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**Test Protocol**

**Wood Waste Facility Diesel Engine**

**CO Compliance Test Program**

*Prepared for . . .*

**Solid Waste Authority of Palm Beach County**

**7501North Jog Road, West Palm Beach, FL**

*Prepared by . . .*

**South Florida** Environmental Services**,** LLC

Anticipated Test Date: No later than May 3, 2013

Project No. 12-531

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# INTRODUCTION

## Overview

South Florida Environmental Services, LLC of West Palm Beach, Florida has been retained by Solid Waste Authority to conduct initial compliance test for Carbon Monoxide (CO) emissions from the Woody Waste Facility Diesel Engine (SWA of PBC ID# W that is to be installed at the landfill. The measurements which will be conducted at the inlet and outlet locations of the emissions control device for the Woody Waste Engine will also include O2. The test program will consist of three one-hour sampling for CO & O2 at both locations. The measurement for CO & O2 will be as per EPA Methods 10 & 3A respectively instead of ASTM D6522-00 (2005).

This test program will be conducted at the Woody Waste Facility located in the landfill complex on Jog Road here in West Palm Beach, FL. This initial compliance test needs to be conducted on later than May 3, 2013. When construction nears completion, a firm test date will be selected. A summary of the primary parties involved in this test program is presented in Table 1-1.

## Program Objectives

The objective of the program is to demonstrate the compliance status of Woody Waste Facility Diesel Engine while operating on Diesel fuel with respect to the RICE requirement for CO emissions set forth in the facility Operating Permit No. 0990234-022-AV.

The specific program objectives are:

1. Conduct three 1-hour CO & O2 measurement at the inlet of the HIBACK II Continuous Parameter Monitoring System.
2. Conduct three 1-hour CO & O2 measurement at the outlet of the HIBACK II Continuous Parameter Monitoring System

## Compliance Summary

A compliance test series consisting of three 60-minute runs at both the inlet and outlet locations of the emission control system while the engine is operating on diesel fuel, will be conducted. Each test run will be comprised of instrumental monitoring for O2 and CO and in accordance with EPA Methods 3A (O2 and CO2), 10 (CO) 40CFR 60, Appendix A. The monitoring data will then be used in conjunction with CEMS calibrations to calculate the CO emissions on a parts per million (ppm) corrected to a 15% O2 basis.

All emissions testing will be conducted in accordance the facility permit No. 0990234-022-AV and the EPA test methods specified in 40 CFR Part 60 – Appendix A.

Table 1-2 provides a summary of test parameters for the CO sampling.

## Protocol Organization

The remainder of this Test Protocol is organized into four additional Sections. Section 2 provides a description of the facility and the CEMS. Section 3 presents a description of the sampling locations for the tests to be conducted. A description of all test methods and analytical procedures is provided in Section 4, while Section 5 addresses the quality assurance/quality control aspects of the program. Section 6 discussed the safety aspects of the program. Example field data sheets, example emission calculation spreadsheets and sample equipment calibrations are included in the appendices.

Table 1‑1 Test Program Informational Summary

|  |  |
| --- | --- |
| **Source Information** | |
| Facility Name:  Address:  Contact:  Phone: | Woody Waste Facility  7501 North Jog Road  West Palm Beach  Mr. Michael Tyson  (561) 640-4000 ext.4616 |
| **Test Firm Information** | |
| Test Organization:  Address:  Contact:  Phone: | South Florida Environmental Services, LLC  2257 Vista Parkway, Unit 25  West Palm Beach, FL 33411  Mr. Francis K Morlu  561) 687-5300 x12 |
| **State Regulatory Information** | |
| Organization:  Address:  Contact:  Phone: | Florida Department of Environmental Protection Southeast District  400 N Congress Avenue  West Palm Beach, Florida  Mr. Scott Trainor  (561) 681-6629 |

Table 1‑2 CO Compliance Summary – Woody Waste Diesel Engine

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Parameter** | **EPA Method** | **No. of Runs** | **Run Duration** | **FDEP Limit** |
| Inlet | O2 | 3A | 3 | 60-minutes | NA |
| Inlet | CO | 10 | 3 | 60-minutes | NA |
| Outlet | O2 | 3A | 3 | 60-minutes | NA |
| Outlet | CO | 10 | 3 | 60-minutes | 23ppm @ 15% O2 |

# PROCESS description

## General

The Woody Waste Facility is located in the landfill complex on North Jog Road. The facility is owned by Solid Waste Authority of Palm Beach County. The woody waste unit which runs on diesel fuel is use for the grinding of waste wood.

## Air Quality Control Equipment

The HIBACK II catalyst system has been installed to reduce CO emissions. This system is designed to reduce the CO emissions by 70 percent or limit the CO emissions to 23 parts per million by volume, dry (ppmvd) corrected to 15 percent O2.

## Process Operation During The Test

The Woody Waste Engine will be operating at normal capacity during the test. All process data that are recorded during the test will be included in the final report.

# sampling locations

## Inlet & Outlet Sampling Locations

The Inlet sampling location is the HIBACK II catalyst inlet which is immediately located at the exhaust of the Woody Waste Diesel Engine.. The Outlet sampling location is the outlet of the HIBACK II catalyst. The test locations are about 8 feet above ground.

Test procedures

## Overview

The following is a description of the test methodologies, equipment and procedures that will be used for this program. Each parameter will be measured and analyzed in strict accordance with EPA and FDEP-approved procedures as presented in the test protocol. All samples will be collected at the sampling locations detailed in Sections 1 through 3.

## CEM Sampling Methodologies

### Carbon Monoxide – EPA Method 10

Carbon monoxide will be monitored in accordance with EPA Method 10, 40 CFR 60, Appendix A. South Florida will comply with Method 10 utilizing a TECO Model 48H (or equivalent) Non-Dispersive Infra Red (NDIR) analyzer calibrated using EPA Protocol gas standards prior to and following each test run to ensure the accuracy of the test data.

### Oxygen – EPA Method 3A

Oxygen will be measured in accordance with EPA Method 3A. This Method will utilize continuous emissions monitoring instrumentation. South Florida Environmental will use a Teledyne Model 326A oxygen analyzer with a range of 0-25%. The instruments meet all of the performance specifications of the Method. It will be calibrated before and after each test period using calibration gases prepared according to EPA Protocol #1.

## Description Of CEM Sampling (O2 &CO)

### CEM Sampling System

What follows is a description of the transportable continuous emissions monitor system used to quantify Oxygen and carbon monoxide. The system meets all the specifications of Reference Methods 3A (O2) and 10 (CO)

**Sample Probe** - A stainless steel probe of sufficient length will be used to sample the locations specified in Section 3.0 for both the Inlet and Outlet locations.

**Sample Line** – Approximately 60 to150’ of 3/8” Teflon tubing (1/16” wall) will be used to transport the sample gas from the probe to the sample conditioning system.

**Sample Conditioning System:**

**Filter** - A spun glass fiber filter will be located near the probe to remove particulate from the gas stream.

**Condenser** (1) - an ice cooled condenser will be located near the probe for bulk moisture removal and Universal Analyzer Sample Chiller condenser system will be located downstream from the pump to remove any remaining moisture from the gas stream.

**Sample Pump** - A diaphragm type vacuum pump will be used to draw gas from the probe through the conditioning system and to the analyzers. The pump head is stainless steel, the valve disks are Viton and the diaphragm is Teflon coated.

**Calibration Valve** - A tee-fitting, located at the base of the probe, will allow the operator to select either the sample stream or inject calibration gas to the CEM system.

**Sample Distribution System** - A series of flow meters, valves and backpressure regulators will allow the operator to maintain constant flow and pressure conditions during sampling and calibration.

**Gas Analyzers** - capable of the continuous determination of NOx, CO, SO2, and CO2 concentrations in a sample gas stream. They each meet or exceed the following specifications:

Calibration Error - Less than +2% of span for the zero, mid- and hi-

range calibration gases.

System Bias - Less than +5% of span for the zero, mid- or

hi-range calibration gases.

Zero Drift - Less than +3% of span over the period of

each test run.

Calibration Drift - Less than +3% of span over the period of each

test run.

**Data Acquisition System** – used to collect CEM data will consist of a computer coupled with data acquisition software. The computer consists of a Dell lap top and the data acquisition software consists of an Iotech data acquisition system (Iotech Personnel-Daq).

The system is programmed to collect data once per second, while reporting 1-minute averages. This software operates in a Windows environment. The one-minute averages will then be put into data blocks defined by the respective start and stop times for each test run. Separate files for each run, and associated calibrations, will be generated. Data will be loaded into a spreadsheet for calculation of interval averages and emission rates. Preliminary reports will be made available on-site.

### O2 and CO Sampling and Calibration Procedures

The O2 and COCEMS analyzers will be calibrated through both a direct and system calibration procedure in order to ensure the validity of all data collected. First, each instrument will be calibrated directly (not through the system) with zero and two upscale points as follows:

1. Deliver zero gas to respective analyzers until stable response is obtained, then adjust each analyzers zero potentiometer or equivalent to read as close to zero as possible.
2. Deliver span (highest value) gas to respective analyzers until stable response is obtained, then adjust each instruments span potentiometer or equivalent to read as close to the cylinder value as possible.
3. Deliver mid-level gas(es) to respective analyzers until stable response is obtained, then calculate if the observed value meets 2% linearity criteria specified by the method. If the calibration meets the linearity criteria, proceed to system calibration procedures. Otherwise, take corrective action and repeat direct calibration procedures for analyzers not meeting the linearity criteria.

Following a successful direct calibration the instruments will be subjected to a system calibration, as follows:

1. Deliver zero gas through the entire sampling system, record the respective analyzer responses and calculate the respective analyzers calibration biases.
2. Deliver a representative upscale calibration gas through the entire system, record the respective analyzer responses and calculate the respective analyzers calibration biases.

If initial bias criteria are satisfactorily met, a sampling run may be initiated following a sufficient purge of the sampling line with stack gas. Following the sampling run a subsequent system calibration is conducted as follows:

1. Deliver zero gas through the entire sampling system, record the respective analyzer response and calculate the respective analyzers calibration drift and biases.
2. Deliver a representative upscale (same gas cylinder as step 5) calibration gas through the entire system, record the respective analyzer responses and calculate the respective analyzers calibration drift and biases.

If all linearity, calibration drift and calibration bias criteria are met then the collected data is considered valid and subsequent runs may be conducted. Each run is required to be bracketed by system calibrations. If calibration criteria are not met, the data collected are not considered valid, corrective action is taken and all calibration steps are repeated.

# quality assurance / quality control

## Overview

Strict QA/QC protocols will be followed during all phases of this project. These protocols include:

• QA objectives for measurement data;

• Data reduction;

• Internal QC;

• Calibration of equipment;

• Corrective action, if necessary; and

• Use of standardized field data sheets.

The following sections summarize specific aspects of the CEMS certification program.

## CEMS QA

Specific procedures will be followed to ensure the validity of the CEMS data collected for this task. The following subsections outline the specific procedures and performance criteria that will be utilized to maintain quality assurance throughout the program.

### Calibration Gases

All calibration gases utilized for the CO sampling and calibration error tests will be prepared according to EPA Protocol quality standards. The gas specification sheets supplied by the vendor will be provided in the final report.

### Instrumental Monitoring

The reference method CEMS system will be leak-checked prior to and following the certification testing. This ensures that a representative sample from the stack is being delivered to the monitors.

### Sampling Setup

The following procedures will be conducted during the initial phase of the program

* **Sample Point Selection** – The sampling will be conducted at the inlet and outlet of the emission control system.
* **Leak Check** – Prior to the initiation of testing the reference method CEMS system will be leak checked from the end of the sample probe. If a leak is detected, it will be traced and fixed. The procedure will then be repeated until successful.
* **System Response Time** – Prior to the initiation of sampling a Reference Method (RM) CEMS response time will be determined. During the test program, the reference method CEMS will be allowed to sample a minimum of 2.5 times the RM CEMS response time prior to the initiation of any sampling runs.

### Calibration Criteria

The following subsections present the CEMS quality assurance criteria that must be adhered to for each diluent/pollutant monitored throughout the conduct of the test program.

* **Analyzer Calibration Error (ACE)** – At the beginning of each test day an analyzer calibration error (direct calibration) will be conducted for each analyzer by introducing zero and an upscale calibration gas upstream from the respective analyzers and calibrating the respective analyzers to the corresponding calibration gas value. A mid-range gas is then injected to the respective analyzers in order to demonstrate linearity. The maximum allowable calibration error is 2% of instrument span. If this limit were not achieved, corrective action would be taken and the procedure would be repeated until successful. Analyzer calibration error is calculated as follows:



Where:

CDir = Measured concentration of a calibration gas (low, mid, or high) when introduced in direct calibration mode, ppmv.

Cv = Manufacturer certified concentration of a calibration gas (low, mid, or high), ppmv.

CS= Calibration span, ppmv.

* **Sampling System Bias (SB)** – Following the performance of the analyzer calibration error a system bias check will be conducted by introducing sampling gas through the entire sampling system (system calibration) and comparing the response of the analyzer calibration error with that of the system calibration. The maximum allowable calibration error is 5% of instrument span. If this limit were not achieved, the test run would be voided and corrective action would be taken. If analyzer adjustments were made, the analyzer calibration error and system bias checks would be repeated until the calibration met the EPA Method 7E criteria. System bias is calculated as follows:



Where:

Cs = Measured concentration of a calibration gas (low, mid, or high) when introduced in system calibration mode, ppmv.

* **Calibration Drift (D)** – Prior to and following each test run a system calibration will be conducted in order to determine calibration drift during each test period. The maximum allowable calibration drift is 3% of instrument span. If the calibration drift were exceeded, corrective action would be taken. If any analyzer adjustments were made, a new analyzer calibration error and system bias check would be conducted. Calibration drift is calculated as follows:



### Calibration Drift and System Bias Correction

Each instrumental analyzer method requires the correction of CEMS data for the system bias and calibration drift observed over each test period. All run averages will be corrected for system bias and calibration drift as follows:



Where:

CGas = Average effluent gas concentration adjusted for bias, ppmv.

CAvg = Average unadjusted gas concentration indicated by data recorder for test run.

Co = Average of initial and final system calibration bias (or 2-point system calibration error) check responses from the low-level (or zero) calibration gas, ppmv.

CM = Average of initial and final system calibration bias (or 2-point system calibration error) check responses for the upscale calibration gas, ppmv.

CMA = Actual concentration of the upscale calibration gas, ppmv.

## Final Report

All test results will be presented in an easy to read table format. Any deviations from approved monitoring methods will be discussed in full. The report will be sectioned as follows:

* Introduction
* Summary of Results
* Monitoring Procedures
* QA/QC
* Appendices (all supporting reference method and process data)