhaust gas stream. One 60-minute opacity run will run concurrently with the instrumental analyzer sampling of the engine exhaust. Integrated fuel gas samples will be obtained during the emissions testing for subsequent analysis for the determination of sulfur dioxide (SO<sub>2</sub>) and hydrogen chloride (HCl) emission factors. The SO<sub>2</sub> and HCl emission factors will be calculated by analyzing the fuel gas for sulfur and chlorine bearing compounds and converting the available atoms of each compound to the target analyte.

The compliance testing will be performed by Derenzo and Associates, Inc., an environmental consulting and testing company located at 39395 Schoolcraft Road, Livonia, Michigan.

**1. IDENTIFICATION AND DESCRIPTION OF THE SOURCE TO BE TESTED**

**1a. Contact Person(s) for Source and Test Plan Information**

All questions concerning the source and test plan should be addressed to:

Mr. Damian Schmitt  
Operations Manager  
Seminole Energy LLC  
46280 Dylan Drive, Suite 200  
Novi, Mi 48377  
(248) 380-3920

Mr. Michael Brack  
Field Services Manager  
Derenzo and Associates, Inc.  
39395 Schoolcraft Rd.  
Livonia, MI 48150  
(734) 464-3880  
mbrack@derenzo.com

**1b. Identification and Description of Source to be Tested**

Seminole Energy operates four (4) CAT Model No. G3520C engines (identified as Emission Unit Nos.: 002-005). These engines are fueled with methane-rich gas, which is generated at the Osceola Road Solid Waste Management Facility, to power base load electricity generator operations.

The FDEP Air Operation Permit requires the facility to perform annual testing on a different engine each year. The 2012 annual test event will be performed on Emission Unit EU-005 (ICE #4).

**1c. Type and Typical Quantity of Raw and Finished Materials Used in each Process**

The IC engines are operated at base load conditions (i.e., 100% of design capacity). The amount of landfill gas that is used by each engine is dependent on its methane content. The upper and lower fuel use rate of each IC engine is approximately 580 - 440 cubic feet per minute (cfm).

**1d. Description of Cyclical or Batch Operations**

The IC engine operating conditions will be continuous and relatively constant for the entire time that base load electricity generation occurs (i.e., 100 percent of design capacity). The total number of IC engines that are operated at the facility may vary on a daily basis based on scheduled and unscheduled maintenance and repair activities.

**1e. Basic Operating Parameters Used to Regulate the Process**

Basic parameters that regulate engine operations are the combustion chamber temperatures and methane content of the landfill gas fuel. The air-to-fuel ratio is the only variable for the CAT Model G3520C engine.

**1f. Rated Capacity of the Processes**

The CAT Model No. G3520C engine will be tested while operations occur at (or near  $\pm$  10% of design capacity) the following power generation and heat input rates:

- Engine Power: 2,233 brake horsepower
- Electricity Generation: 1,600 kilowatts
- Heat Input (HHV): 16.5 MMBtu/hr

**1g. Permit Limits**

The following emission limits apply to each engine operated at the facility.

Parameter	g/bhp-hr	lb/hr
Carbon Monoxide	3.5	17.2
Nitrogen Oxides	0.6	3.0
Volatile Organic Compounds	0.28	1.4

**2. DESCRIPTION OF THE CONTROL EQUIPMENT**

**2a. Type of Control Device**

The CAT Model No. G3520C engines have no add on air pollution control equipment, emissions from each engine are exhausted, vertically, directly to the atmosphere.

**3. PERMIT NO.**

Seminole Energy operates under Permit No. 1170084-009-AC issued by the Florida DEP.

**4. POLLUTANTS TO BE MEASURED**

One IC engine will be tested to verify the concentrations of CO, NO<sub>x</sub> and VOC in the exhaust stack. Opacity observations will also be conducted as part of the compliance demonstration. Volumetric flowrate will be measured to calculate the CO, NO<sub>x</sub> and VOC mass emission rate (pounds per hour). Kilowatt output values will be recorded during the emissions testing to calculate the grams per brake horsepower-hour (g/bhp-hr) emission rates for NO<sub>x</sub>, CO, and VOC. SO<sub>2</sub> and HCl emission factors will be calculated based on fuel use and available atoms (of sulfur and chlorine) and reported in units of pounds per million standard cubic feet (lb/MMscf) of fuel consumed.

**5. DESCRIPTION OF SAMPLING TRAINS**

The following table presents test methods that will be used to measure the specified engine pollutant emission and exhaust parameter:

Analyte/Parameter	Sampling Methodology	Analytical Methodology
Velocity traverses	USEPA Method 1	Data Reduction
Volumetric flow rate	USEPA Method 2	Data Reduction
Oxygen and carbon dioxide	USEPA Method 3A	Zirconia Ion & NDIR
Moisture	USEPA Method 4	Gravimetric
Nitrogen oxides	USEPA Method 7E	Chemiluminescence
Opacity	USEPA Method 9	Visual – Certified Reader
Carbon monoxide	USEPA Method 10	NDIR
Non-Methane Hydrocarbons	USEPA Method Alt 078	GC/FID instrument
Chlorinated Compounds	USEPA Method TO15	GC/MS
Sulfur Compounds	ASTM D-5504	GC/SCD

Notes: NDIR denotes non-dispersive infrared; GC denotes gas chromatography; MS denotes Mass Spectroscopy; SCD denotes sulfur chemiluminescence detection.

Derenzo and Associates, Inc. will perform and complete the specified engine emission pollutant and exhaust parameter measurements in accordance with the following United States Environmental Protection Agency (USEPA) reference test methods:

- USEPA Methods 1 and 2 – Determination of Sampling Locations, Traverse Points, and Stack Gas Velocity and Flow rates.

- USEPA Method 3A – Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure).
- USEPA Method 4 – Determination of moisture content in stack Gases.
- USEPA Method 7E – Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure).
- USEPA Method 9 – Visual Determination of the Opacity of Emissions from Stationary Sources.
- USEPA Method 10 – Gas Analysis for the Determination of Carbon Monoxide in Emissions from Stationary Sources (Instrumental Analyzer Procedure);
- USEPA ALT-078; use of the Thermo Environmental Instruments Model 55C analyzer for measuring VOC (as NMHC) in IC engine exhaust gas.
- USEPA Method TO-15 – Determination of chlorine containing compound concentration using gas chromatography / mass spectrometry.
- ASTM Method D-5504 – Determination of sulfur containing compound concentration using gas chromatography / sulfur chemiluminescence detection .

In addition to the sampling and analytical methods presented in the preceding text, the following method will be used as part of the engine emissions performance tests:

- USEPA Method 205, “Verification of Dilution Systems for Field Instrument Calibrations,” will be used to verify dilution system linearity.

## **6. DETAILED SAMPLING AND ANALYSIS PROCEDURES**

The compliance test will consist of three (3) one-hour test periods, in which CO, NO<sub>x</sub>, VOC, O<sub>2</sub> and CO<sub>2</sub> concentration, and moisture content will be determined for the IC engine exhaust gas stream. One (1) 60-minute opacity run will run concurrently with the isokinetic and instrumental analyzer sampling of the engine exhaust. The concentration and exhaust gas flowrate measurements will be performed in the IC engine vertical exhaust stack, upstream of the muffler.

Landfill gas samples shall also be collected during the performance test. During the instrumental analyzer sampling, landfill gas shall be collected into SUMMA canisters for determination of landfill gas chlorinated compound content and into a tedlar bag for sulfur compound analysis.

Attachment A provides a diagram of the proposed sampling locations. Attachment B presents information of a typical extractive gas sampling and conditioning system. Attachment C provides a diagram of the extractive gas system. The actual system used during the tests may vary slightly from that depicted in the diagram.

#### 6.1 Velocity traverse locations, measurement of stack gas velocity (USEPA Method 1 and 2)

Prior to commencing the engine emission performance test field measurements, stack gas sampling locations (i.e., pollutant concentration and velocity pressure measurement locations) will be determined in accordance with USEPA Method 1.

To determine hourly pollutant emission rates, the stack gas velocity and volumetric flowrate will be measured using USEPA Method 2 at the beginning of, and following, each test run sampling period. Gas velocity measurements that are performed at the beginning of a test run sampling period, in some cases, will also be used as the final gas velocity measurements for previous test run sampling periods. Gas velocity (pressure) measurements will be conducted at each traverse point of the stack with an S-type Pitot tube and red-oil manometer. Temperature measurements will be conducted at each traverse point using a K-type thermocouple and a calibrated digital thermometer. Once the molecular weight and moisture content of the engine exhaust gas is obtained, the stack exhaust volumetric flowrate will be determined.

Prior to performing the initial engine exhaust stack velocity traverse, and periodically throughout the test program, the S-type Pitot tube and manometer lines will be leak-checked at the test site. This check will be made by blowing into the impact opening of the Pitot tube until 3 or more inches of water are recorded on the manometer, then capping the impact opening and holding it closed for 15 seconds to ensure that it is leak free. The static pressure side of the Pitot tube will be leak-checked using the same procedure. Cyclonic flow determinations will be conducted on each velocity measurement point.

#### 6.2 Measurement of carbon dioxide and oxygen concentrations (USEPA Method 3A)

Engine exhaust CO<sub>2</sub> and O<sub>2</sub> concentration and pollutant emission measurements will be performed concurrently during each test run sample period using an instrumental analyzer in accordance with Method 3A. A non-dispersive infrared (NDIR) gas analyzer will be used to measure the CO<sub>2</sub> concentrations of the engine exhaust gas. A zirconia ion analyzer will be used to measure the O<sub>2</sub> concentrations of the engine exhaust gas.

Attachment B provides information of the extractive gas sampling and conditioning system that will be used to deliver engine exhaust gas samples to the Method 3A instruments.

Engine exhaust CO<sub>2</sub> concentrations are expected to be approximately 12.0% by volume and 8.0% by volume for O<sub>2</sub>. Therefore, the Method 3A instrument ranges will be set to 15% by volume for CO<sub>2</sub> concentration measurements, and 15% or 25% by volume for O<sub>2</sub> concentration measurements, dependent upon the available calibration gas.

#### 6.3 Determination of moisture content via non-isokinetic sampling (USEPA Method 4)

The engine exhaust gas moisture content will be determined in accordance with the USEPA Method 4 chilled impinger method for each of the test run sample periods. A sample of the engine exhaust gas will be extracted at a constant rate from the source; and moisture in the sample will be collected in the

chilled impinger. The moisture content of the collected sample will be determined gravimetrically (or volumetrically) based on the water gain measured in the impinger. A non-heated probe will be used to collect the moisture sample at a single point within the stack since the engine exhaust temperature will be significantly greater than 800 °F and by definition non-stratified.

#### 6.4 Measurement of nitrogen oxides via instrumental analyzers (USEPA Method 7E)

Engine exhaust NO<sub>x</sub> concentrations will be determined during each test run sample period using a chemiluminescence analyzer in accordance with USEPA Method 7E.

Samples of the engine exhaust gas will be delivered to the instrument analyzer using an extractive gas sampling system that prevents condensation or contamination of the sample. The exhaust gas samples will be conditioned (i.e., dried) prior to being introduced to the instrument analyzer. Therefore, NO<sub>x</sub> measurements correspond to standard conditions with moisture correction (dry basis).

The specified instrument analyzer will be calibrated using certified NO<sub>x</sub> concentrations in nitrogen.

The engine exhaust NO<sub>x</sub> concentration is expected to be approximately 80 ppm (by volume). This value is based on the results of NO<sub>x</sub> concentration measurements that have been performed on identical engine exhausts. Therefore, the instrument analyzer NO<sub>x</sub> measurement range will be set to 200 ppm (by volume).

Attachment B provides information of the extractive gas sampling and conditioning system that will be used to deliver engine exhaust gas samples to the Method 7E instruments.

#### 6.5 Measurement of carbon monoxide via instrumental analyzers (USEPA Method 10)

Engine exhaust CO concentrations will be determined during each test run sample period using a NDIR gas analyzer in accordance with USEPA Method 10 for direct measurement of CO concentration in exhaust gases.

Samples of the engine exhaust gas will be continuously delivered to the instrument analyzer using an extractive gas sampling system that prevents condensation and contamination of the sample. The engine exhaust gas samples will be conditioned (i.e., dried) prior to being introduced to the instrument analyzer. Therefore, CO measurements correspond to standard conditions with moisture correction (dry basis). The instrument analyzer will be calibrated using certified CO concentrations in nitrogen.

The engine exhaust CO concentration is expected to be approximately 600 ppm (by volume). This value is based on the results of CO concentration measurements that have been performed on identical engine exhausts. Therefore, the instrument analyzer CO measurement range will be set to 1,000 ppm (by volume). The specific measurement span will be dependent upon the high-level calibration gas employed in the field.



Attachment B provides information of the extractive gas sampling and conditioning system that will be used to deliver engine exhaust gas samples to the Method 10 instruments.

#### 6.6 Opacity Determinations (USEPA Method 9)

USEPA Method 9 procedures will be used to evaluate the opacity of the outlet exhaust for one 60-minute run concurrent with instrumental analyzer sampling of the engine exhaust. In accordance with USEPA Method 9, the qualified observer will stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. As much as possible, the line of vision will be approximately perpendicular to the plume direction.

Opacity observations will be made at the point of greatest opacity in the portion of the plume where condensed water vapor is not present. Observations will be made at 15-second intervals for the duration of the 60-minute observation period.

All visible emissions determinations will be performed by a qualified observer in accordance with USEPA Method 9, Section 3.

#### 6.7 Measurement of VOC concentrations (USEPA Alt 078)

VOC as non-methane hydrocarbon (NMHC or NMOC) concentrations in the IC engine exhaust will be determined using a Thermo Environmental Instruments, Inc. (TEI), Model 55C Methane-NMHC analyzer in accordance with USEPA Alternate Method (ALT) 078 for direct measurement of NMHC concentrations in exhaust gases for IC engines.

The TEI 55C is an automated batch analyzer that repeatedly collects and analyzes samples of the exhaust gas stream that are drawn into the instrument by the internal sampling pump. The sampled gas is separated by an internal gas chromatography (GC) column into methane and non-methane fractions and each fraction is analyzed separately using a flame ionization detector (FID), in accordance with USEPA Method 25A.

Samples of the exhaust gas will be delivered to the instrument analyzer using an extractive gas sampling system that prevents condensation or contamination of the sample. The exhaust gas samples will be delivered directly to the instrument analyzer. Therefore, VOC measurements correspond to standard conditions with no moisture correction (wet basis).

The specified instrument analyzer will be calibrated using certified propane concentrations in hydrocarbon-free air.

Based on previous IC engine testing, the VOC concentrations measured with the TEI Model 55C analyzer are expected to be approximately 10 to 40 ppmv for the exhaust, measured as propane.

Attachment B provides information of a typical extractive gas sampling and conditioning system that will be used to deliver engine exhaust gas samples to the TEI Model 55C analyzer.

Attachment D also provides the approval letter from the USEPA for the use of Test Method ALT-078 (TEI Model 55C Analyzer) for IC engines.

#### **6.8 Determination of chlorine containing compound concentration (USEPA Method TO-15)**

A representative sample of inlet landfill gas will be collected in evacuated stainless steel cylinders from the LFG common header at a location after the discharge side of the gas blower. The sampling system consists of a Teflon® connective tubing, a 7-micron stainless steel particulate filter, and an evacuated stainless steel sample cylinder.

Prior to shipment to the sampling site, the stainless steel sample cylinder will be leak checked at the laboratory, by evacuating the tank within 10 millimeters of mercury (mm Hg) absolute pressure and filled with helium to an absolute pressure of 345 mm Hg, and allowed to sit for at least 60 minutes. If no change in vacuum is observed on a mercury manometer or vacuum gauge, each tank is then considered to have an acceptable pre-test leak check. The gas sample will be drawn from the LFG header until the sampling cylinder absolute pressure was slightly below atmospheric pressure. Final cylinder pressure (absolute pressure or vacuum) will be recorded at the sampling site prior to shipment to the laboratory. The cylinder pressure/vacuum will be verified by laboratory personnel upon receipt to confirm sample container integrity.

The gas samples will be shipped to Air Toxics, Ltd. (Folsom, California) and analyzed for specific chlorinated hydrocarbons, according to the procedures specified in USPEA Compendium Method TO-15.

#### **6.8 Determination of sulfur containing compound concentration (ASTM Method D-5504)**

A representative sample of inlet landfill gas will be collected into a tedlar bag from the LFG common header at a location after the discharge side of the gas blower. The sampling system consists of a Teflon® connective tubing, a 7-micron stainless steel particulate filter, and a leak free tedlar bag.

Prior to shipment to the sampling site, the tedlar bag will be leak checked at the laboratory, by filling the bag with nitrogen, and allowed to sit for at least 60 minutes. If no change in volume is observed, each bag is then considered to have an acceptable pre-test leak check. The gas sample will be drawn from the LFG header until the sampling bag is 75% full. The sample will be shipped in accordance with federal Dangerous Goods shipping regulations.

The gas samples will be shipped to Air Toxics, Ltd. (Folsom, California) and analyzed for specific sulfur bearing compounds, according to the procedures specified in ASTM TO-15.

### **7. NUMBER AND LENGTH OF SAMPLING RUNS**

The emission performance tests will consist of three (3), one-hour test runs for CO, NO<sub>x</sub>, VOC, O<sub>2</sub> and CO<sub>2</sub> concentrations and moisture content measurement on the exhaust of one (1) CAT

Model No. G3520C IC engine. A single, 60-minute opacity observation period will be performed for the compliance demonstration.

## 8. DIMENSIONED SKETCHES OF SAMPLING LOCATIONS

The following table presents information on the engine exhaust stack sampling location. Actual measurements for the specified stack parameters will be verified prior to conducting the engine performance tests and reported with the results.

Sampling Location	Nominal Stack Dia. (in.)	Up Stream/ Down Stream Distances (dia)	Discharge (orientation)	Rain Cap (presence)
Engine Exhaust	15.5	3.4	Vertical	None

## 9. ESTIMATED FLUE GAS CONDITIONS

Sampling Location	Temperature (°F)	Expected O <sub>2</sub> Conc. (%)	Expected CO <sub>2</sub> Conc. (%)	Expected Moisture (%)	Expected Flowrate (dscfm)
Engine Exhaust	950	8.0	12.0	13.0	4,500

## 10. PROJECTED PROCESS OPERATING CONDITIONS

For the compliance demonstration, the IC engine will be operated at base load conditions (i.e., 100% of design capacity). The generator that is powered by the IC engine is expected to produce approximately 1600 kW of electricity (+/- 10%).

## 11. PROCESS OR CONTROL EQUIPMENT DATA TO BE COLLECTED

For each compliance test-period, Seminole Energy will monitor and record the average hourly kilowatt output of the generator connected to the IC engine that is being tested. The facility utilizes a calibrated gas usage metering device for the entire facility; however, individual engine fuel usage metering devices are not installed at the facility. The fuel usage values for the engine tested will be calculated based on the total facility-wide fuel used during the compliance testing, divided by the number of engines operating during the test times.

## 12. CHAIN OF CUSTODY PROCEDURES

Chain-of-Custody documentation for laboratory analysis will be incorporated as part of the compliance report.

### **13. FIELD QA/QC PROCEDURES**

#### **13.1 Instrument Calibration and System Bias Checks**

At the beginning of each test day, three-point instrument analyzer calibrations will be initially performed by injecting calibration gas directly into the inlet sample port for each instrument analyzer, this is the Calibration Error determination limited to 2% error. System Bias (SB) checks will be performed prior to, and at the conclusion, of each test run sample period. SB checks are performed by introducing the appropriate upscale calibration gas and zero gas into the sampling system (at the base of the stainless steel sampling probe prior to the particulate filter and Teflon® heated sample line) and verifying the instrument analyzer response against the initial instrument calibration readings. SB determinations are limited to 5%. Analyzer drift determinations are also calculated based on the SB measurements and are limited to 3%.

The instrument analyzers will be calibrated with USEPA Protocol 1 certified CO<sub>2</sub>, O<sub>2</sub>, NO<sub>x</sub> and CO concentrations in nitrogen and zeroed using nitrogen.

#### **13.2 NO<sub>2</sub> – NO Converter Test**

The NO<sub>2</sub> – NO conversion efficiency of the TEI Model 42C instrumental analyzer will be verified prior to the commencement of the performance tests. A USEPA Protocol 1 certified NO<sub>2</sub> calibration gas will be used to verify the efficiency of the NO<sub>2</sub> – NO converter. The instrument analyzer NO<sub>2</sub> – NO converter uses a catalyst at high temperatures to convert the NO<sub>2</sub> to NO for measurement. The conversion efficiency of the instrument analyzer will be deemed acceptable if the calculated NO<sub>2</sub> – NO conversion efficiency is greater than or equal to 90%.

#### **13.3 Sampling System Response Time Determination**

The response time of the sampling system will be determined prior to the commencement of the engine performance tests by introducing upscale gas and zero gas, in series, into the sampling system using a tee connection at the base of the sample probe. The elapsed time for the analyzer to display a reading of 95% of the expected concentration will be determined using a stopwatch.

#### **13.4 Determination of Exhaust Gas Stratification**

Exhaust gas stratification measurements will be performed on the engine exhaust stack prior to the commencement of the performance tests. A stainless steel sample probe will be positioned at measurement points that correlate to 16.7%, 50.0% (centroid) and 83.3% of the stack diameter. Pollutant concentration data will be recorded at each sample point for a minimum of twice the maximum system response time.

### **14. LABORATORY QA/QC PROCEDURES**

Laboratory qa/qc procedures will be followed in accordance with each stated method. The D-5504 and TO-15 samples will include laboratory blanks as no field blank is required.

**15. TESTING PERSONNEL**

The personnel conducting the engine performance tests will be selected from the following qualified Derenzo and Associates, Inc. employees. Mr. Michael Brack, Field Services Manager with Derenzo and Associates will be the project manager for the Seminole Energy compliance emissions testing project. Mr. Brack can be contacted at (734) 464-3880 or [mbrack@derenzo.com](mailto:mbrack@derenzo.com).

1. Michael Brack, Field Services Manager
2. Robert Harvey, Engineering Services Manager
3. Andrew Rusnak, Environmental Engineer
4. Daniel Wilson, Field Technician
5. Robert Bingham, Field Technician
6. Charles Scamp, Environmental Consultant
7. Tyler Wilson, Environmental Consultant

Test Protocol Prepared By:



Daniel Wilson  
Field Technician

Test Protocol Reviewed By:



Michael J. Brack  
Field Services Manager

**Derenzo and Associates, Inc.**

**ATTACHMENT A**

Seminole Energy Landfill Gas Electricity Generation Facility Process Flow  
Seminole Energy General Engine Operation Flow  
CAT Model G3520C Engine Exhaust Sampling Locations

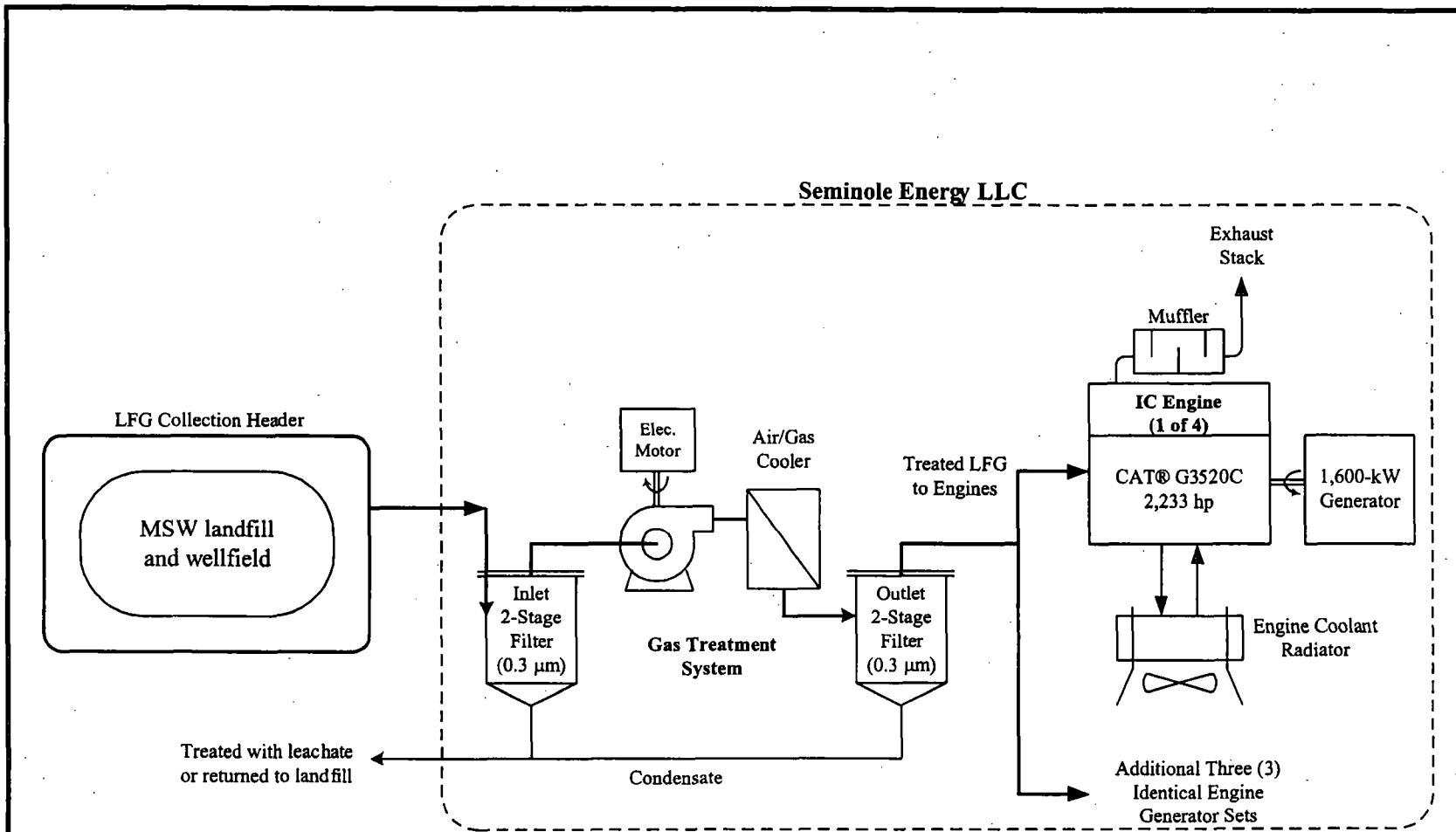


Figure 1.

<b>Seminole Energy LLC</b>		
<b>LFG Electricity Generation Facility</b>		
Scale None	Sheet 1 of 1	Derenzo and Associates Project No. 1201046

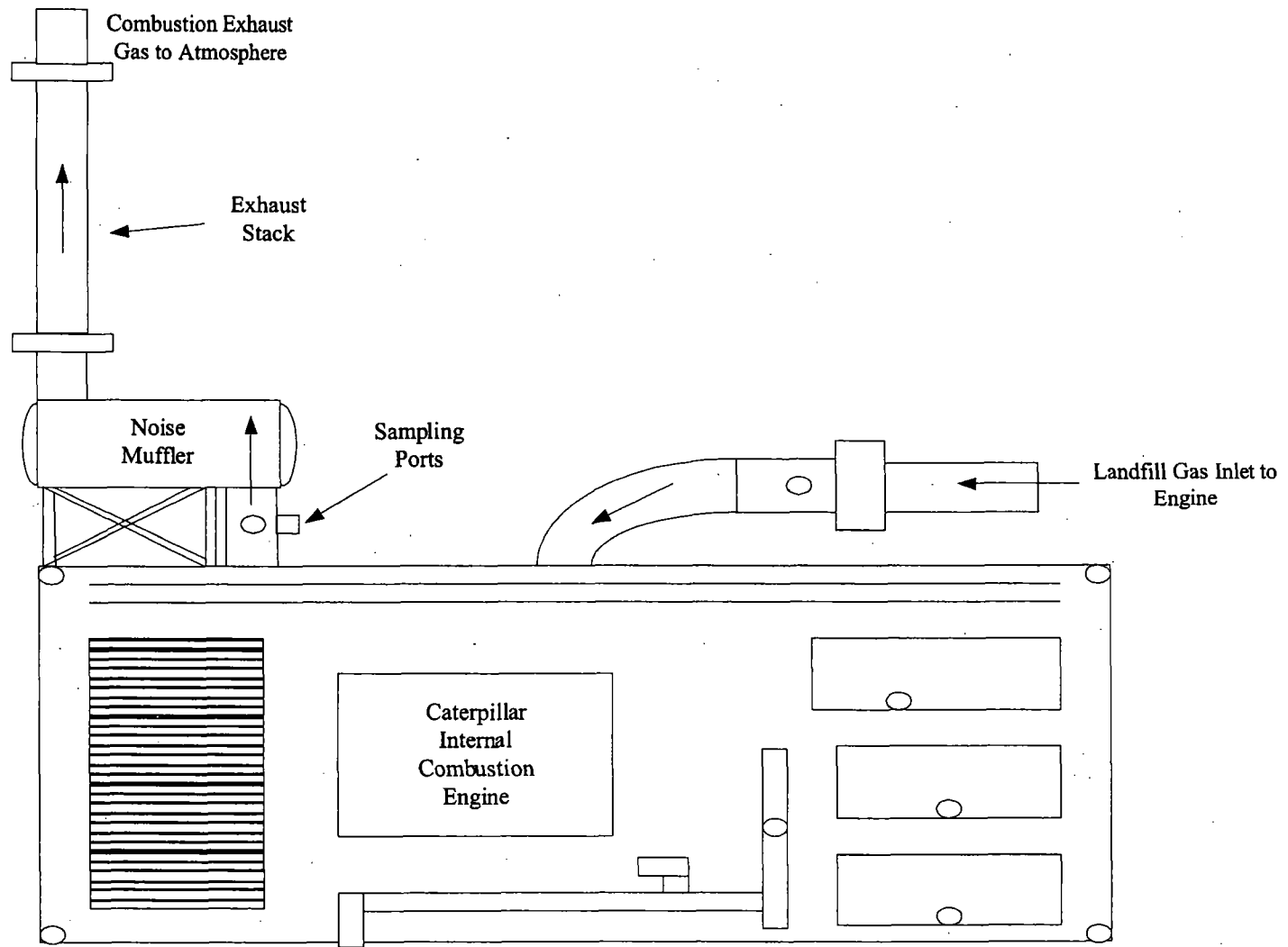


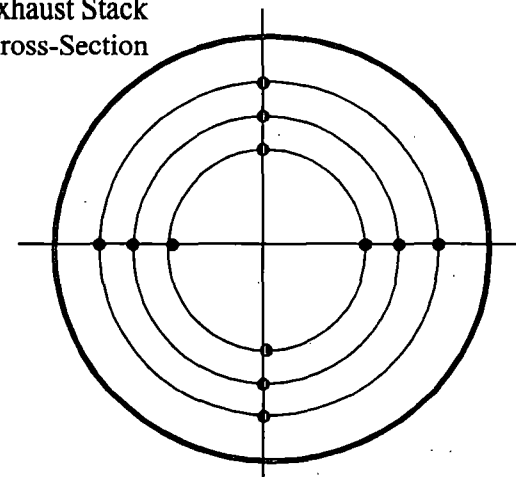
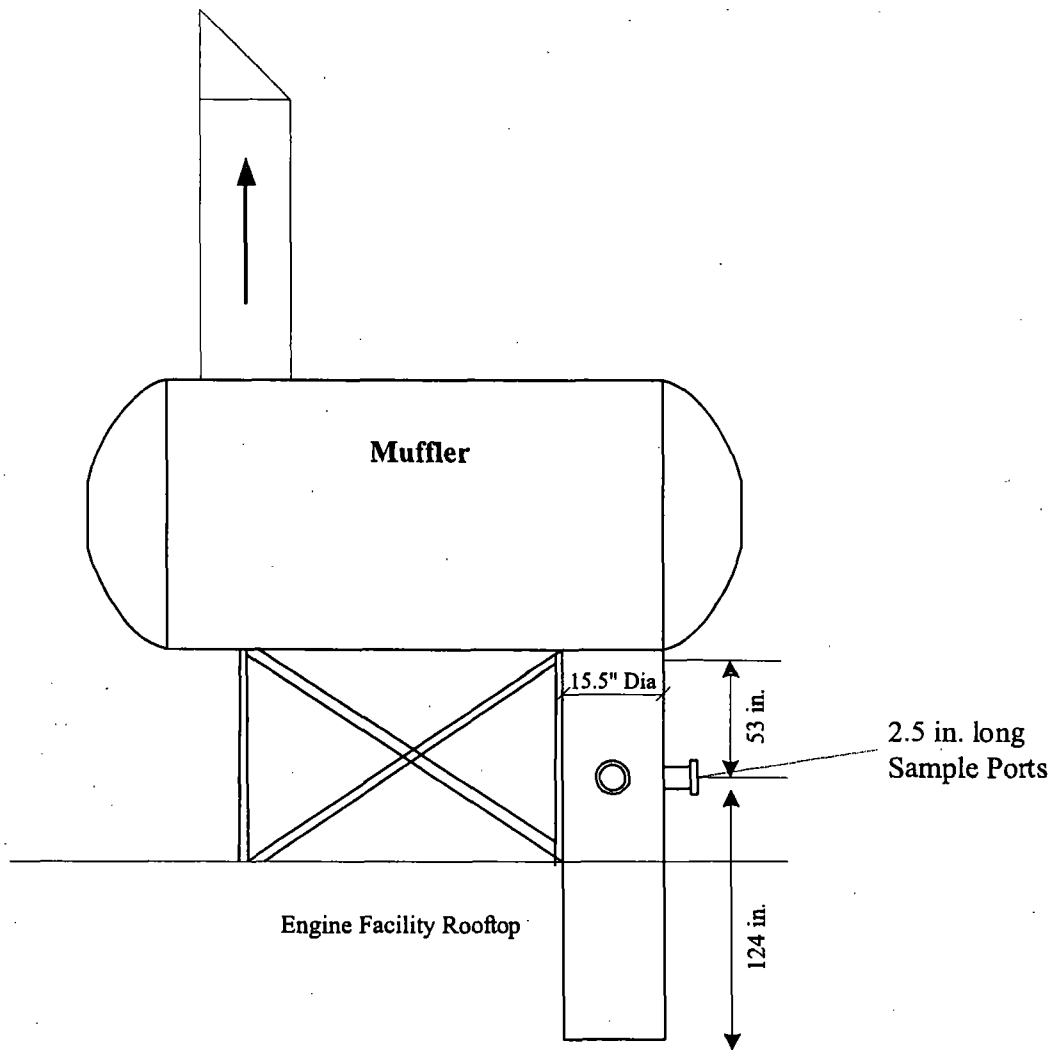
Figure 2

2/7/2012	<b>Seminole Energy LLC General Engine Operation Flow Diagram</b>		
	Scale None	Sheet 1 of 1	Derenzo and Associates Project No. 1201046



**Engine Exhausts**

**Exhaust Stack  
Cross-Section**



Velocity sample locations as measured from sample port opening

Sample Port	
Pt. #	in.
1	3.18
2	4.76
3	7.09
4	13.41
5	15.74
6	17.32

**Figure 3**

<b>Seminole Energy LLC Exhaust Sample Locations</b>		
Scale None	Sheet 1 of 1	Derenzo and Associates Project No. 1201046

**ATTACHMENT B**

Extractive Gas Sampling Procedures  
Evacuated Canister Sampling System and Procedures  
Moisture Train Sampling Procedures  
Tedlar Bag Sampling Procedures

## **INSTRUMENT SAMPLING AND CALIBRATION PROCEDURES**

### **1.0 Extractive Gas Sampling System for Instrumental Analyzers**

The extractive gas sampling system that serves the instrumental analyzers used for Methods 3A, 7E, 10 and Alt 078 is configured as described below.

Sample probe - Stainless steel single opening probe placed at the required sampling location.

Three-way valve - A stainless steel three-way valve is installed between the sample probe and a stainless steel particulate filter to allow the introduction of calibration gases into the sampling system. The three-way valve is turned toward the desired gas flow direction during this sampling. During system bias checks, excess calibration gas exits the sampling probe tip to avoid the introduction of process gas or ambient air during calibration.

Tee and poppet check valve - A stainless steel "Tee" will be installed between the sample probe and a stainless steel particulate filter to allow the introduction of calibration gases through a stainless steel 10 psig poppet check valve into the sampling system. When sampling, the poppet check valve is normally closed, though upon the introduction of pressurized (i.e. > 10 psig) calibration gases from a remote

Teflon® line to the poppet check valve, the check valve opens and allows the calibration gases to be introduced near the base of the sample probe. During this dynamic calibration (or sampling system bias check) procedure, excess calibration gas exits the sampling probe tip to avoid the introduction of process gas during calibration.

Heated sample line - A heated Teflon® line is used to transport the sample gas from the stack to the instrument rack. The heated Teflon® line is equipped with a temperature controller which maintains the temperature of the sample line at approximately 250°F to prevent moisture condensation.

Sample pump and flow control valve - A single head 100% oil-free vacuum pump fitted with a stainless steel flow control valve is used to transfer sampled gases from the heated sample line to the instrumental analyzer. The vacuum pump is leak-free and non-reactive to the gases being sampled. Subsequent sample transport lines and fittings are either stainless steel or Teflon®.

Gas Conditioner - thermal-electric based condenser equipped with a peristaltic pump is used to remove moisture from the sampled gas stream that is directed to the instrumental analyzers, which require a conditioned (or dry) gas samples. From the moisture removal system, a sample gas manifold constructed of Teflon® transport lines and stainless steel Tee fittings is used to continuously deliver the sampled gas to the instrumental analyzers. Since the instrumental analyzers are equipped with internal sampling pumps, the end of the sample gas manifold is equipped with an atmospheric dump (or bypass discharge vent) to avoid over pressurization of the instrumental analyzers.

Data Logger - A data logging system is used to record 1-minute average data from the analog output of the instrumental analyzers.

## **2.0 Instrumental Analyzer Quality Assurance / Calibration Procedures**

Upon site arrival, the instrumental analyzers are set-up in accordance with the manufacturer's written recommended procedures. Upon setting the appropriate range for the instrument, zero and appropriate span gases are introduced sequential order to verify instrument accuracy (three-point analyzer calibration error test).

Prior to the first test run, appropriate upscale and low-range (zero) span gases are introduced in series at the three-way valve in the sampling system. This dynamic calibration procedure is the sampling system bias check, and the analyzer's response time is recorded.

The start of the test run occurs when the calibration gases are cleared from the sampling system and the data acquisition system records a consistent instrumental analyzer response on the stack gas sample (at least twice the system response time is allowed to verify representative readings).

At the conclusion of the sampling period, an appropriate upscale and low-range (zero) gases are re-introduced in series at the three-way valve in the sampling system to check against the method's performance specifications for calibration drift and zero drift error. If the drift error is within 3% of the span over the period of the test run, the test run will be considered acceptable.

### Calibration gas dilution equipment

A STEC Model SGD-SC-5L five-step gas divider may potentially be used to obtain appropriate calibration span gases in the field, as necessary. The five-step gas divider is National Institute of Standards and Technology (NIST)-certified for primary flow standards in accordance with USEPA Method 205. When cut with an appropriate zero gas, the five-step gas divider delivers calibration gas values at 0, 20, 40, 60, 80, and 100% of the introduced USEPA Protocol 1 calibration gas. The field evaluation procedures described in Section 3.2 of USEPA Method 205 will be performed prior to the compliance testing program, in order to validate the use of the five-step gas divider.

## **3.0 Evacuated Canister Sampling System and Procedures for LFG Chlorine Content**

An evacuated SUMMA passivated sampling canister will be utilized to sample the landfill gas for chlorine analysis. The canister will be conditioned in accordance with US EPA Method TO-15 guidelines, which includes evacuation of the canister to within 10mm of absolute pressure and allowing the canister to sit for 30 minutes. The tank will be acceptable if no change more than  $\pm 2$  mm is noted. The leak check value will be included in the results report. The canister is then pre-charged with Helium for shipment purposes so that the samples will not be considered hazardous.

Sampling shall be conducted at a flow rate equivalent to filling the remainder of the canister so that it is approximately 80% full at the completion of the testing. Sampling shall be conducted at a flow rate of 50 – 70 cc/min. All sample train components shall consist of Teflon and stainless steel.

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The samples will be clearly and uniquely marked prior to shipment. Chain-of-custody forms shall be prepared prior to departing the test site. Sample analysis shall be conducted using Air Toxics, LTD.

### **4.0 Exhaust Gas Moisture Determination - USEPA Method 4 Chilled Impinger**

The moisture content of the IC Engine exhaust gas will be determined in accordance with the USEPA Method 4 chilled impinger method. A gas sample will be extracted at a constant rate from the source and bubbled through a condenser where moisture will be removed from the sample stream, and determined gravimetrically.

The moisture sampling train consisted of a non-heated probe connected to the first chilled impinger by a sufficient length of tubing. The impinger train will consist of four (4) impingers, connected in series and immersed in an ice bath. Crushed ice will be placed around the impingers to keep the temperatures of the gases leaving the last impinger at 68 °F or less. Each impinger will be weighed gravimetrically before and after each test to determine the net moisture gain. The impinger train will be constructed and charged as follows:

1. modified Greensburg-Smith (G-S) impinger containing 100 ml of distilled water;
2. standard G-S impinger containing 100 ml of distilled water;
3. modified G-S impinger, dry, to serve as a knockout; and;
4. modified G-S impinger containing approximately 200 - 300 grams of pre-dried silica gel and glass fiber.

An umbilical line will be used to connect the sample probe and impinger train to the Nutech® Metering System. The umbilical line includes type K thermocouples, used to measure the impinger outlet.

A Nutech® Metering System will be used to maintain a constant sampling rate. The system consists of a vacuum gauge, leak-free carbon vane pump, calibrated dry gas meter and thermocouples. The thermocouples will be connected to a digital thermometer that displays temperature readings from the thermocouples on the umbilical line and dry gas meter.

Prior to each test run, the moisture sampling train will be assembled and leak-checked at the sampling site by plugging the inlet to the probe and pulling a vacuum of approximately 15 in. Hg. At the conclusion of the test run, a post test leak check will be performed by drawing a vacuum equal to or greater than the highest vacuum measured during the test run.

During sampling, a single representative sample location will be used in lieu of collecting the sample across the velocity traverse profile. At 5-minute intervals, sampling train data will be recorded. An aneroid-type barometer will be used to measure the barometric pressure of the ambient air. All sampling data will be recorded on field data sheets. Percent moisture will be calculated using the measured mass gain of the impingers along with the metering console and calibration data.

### **5.0 Tedlar Bag Sampling Procedures for SO<sub>2</sub> Emission Factor**

Samples of the fuel gas will be obtained into a tedlar bag by purging the Teflon sample line and introducing the gas directly into the bag. The fuel feed will be under pressure limiting

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any potential for dilution. Upon conclusion of the bag sampling the valve will be securely closed and the bag will be placed in a rigid metal container for shipment.

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**ATTACHMENT C**

**USEPA Method 3A/10/7E/Alt 078 Extractive Gas Sampling System Diagram**

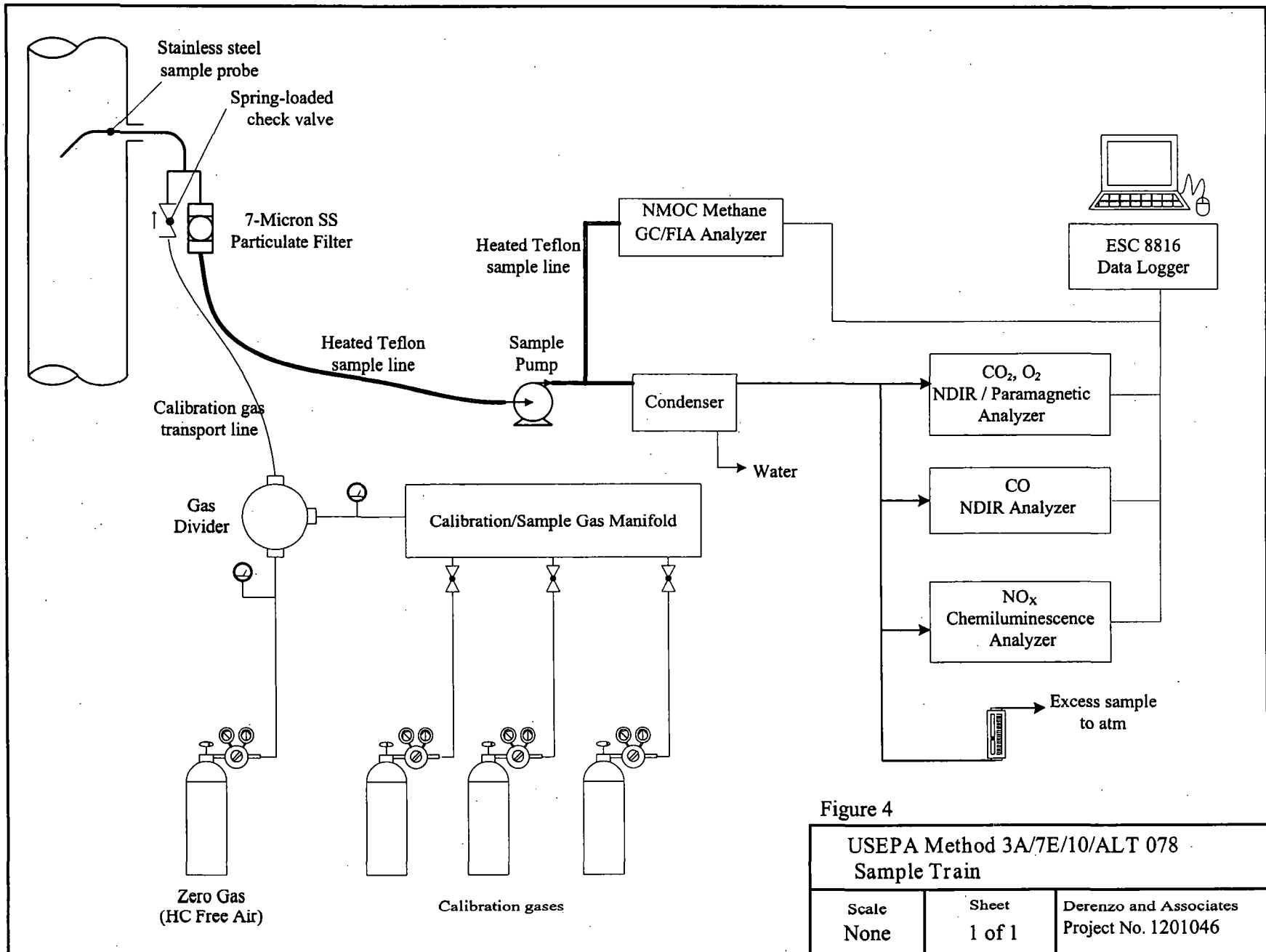


Figure 4

USEPA Method 3A/7E/10/ALT 078 Sample Train		
Scale None	Sheet 1 of 1	Derenzo and Associates Project No. 1201046

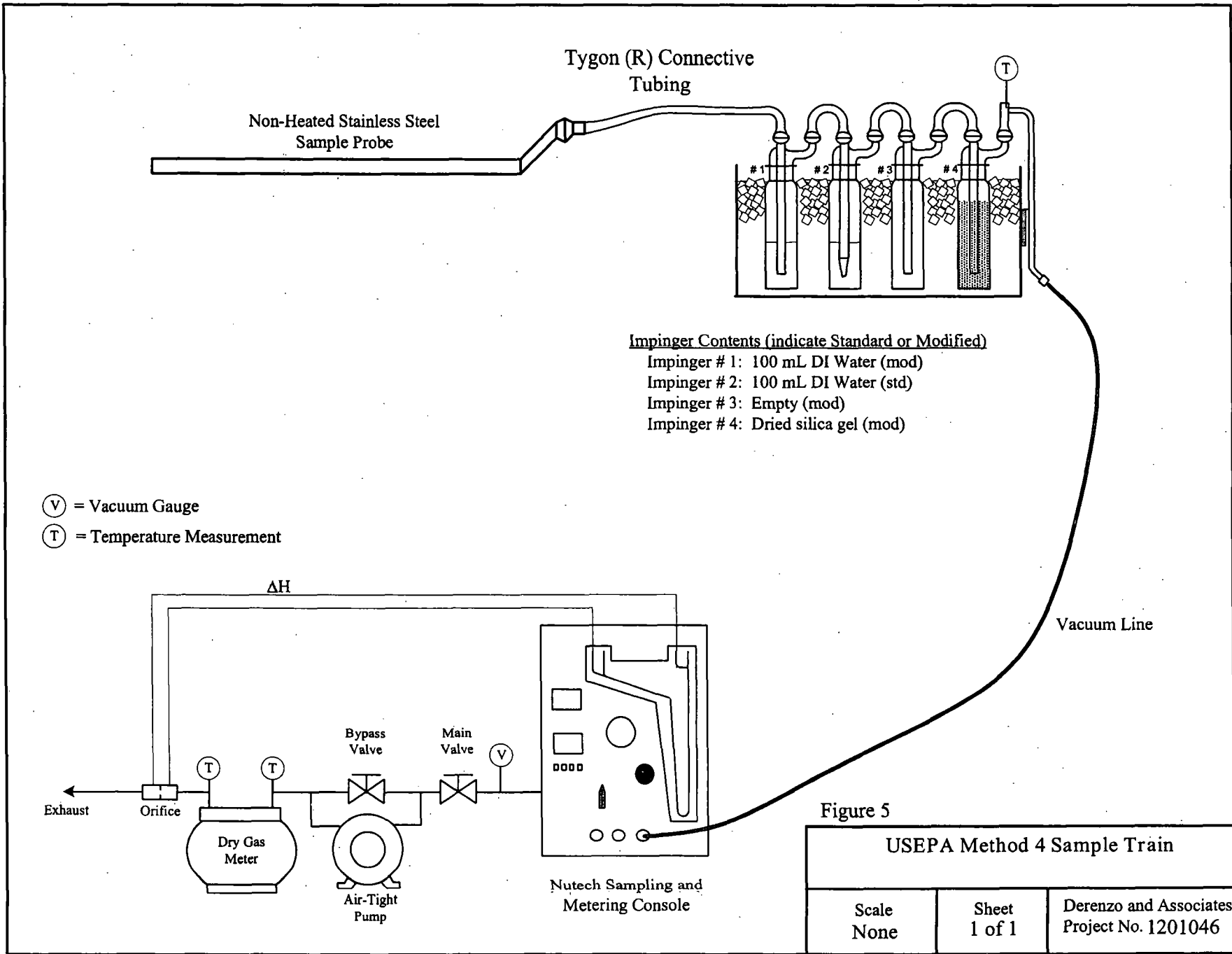


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**ATTACHMENT D**

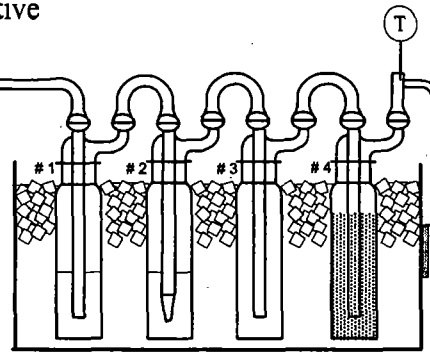
**Moisture Sampling System Diagrams  
USEPA Alt 078 Approval Letter**

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Tygon (R) Connective Tubing

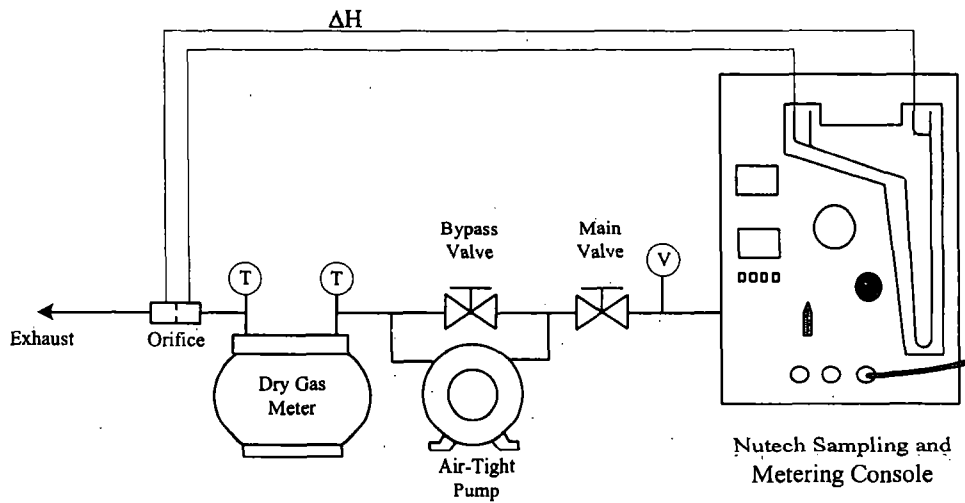
Non-Heated Stainless Steel Sample Probe



Impinger Contents (indicate Standard or Modified)

- Impinger # 1: 100 mL DI Water (mod)
- Impinger # 2: 100 mL DI Water (std)
- Impinger # 3: Empty (mod)
- Impinger # 4: Dried silica gel (mod)

(V) = Vacuum Gauge  
 (T) = Temperature Measurement



Vacuum Line

Figure 5

USEPA Method 4 Sample Train		
Scale None	Sheet 1 of 1	Derenzo and Associates Project No. 1201046



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
RESEARCH TRIANGLE PARK, NC 27711

JUL 21 2010

OFFICE OF  
AIR QUALITY PLANNING  
AND STANDARDS

Howard Schiff  
TRC Companies Inc.  
650 Suffolk Street  
Wannalancit Mills  
Lowell, MA 01854

Dear Mr. Schiff:

In an alternative methods approval letter dated February 25, 2010, we granted Derenzo & Associates permission to use the TECO Model 55C analyzer in place of Method 18 to measure methane from internal combustion engines subject to 40 CFR Part 60, Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines. You brought to our attention that the proposed analyzer more appropriately measures non-methane organics and should be allowed as an alternative to the “cutter” analyzers already allowed by the regulation.

We see your point and appreciate your bringing it to our attention. This letter grants approval to use the TECO Model 55C analyzer to measure non-methane organic compounds from Subpart JJJJ engines. The analyzer may also be used by others at other Subpart JJJJ engines. We will announce this as broadly applicable to all stationary spark ignition combustion engines on EPA’s web site (at <http://www.epa.gov/ttn/emc/tmethods.html#CatB>).

If you need further assistance, please contact Foston Curtis at (919) 541-1063 or Gary McAlister at (919) 541-1062.

Sincerely,

A handwritten signature in cursive script that reads "Conniesue B. Oldham".

Conniesue B. Oldham, Ph.D., Group Leader  
Measurement Technology Group

cc: Michael Brack, Derenzo & Associates  
Foston Curtis, E143-02  
Gary McAlister E143-02