Consumers Energy
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PM CEMS
Relative Response Audit
Test Report

EU-KARN1

Consumers Energy Company
D.E. Karn Generating Complex
2742 North Weadock Highway
Essexville, Michigan 48732
SRN: B2840
ORIS: 1702
FRS: 110000593171

December 5, 2022

Test Date: October 13, 2022

Test performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Department
Work Order No. 6514267

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EXECUTIVE SUMMARY

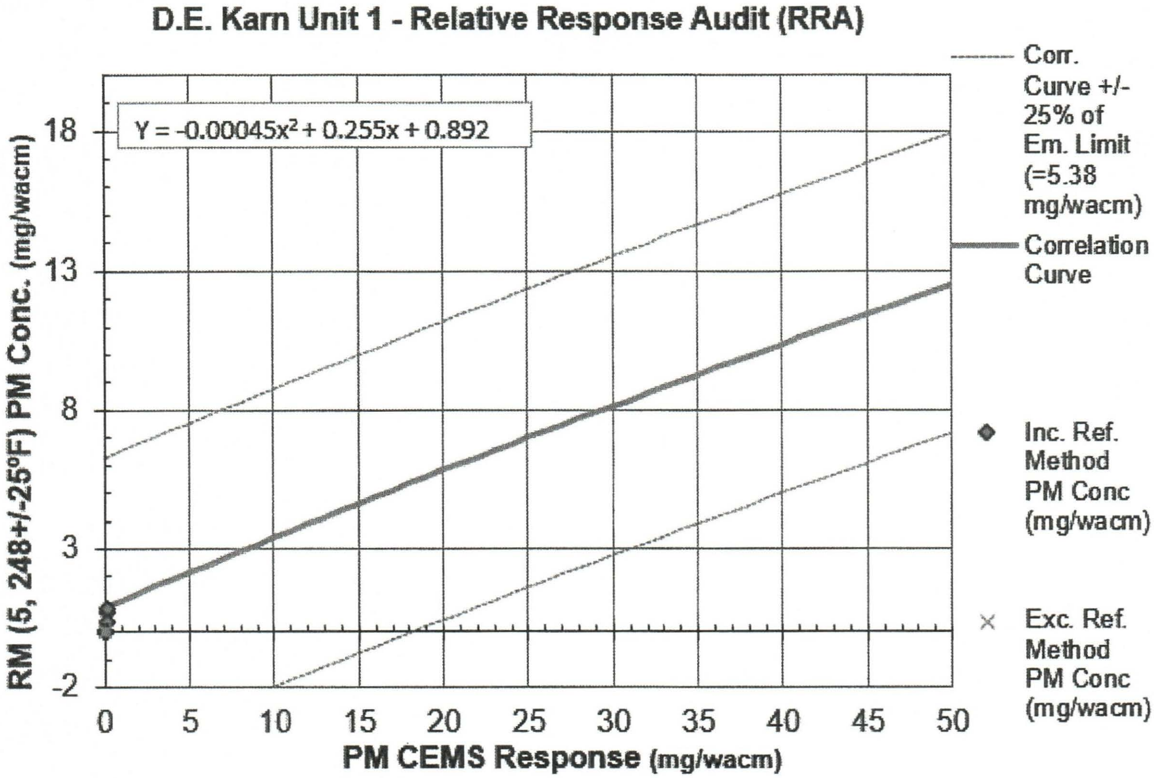
Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted filterable particulate matter (PM) testing at the exhaust of coal-fired boiler EU-KARN1 (Unit 1). Unit 1 is an electric utility steam generating unit (EGU) which generates steam that turns a turbine and the rotating turbine generates electricity at the D.E. Karn facility in Essexville, Michigan. The test program was performed October 13, 2022 to evaluate the continued validity of the particulate matter (PM) continuous emissions monitoring system (CEMS) correlation curve by conducting a relative response audit (RRA) as required by 40 CFR 63, Subpart UUUUU, *National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units* (aka Mercury and Air Toxics Rule [MATS]), Section 63.10010(i)(2) and incorporated in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B2840-2022. The PM CEMS is used to demonstrate continuous compliance with the filterable particulate matter (FPM) emission limits listed under special conditions I. 5 of FG-KARN12-1 and special condition I. 1 of FG-MATS-1 in (ROP) MI-ROP-B2840-2022. Emission unit EU-KARN1 is part of FG-KARN12-1 and FG-MATS-1 in the recently issued Karn (ROP) MI-ROP-B2840-2022 that replaced Karn (ROP) MI-ROP-B2840-2014c.

Three 120-minute PM test runs were conducted on each unit following the procedures in United States Environmental Protection Agency (USEPA) Reference Methods (RM) 1, 2, ALT-123, 4, 5, and 19 in 40 CFR 60, Appendix A; Appendix F, Procedure 2; and 40 CFR 63, Subpart UUUUU. During testing, Unit 1 was operating at a load representative of site specific normal operations. There were no deviations from the stack test protocol submitted July 28, 2022, or the USEPA Reference Methods therein. The Unit 1 PM results and RRA summary are presented in the following tables and graphs.

Summary of PM CEMS RRA Results

Run	Unit Load	Reference Method Results	Raw PM CEMS Response
	MWg	mg/wacm	
EU-KARN1-1	**Correlation Equation: $Y = -0.00045x^2 + 0.255x + 0.892$**		
1	255	0.706	0.080
2	255	0.371	0.090
3	255	0.844	0.080

PM CEMS Relative Correlation Audit Results and Correlation Curves



Summary of PM CEMS RRA – Unit 1

Regulation	Section	Comment
40 CFR 60, Appendix F – Procedure 2	10.4(6)(i)	**CRITERIA:** PM CEMS responses are no greater than the highest PM CEMS response during the correlation (67.6 mg/wacm) **RESULT = PASSING:** All PM CEMS responses ≤0.090 mg/wacm
	10.4(6)(ii)	**CRITERIA:** At least 2 of the 3 data points fall within the area on a graph of the correlation curve bounded by two parallel lines at ±25% of the emissions limit. (When assessing PM CEMS performance in relation to the "emissions limit", the MATS limit of 0.030 lb/mmBtu is used) **RESULT = PASSING:** All 3 of the collected data points fall within ±25% of the emission limit relative to the applicable correlation curve.

The results of the testing indicate that the PM CEMS met the criteria specified in Section 10.4(6) in Procedure 2 of 40 CFR 60, Appendix F. The results indicate continued validity of the PM CEMS correlation used for continuously determining compliance with emission standards or operating permit limits.

Detailed results are presented in Appendix Table 1. Sample calculations, field data sheets, and laboratory data are presented in Appendices A, B, and C. Operating/CEMS data and supporting documentation are provided in Appendices D and E.

1.0 INTRODUCTION

This report summarizes the results of particulate matter (PM) continuous emission monitoring system (CEMS) relative response audit (RRA) testing conducted October 13, 2022 on EU-KARN1-1 (Unit 1) operating at the Consumers Energy D.E. Karn facility in Essexville, Michigan.

This document was prepared using the Michigan Department of Environment, Great Lakes, and Energy (EGLE) *Format for Submittal of Source Emission Test Plans and Reports* published in November of 2019. Please exercise due care if portions of this report are reproduced, as critical substantiating documentation and/or other information may be omitted or taken out of context.

1.1 Identification, Location, and Dates of Tests

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted filterable PM tests at the dedicated exhaust of coal-fired boiler EU-KARN1-1 operating at the D.E. Karn facility in Essexville, Michigan October 13, 2022. A test protocol was submitted to EGLE on July 28, 2022 and subsequently approved by Daniel Droste of EGLE in his letter dated August 10, 2022.

1.2 Purpose of Testing

The test program was performed to evaluate the continued validity of the PM CEMS correlation curve by conducting a RRA as required by 40 CFR 63, Subpart UUUUU, *National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units* (aka Mercury and Air Toxics Rule [MATS]), Section 63.10010(i)(2) and incorporated in Renewable Operating Permit (ROP) MI-ROP-B2840-2022. The RRA is also a component of an approved PM CEMS Quality Assurance / Quality Control Protocol that originated in the Consent Decree (CD), Civil Action No.: 14-13580. It should be noted that while the CD was terminated on September 2, 2020, enduring performance, operation, maintenance and control technology requirements are incorporated into the ROP.

The criteria to pass an RRA described in Section 10.4(6) of Procedure 2 are listed in Table 1-1 below.

Table 1-1
Criteria for Passing an RRA

Regulation	Section	Criteria
40 CFR 60, Appendix F – Procedure 2	10.4(6)(i)	For all three data points, the PM CEMS response value can be no greater than the greatest PM response value used to develop the correlation curve (67.6 mg/wacm for Unit 1)
	10.4(6)(ii)	At least 2 of the 3 data points fall within the area on a graph of the correlation curve bounded by two parallel lines at ±25% of the emissions limit. (When assessing PM CEMS performance in relation to the "emissions limit", the MATS limit of 0.030 lb/mmBtu is used)

1.3 Brief Description of Source

EU-KARN1-1 is a coal-fired electric utility steam generating unit (EGU) that turns a turbine connected to an electricity producing generator.

1.4 Contact Information

Table 1-2 presents the names, addresses, and telephone numbers of the contacts for information regarding the test and the test report, and names and affiliation of personnel involved in conducting the testing.

Table 1-2
Contact Information

Program Role	Contact	Address
EPA Regional Contact	Compliance Tracker, Air Enforcement and Compliance Assurance Branch	U.S. EPA Region 5 77 W. Jackson Blvd. (AE-17J) Chicago, Illinois 60604
State Regulatory Administrator	Mr. Jeremy Brown Acting TPU Supervisor 517-599-7825 brownj9@michigan.gov	EGLE – Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
Responsible Official	Mr. Cresencio Hernandez III Site Production Manager 989-891-3407 cresencio.hernandez@cmsenergy.com	Consumers Energy Company D.E. Karn Generating Plant 2742 N Weadock Highway Essexville, Michigan 48732
Corporate Air Quality Contact	Mr. Jason M. Prentice Senior Engineer Lead 517-788-1467 jasaon.prentice@cmsenergy.com	Consumers Energy Company Environmental Services Department 1945 West Parnall Road; P22-334 Jackson, Michigan 49201
Test Facility	Mr. George E. Eurich Sr. Engineering Tech. Analyst Lead 989-891-3317 George.Eurich@cmsenergy.com	Consumers Energy Company D.E. Karn Generating Plant 2742 N Weadock Highway Essexville, Michigan 48732
Test Team Representative	Mr. Dillon A. King, QSTI Sr. Engineering Technical Analyst 989-793-5983 Dillon.King@cmsenergy.com	Consumers Energy Company Saginaw Service Center 2400 Weiss Street Saginaw, Michigan 48602

2.0 SUMMARY OF RESULTS

The results of the RRA testing indicate the Unit 1 PM CEMS installed and operating at the D.E. Karn Facility met all criteria specified in Section 10.4(6) in Procedure 2 of 40 CFR 60 Appendix F.

The results are summarized in Table 2-1. Sample calculations are presented in Appendix A. Comprehensive test results are presented in Appendix B.

2.1 Operating Data

During the tests, Unit 1 fired 100% western coal. The boiler was operated at maximum load available under normal operating conditions for the associated fuel blend. Unit 1 testing was performed while the boiler was operating within the range of 254 MWg to 256 MWg and averaged 255 MWg during testing (approximately 93.8% of the achievable capacity of 272 MWg when firing a blend of eastern and western coals).

Refer to Attachment D for detailed operating data. The data is recorded in Eastern Standard Time (EST), which was 1-hour behind Eastern Daylight Time during testing.

2.2 Applicable Permit Information

The D.E. Karn generating station has State of Michigan Registration Number (SRN) B2840 and operates in accordance with air permit MI-ROP-B2840-2022. The air permit incorporates federal regulations and reports under Federal Registry Service (FRS) identification number 110000593171. EU-KARN1-1 and EU-KARN2-1 are the emission unit source identifications in the permit and both are included in the FG-MATS-1 flexible group. Incorporated within FG-MATS-1 of the ROP are the applicable requirements of 40 CFR 63, Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units.

2.3 Results

The results of the testing indicate the PM CEMS met the criteria specified in Section 10.4(6) in Procedure 2 of 40 CFR 60, Appendix F. The results indicate continued validity of the PM CEMS correlation used for continuously determining compliance with emission standards or operating permit limits. Refer to Table 2-1 for a summary of the PM CEMS RRA results and Figure 2-1 for a plot of the data with correlation curve.

Figure 2-1. PM CEMS Relative Correlation Audit Results and Correlation Curves

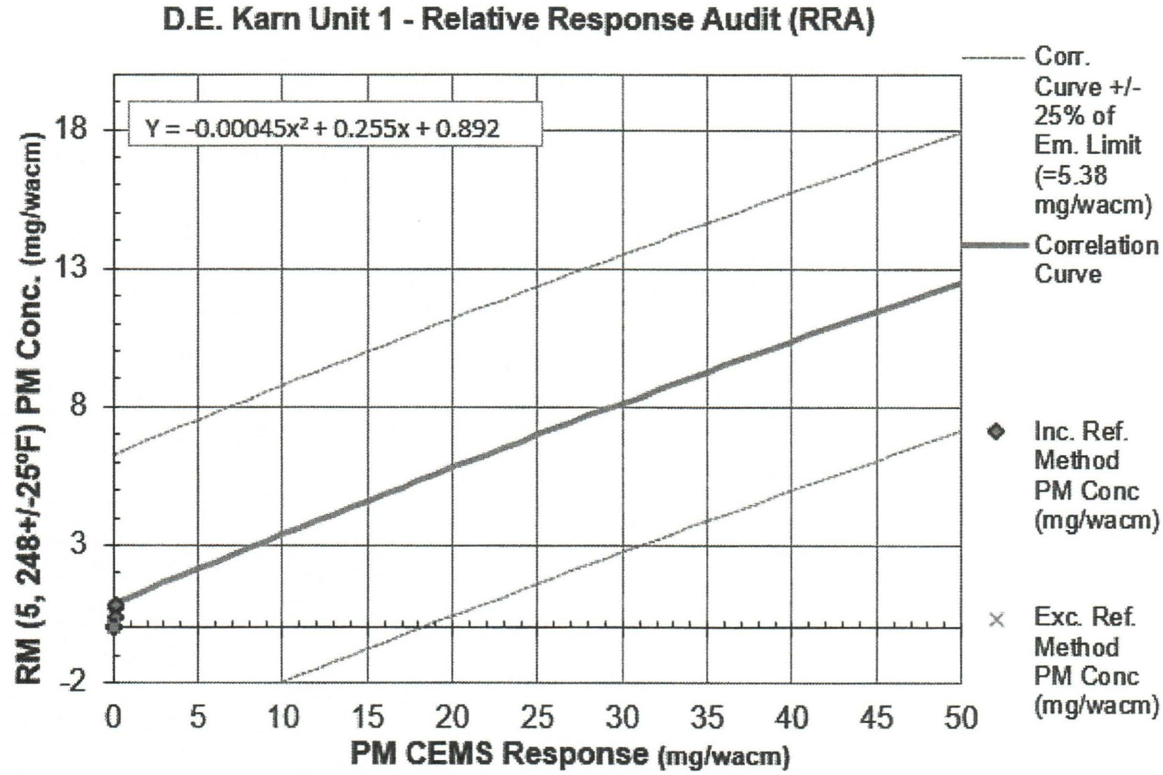


Table 2-1
Summary of PM CEMS RRA – Unit 1

Regulation	Section	Comment
40 CFR 60, Appendix F – Procedure 2	10.4(6)(i)	**CRITERIA:** PM CEMS responses are no greater than the highest PM CEMS response during the correlation (67.6 mg/wacm) **RESULT = PASSING:** All PM CEMS responses ≤0.090 mg/wacm
	10.4(6)(ii)	**CRITERIA:** At least 2 of the 3 data points fall within the area on a graph of the correlation curve bounded by two parallel lines at ±25% of the emissions limit. (When assessing PM CEMS performance in relation to the "emissions limit", the MATS limit of 0.030 lb/mmBtu is used) **RESULT = PASSING:** All 3 of the collected data points fall within ±25% of the emission limit relative to the applicable correlation curve.

Detailed results are presented in Appendix Table 1. A discussion of the results is presented in Section 5.0. Sample calculations, field data sheets, and laboratory results are presented in Appendices A, B, and C. Boiler operating data and supporting information are provided in Appendices D and E.

3.0 SOURCE DESCRIPTION

EU-KARN1-1 is a coal-fired EGU that turns a turbine connected to electricity producing generators.

3.1 Process

EU-KARN1-1 is a dry bottom wall-fired coal boiler also with fuel oil startup capabilities and supplemental co-firing for flame stabilization and mill outages.

Coal is fired in the furnace where the combustion heats boiler tubes containing water, producing steam. The steam is used to turn an engine turbine that is connected to an electricity producing generator. The electricity is routed through the transmission and distribution system to consumers.

3.2 Process Flow

The flue gas generated through coal combustion is controlled by multiple pollution control devices. EU-KARN1-1 utilizes a selective catalytic reduction (SCR) system for the control of nitrogen oxides (NO_x). Unit 1 is also equipped with pulse jet fabric filter (PJFF) baghouses for PM control and spray dry absorbers (SDAs) for the control of sulfur dioxide (SO_2) and other acid gases. Unit 1 is also equipped with activated carbon injection (ACI) for the control of mercury (used on an as needed basis to comply with the applicable MATS mercury emission limit).

3.3 Materials Processed

The normal fuel utilized in Unit 1 is 100% western subbituminous coal, with periodic firing of eastern bituminous coal to support periods of high demand. The boiler is classified as a coal-fired unit not firing low rank virgin coal as described in Table 2 to Subpart UUUUU. For this test, Unit 1 was burning 100% western subbituminous coal.

3.4 Rated Capacity

Unit 1 has a nominally rated heat input capacity of 2,500 million BTU per hour and can generate a gross electrical output of approximately 272 MWg.

Unit 1 operates in a continuous manner in order to meet the electrical demands of Midcontinent Independent System Operator, Inc. (MISO) and Consumers Energy customers. EUKARN1-1 is considered a baseload unit because it is designed to operate 24 hours a day, 365 days a year.

3.5 Process Instrumentation

The process was continuously monitored by boiler operators, environmental technicians, and data acquisition systems during testing. One-minute data for the following parameters were collected during each PM test run:

- CO_2 (Vol-% Wet)
- Flow (SCFH)
- Load (MWg)
- NO_x (lb/MMBtu)
- Opacity (%)
- PM CEMS raw response (mg/wacm)
- Stack Pressure (in. Hg)
- SO_2 (ppmvw, lb/MMBtu)
- Stack Temperature (°F)

Refer to Appendix D for operating data.

Unit 1 measures particulate concentrations using a SICK Dusthunter SP100 PM CEMS system with data recorded by an ESC Spectrum (ESC) data acquisition and handling system (DAHS). Table 3-1 provides a summary of the PM CEMS audited during this test program.

Table 3-1
PM CEMS Specifications

Unit	Manufacturer and Model Number	Serial Number
EU-KARN1-1	SICK Dusthunter SP100	14468336

4.0 SAMPLING AND ANALYTICAL PROCEDURES

RCTS tested for PM using the USEPA test methods presented in Table 4-1. The sampling and analytical procedures associated with each parameter are described in the following sections.

Table 4-1
Test Methods

Parameter	Method	USEPA Title
Sample/traverse point locations	1	Sample and Velocity Traverses for Stationary Sources
Flow rate	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

Table 4-1
Test Methods

Parameter	Method	USEPA Title
Molecular weight (O_2 and CO_2)	3A/3B ALT-123	Alternative Test Method for Diluent Measurement to Support Particulate Testing under 40 CFR 63, Subpart UUUUU
Moisture content	4	Determination of Moisture Content in Stack Gases
Filterable particulate matter	5	Determination of Particulate Matter Emissions from Stationary Sources
Emission rates	19	Sulfur Dioxide Removal and Particulate, Sulfur Dioxide and Nitrogen Oxides from Electric Utility Steam Generators

4.1 Description of Sampling Train and Field Procedures

The test matrix presented in Table 4-2 summarizes the sampling and analytical methods performed for the specified parameters during this test program.

Table 4-2
Test Matrix

Date (2022)	Run	Sample Type	Start Time (EST)	Stop Time (EST)	Test Duration (min)	EPA Test Method
EU-KARN1-1						
Oct. 13	1	O_2/CO_2 Moisture PM	7:15	9:30	120	1 ALT-123 4 5 19
	2		9:47	11:58	120	
	3		12:30	14:45	120	

4.1.1 Sample Location and Traverse Points (USEPA Method 1)

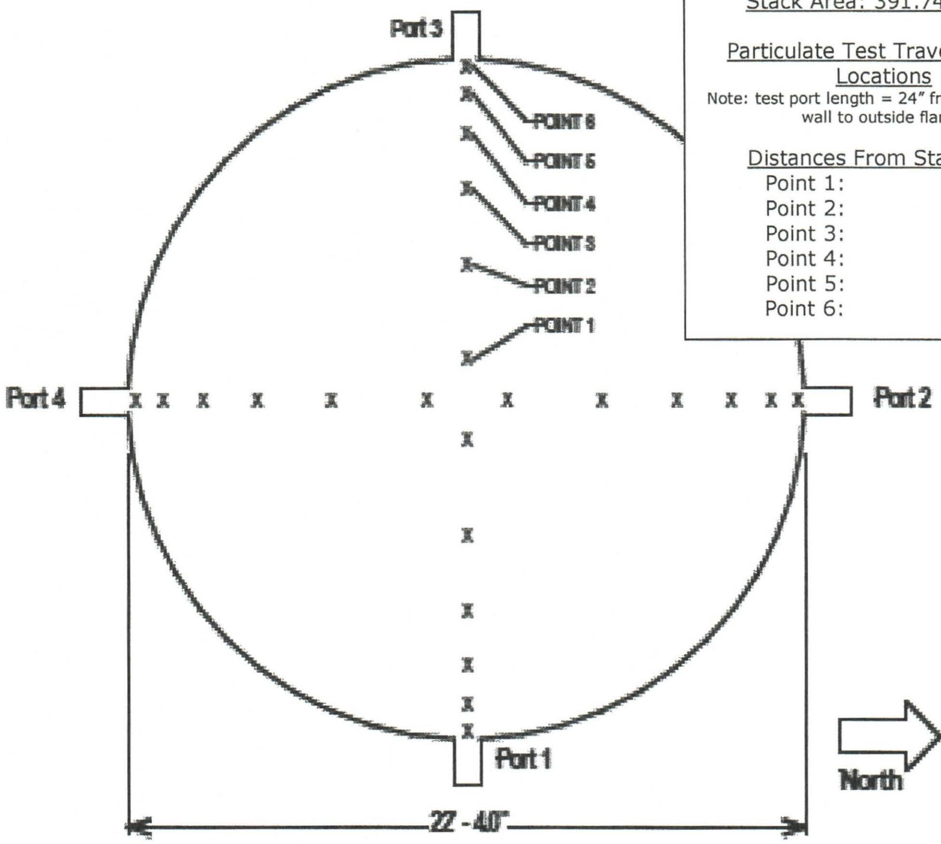
The number and location of traverse points for determining particulate concentrations and exhaust gas velocity/volumetric air-flow was determined in accordance with USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources.* Four test ports are located in the horizontal plane of the vertical stack. The cross-sectional area at the sampling location was calaculated, and the cross-section was then divided into a number of equal areas based on the location of existing air flow disturbances. Unit 1 has a stack diameter of 22.4 feet, and the ports are situated:

- Approximately 70 feet downstream of the breechings entering the exhaust stack, and
- Approximately 200 feet upstream of the exhaust stack exit.

The sample ports are 6-inches in diameter and extend 24 inches beyond the stack wall. Flue gas was sampled for five minutes at six traverse points from each of the four sample ports, for a total of 24 sample points and 120 minutes. A drawing of the Unit 1 traverse points are presented as Figure 4-1, while a drawing of the Unit 1 Test Port Locations is presented as Figure 4-2.

Figure 4-1. Unit 1 Duct Cross Section and Test Port/Traverse Point Detail

D E KARN UNIT 1 PARTICULATE EMISSION TEST POINT LOCATIONS



Stack Area: 391.74 Sq. Ft.

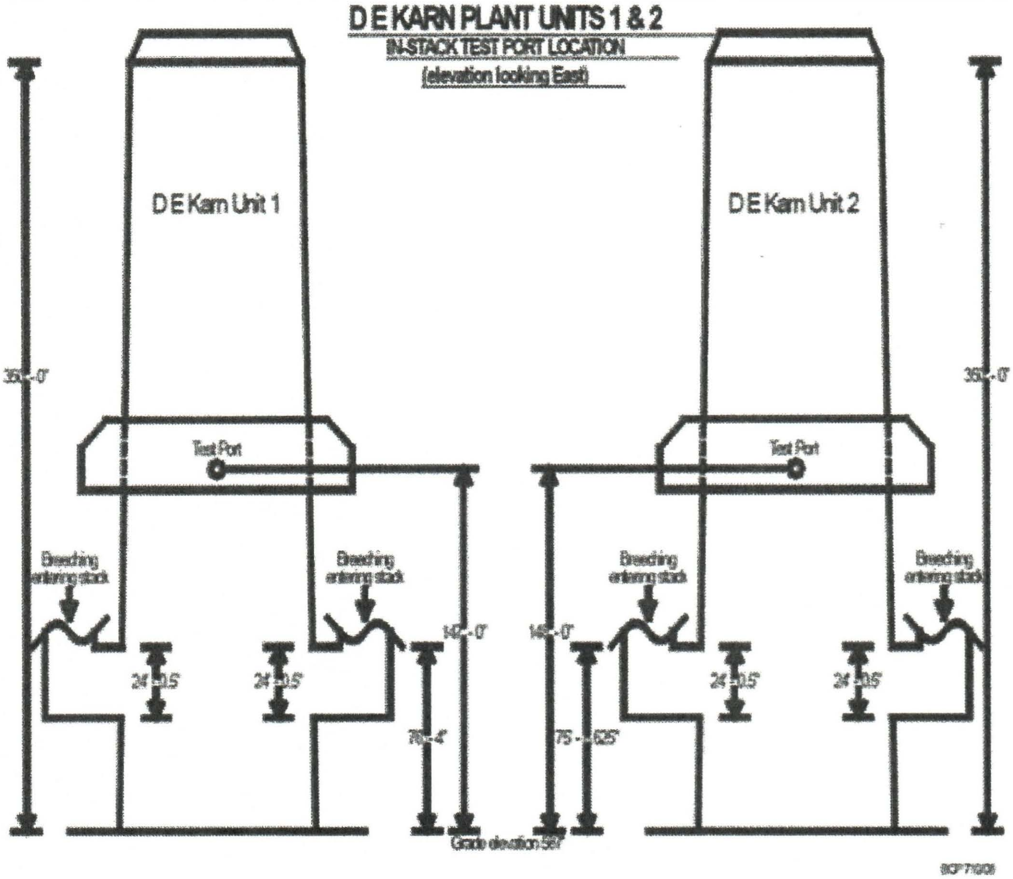
Particulate Test Traverse Point Locations

Note: test port length = 24" from inside stack wall to outside flange

Distances From Stack Wall

Point 1:	95.4"
Point 2:	67.0"
Point 3:	47.4"
Point 4:	31.6"
Point 5:	18.0"
Point 6:	5.6"

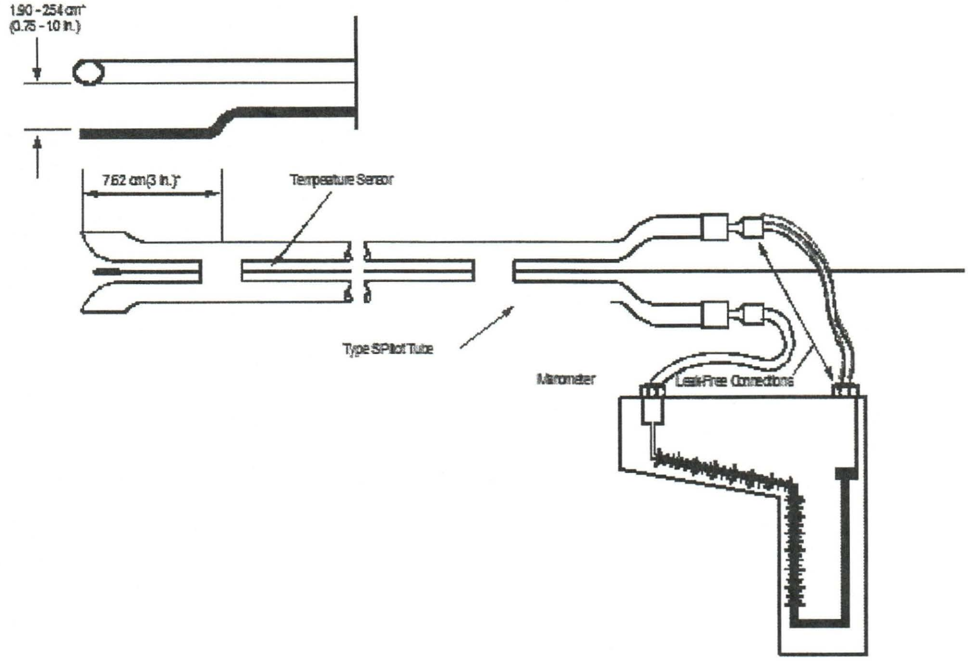
Figure 4-2. Unit 1 & 2 Duct Cross Section and Test Port/Traverse Point Detail



4.1.2 VELOCITY AND TEMPERATURE (USEPA METHOD 2)

The exhaust gas velocity and temperature were measured using USEPA Method 2, *Determination of Stack Gas Temperature and Velocity (Type S Pitot Tube)*. The pressure differential (ΔP) across the positive impact and negative static openings of the Pitot tube inserted in the exhaust duct at each traverse point were measured using an "S Type" (Stauscheibe or reverse type) Pitot tube connected to an appropriately sized oil filled inclined manometer. Exhaust gas temperatures were measured using a nickel-chromium/nickel-alumel "Type K" thermocouple and a temperature indicator. Refer to Figure 4-3 for the Method 2 Pitot tube, thermocouple, and inclined oil-filled manometer configuration.

Figure 4-3. Method 2 Sample Apparatus



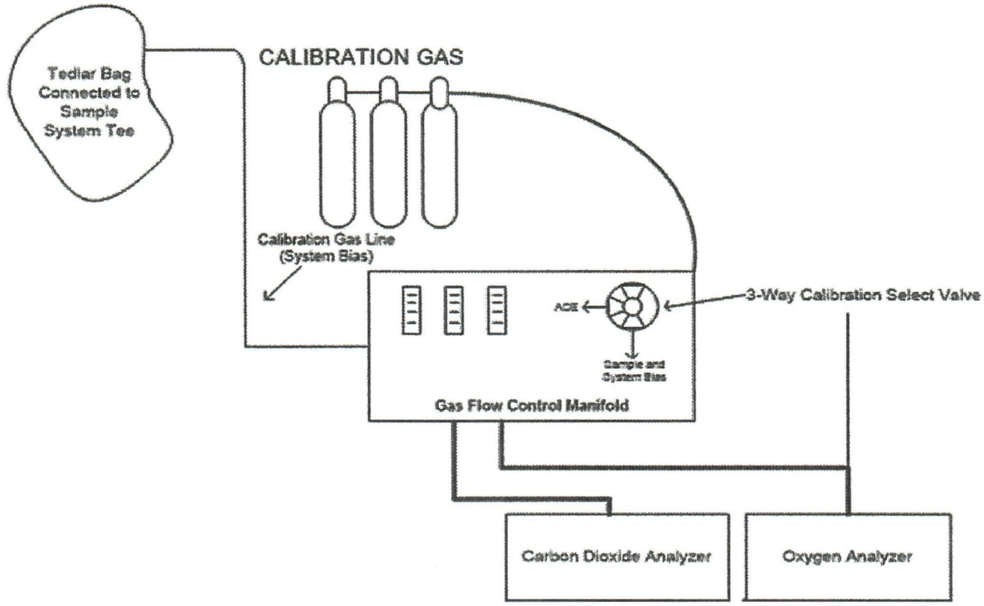
Appendix B of this report includes cyclonic flow test data as verification of the absence of cyclonic flow at the sample location. Method 1, § 11.4.2 states "if the average (null angle) is greater than 20°, the overall flow condition in the stack is unacceptable, and alternative methodology…must be used." The average null yaw angle measured at the Unit 1 exhaust on August 20, 2017 was 3.25°. In the absence of ductwork and/or stack configuration changes, this null angle information is considered to be valid and additional cyclonic flow verification was not performed.

4.1.3 Molecular Weight (USEPA ALT-123)

The exhaust gas composition and molecular weight were measured using the sampling and analytical procedures of USEPA ALT-123, Alternative Test Method for Diluent Measurement to Support Particulate Matter Testing Under 40 CFR 63, Subpart UUUUU. ALT-123 combines the sample collection procedures of USEPA Method 3B, Gas Analysis for the Determination of Emission Rate Correction Factor or Excess Air with the analytical procedures of USEPA Method 3A, Oxygen and Carbon Dioxide Concentrations from Stationary Sources – (Instrumental Analyzer Procedure.) The flue gas oxygen and carbon dioxide concentrations were used to calculate molecular weight, flue gas velocity, and emissions in lb/mmBtu.

Flue gas was extracted from the stack during each test from each of the 24 traverse points through a stainless steel lined probe and inert tubing into a flexible sample bag. The sample was then withdrawn from the flexible bag and conveyed into a multi gas analyzer that measured oxygen and carbon dioxide concentrations. Figure 4-4 depicts the ALT-123 sampling system.

Figure 4-4. USEPA Method ALT-123 Sampling System



Prior to sampling flue gas, the analyzer was calibrated by performing a calibration error test where zero-, mid-, and high-level calibration gases were introduced directly to the analyzer. The calibration error check was performed to evaluate if the analyzer response was within ±2.0% of the calibration gas span. Analyzer system-bias and drift tests were performed by filling inert flexible sample bags with zero- and mid- or high- calibration gases and introducing these calibration standards into the gas analyzer to measure the ability of the system to respond to within ±5.0 percent of span.

At the conclusion of the bag sample analysis, an additional system bias check was performed to evaluate the drift from the pre- and post-test system bias checks. The system-bias checks evaluated if the analyzer drift was within the allowable criterion of ±3.0% of span from pre- to post-test system bias checks. The measured oxygen and carbon dioxide concentrations were corrected for analyzer drift. Refer to Appendices B and E for analyzer calibration data and supporting documentation.

4.1.4 Moisture Content (USEPA Method 4)

The exhaust gas moisture content was measured using USEPA Method 4, *Determination of Moisture in Stack Gases* in conjunction with the Method 5 sample apparatus. Sampled gas was drawn through a series of impingers immersed in an ice bath to condense and remove water from the flue gas. The amount of water condensed and collected in the impingers was measured gravimetrically and used to calculate the exhaust gas moisture content.

4.1.5 Particulate Matter (USEPA Method 5)

Filterable particulate matter samples were collected isokinetically by withdrawing a sample of the flue gas through a pre-weighed filter following the procedures of USEPA Method 5, *Determination of Particulate Matter Emissions from Stationary Sources.*

In a letter received from USEPA on August 15, 2018 in response to a August 9, 2018 request by Consumers Energy, USEPA has approved the use of USEPA Method 5 as an alternative to MATS 5 in order to avoid having to conduct compliance tests using multiple test methods. Documentation of this approval is included as an attachment in Appendix E.

In the Method 5 sampling apparatus the flue gas was passed through a nozzle, heated probe, quartz-fiber filter, and into a series of impingers with the configuration presented in Table 4-3. The filter collected filterable particulate matter while the impingers collected water vapor and/or condensable particulate matter. Figure 4-5 depicts the USEPA Method 5 sampling apparatus.

Table 4-3
USEPA Method 5 Impinger Configuration

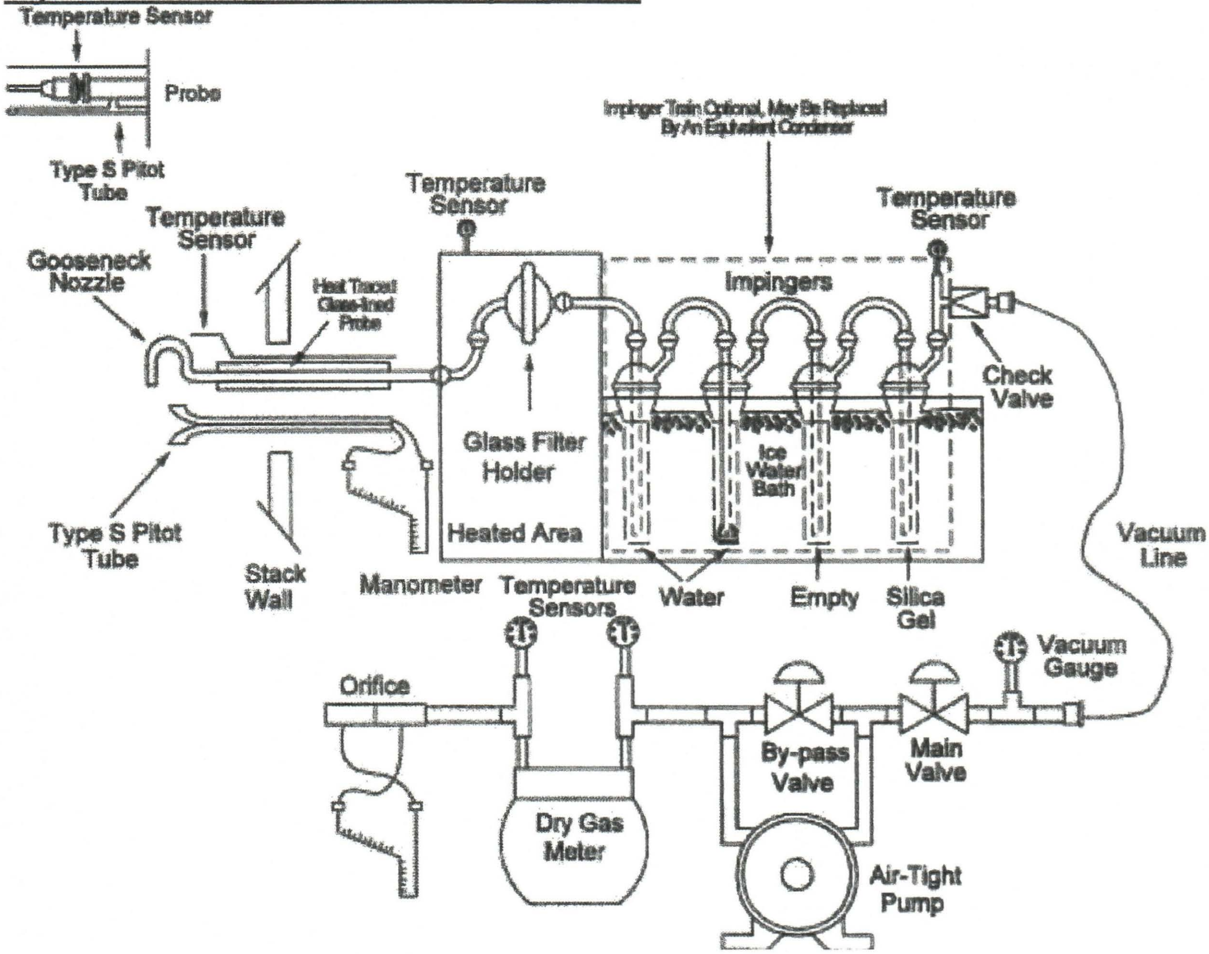
Impinger Order (Upstream to Downstream	Impinger Type	Impinger Contents	Amount (gram)
1	Modified	Water	~100
2	Greenburg-Smith	Water	~100
3	Modified	Empty	-
4	Modified	Silica Gel Desiccant	~200-300

Before testing, representative flow data from previous measurements were reviewed to calculate an ideal nozzle size that allowed isokinetic sampling to be performed. A pre-cleaned nozzle that had an inner diameter that approximates the calculated value was measured with calipers across three cross-sectional chords, rinsed and brushed with acetone, and connected to the sample probe.

The impact and static pressure openings of the Pitot tube were leak-checked at or above a velocity head of 3.0 inches of water for a minimum of 15 seconds. The sampling train was leak-checked by capping the nozzle opening and applying a vacuum of approximately 15 inches of mercury. The dry-gas meter was monitored for approximately 1 minute to verify the sample apparatus leakage rate was less than 0.02 cubic foot per minute (cfm). The sample probe was then inserted into the sampling port to begin sampling.

Ice and water were placed around the impingers and the probe, and filter temperatures were allowed to stabilize to a temperature of 248±25°F before sampling. After the desired operating conditions were coordinated with the facility, testing was initiated. Stack and sampling apparatus parameters (e.g., flue velocity, temperature) were monitored to establish the isokinetic sampling rate to within 100±10 % for the duration of the test.

Figure 4-5. USEPA Method 5 Sampling Train



At the conclusion of a test run and the post-test leak check, the sampling train was disassembled and the impingers and filter housing were transported to the recovery area.

The filter was recovered from the filter housing and placed in a Petri dish, sealed with Teflon tape, and labeled as "FPM Container 1." The nozzle and probe liner, and the front half of the filter housing were triple rinsed with acetone to collect particulate matter. The acetone rinses were collected in pre-cleaned sample containers, sealed with Teflon tape, and labeled as "FPM Container 2." The weight of liquid collected in each impinger, including the silica gel impinger, were measured using an electronic scale; these weights were used to calculate the moisture content of the sampled flue gas. The contents of the impingers were discarded. Refer to Figure 4-6 for the USEPA Method 5 sample recovery scheme.

The sample containers, including blanks were transported to the laboratory for analysis. The sample analysis followed USEPA Method 5 procedures as summarized in the sample recovery scheme presented in Figure 4-7

Figure 4-6. USEPA Method 5 Sample Recovery Scheme

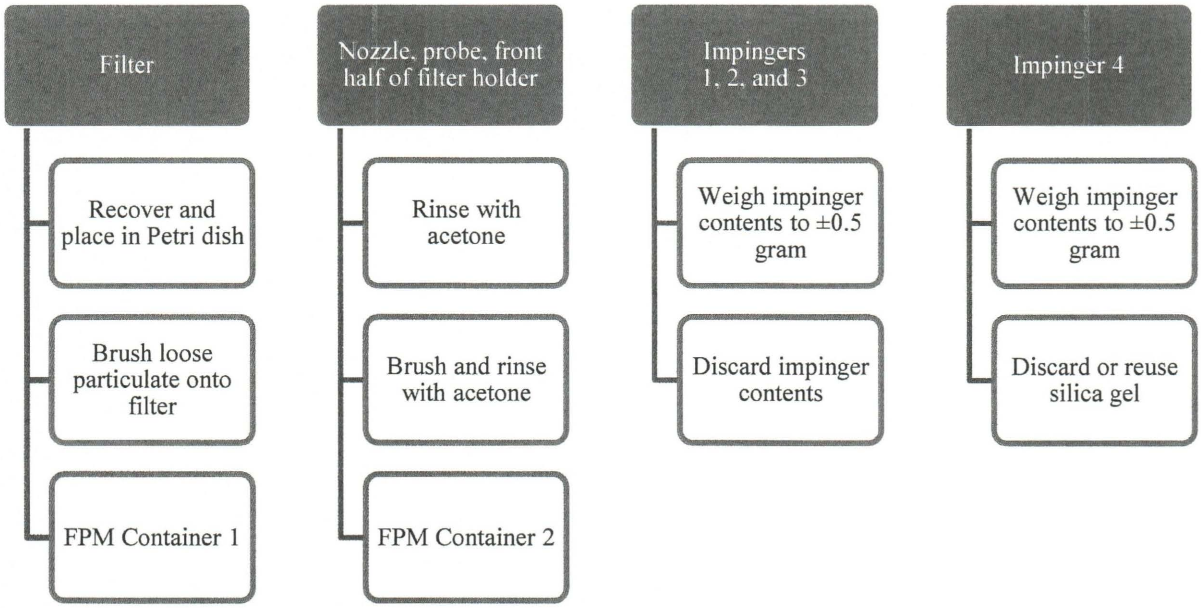
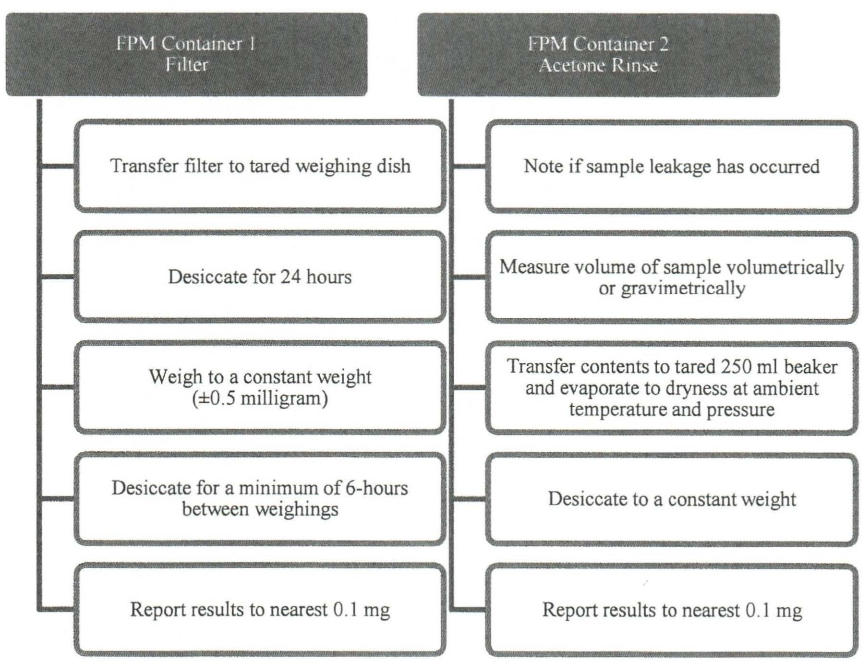


Figure 4-7. USEPA Method 5 Analytical Scheme



4.1.6 Emission Rates (USEPA Method 19)

USEPA Method 19, *Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates*, was used to calculate PM emission rates in units of lb/mmBtu. Measured carbon dioxide concentrations and F factors (ratios of combustion gas volumes to heat inputs) were used to calculate emission rates using equation 19-6 from the method. Figure 4-8 presents the equation used to calculate lb/mmBtu emission rate:

Figure 4-8. USEPA Method 19 Equations 19-6

$$Eq. 19-6 \quad E = C_d F_c \frac{100}{\%CO_{2d}}$$

Where:

E	=	Pollutant emission rate (lb/mmBtu)
C_d	=	Pollutant concentration, dry basis (lb/dscf)
F_c	=	Volumes of combustion components per unit of heat content 1,840 scf CO_2/mmBtu for subbituminous coal (including blends with bituminous coal) from 40 CFR 75, Appendix F, Table 1
$\%CO_{2d}$	=	Concentration of carbon dioxide on a dry basis (%, dry)

5.0 TEST RESULTS AND DISCUSSION

The purpose of this test program was to evaluate the continued validity of the PM CEMS correlation curve by conducting a RRA. The results of the testing indicate the PM CEMS met the criteria specified in Section 10.4(6) in Procedure 2 of 40 CFR 60 Appendix F.

5.1 Tabulation of Results

Table 2-1 in Section 2 of this report summarizes the results and Appendix Table 1 contains a detailed tabulation of results, process operating conditions, and exhaust gas conditions.

5.2 Significance of Results

The results of the testing indicate continued validity of the PM CEMS correlation used for continuously determining compliance with emission standards or operating permit limits. The existing correlation equations used by the PM CEMS for Unit 1 will remain. In accordance with the MATS rule, an RRA will be performed at least once annually to verify the validity of PM CEMS operation; a relative correlation audit (RCA) is required to be performed at least once every three years, however Unit 1 will not be in operation when the next RCA is required to occur.

5.3 Variations from Sampling or Operating Conditions

No other sampling or operating condition variations were encountered during the test program.

5.4 Process or Control Equipment Upset Conditions

The boiler and associated control equipment were operating under routine conditions and no upsets were encountered during testing.

5.5 Air Pollution Control Device Maintenance

No significant pollution control device maintenance occurred during the three months prior to the test. Optimization of the air pollution control equipment is a continuous process to ensure compliance with regulatory emission limits.

5.6 Re-Test Discussion

Based on the results of this test program, a re-test is not required.

5.7 Results of Audit Samples

5.7.1 Performance Audit Sample

Performance audit samples were not required for this test program.

5.7.2 Reference Method Audits

The USEPA reference methods performed state reliable results are obtained by persons equipped with a thorough knowledge of the techniques associated with each method. Factors with the potential to cause measurement errors are minimized by implementing quality control (QC) and assurance (QA) programs into the applicable components of field testing. QA/QC components were included in this test program. Table 5-1 summarizes the primary field quality assurance and quality control activities that were performed. Refer to Appendix E for supporting documentation.

Table 5-1
QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria
M1: Sampling Location	Evaluates if the sampling location is suitable for sampling	Measure distance from ports to downstream and upstream flow disturbances	Pre-test	≥2 diameters downstream; ≥0.5 diameter upstream.
M1: Duct diameter/ dimensions	Verifies area of stack/duct is accurately measured	Review as-built drawings and field measurement	Pre-test	Field measurement agreement with as-built drawings
M2: Pitot tube calibration and standardization	Verifies construction and alignment of Pitot tube	Inspect Pitot tube, assign coefficient value	Pre-test and after each field use	Method 2 alignment and dimension requirements
M3A/ALT-123: Calibration gas standards	Ensures accurate calibration standards	Traceability protocol of calibration gases	Pre-test	Calibration gas uncertainty ≤2.0%
M3A/ALT-123: Calibration Error	Evaluates operation of analyzers	Introduce calibration gas directly into analyzers	Pre-test	±2.0% of the calibration span
M3A/ALT-123: System Bias and Analyzer Drift	Evaluates analyzer and sample system integrity and accuracy	Calibration gas introduced via flexible tedlar bags	Pre-test and Post-test	Bias: ±5.0% of calibration span Drift: ±3.0% of calibration span

Table 5-1
QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria
M3A/ALT-123: Multi- point integrated sample	Ensure representative sample collection	Insert probe into stack and purge sample system	Pre-test	Collect samples at traverse points
M4: Field balance calibration	Verify moisture measurement accuracy	Use Class 6 weight to check balance accuracy	Daily before use	The field balance must measure the weight within ±0.5 gram of the certified mass
M5: nozzle diameter measurements	Verify nozzle diameter used to calculate sample rate	Measure inner diameter across three cross-sectional chords	Pre-test	3 measurements agree within ±0.004 inch
M5: Sample rate	Ensure representative sample collection	Calculate isokinetic sample rate	During and post-test	100±10% isokinetic sample rate
M5: Post-test leak check	Evaluate if the sample was affected by system leak	Cap sample train; monitor dry gas meter	Post-test	≤0.020 cfm
M5: Post-test meter audits	Evaluates accurate measurement equipment for sample volume	Calibrate DGM pre- and post-test; compare calibration factors (Y)	Pre-test Post-test	±5 %

5.8 Calibration Sheets

Calibration sheets, including dry gas meter, gas protocol sheets, nozzle calibration and Pitot tube inspection sheets are presented in Appendix E.

5.9 Sample Calculations

Sample calculations and formulas used to compute emissions data are presented in Appendix A.

5.10 Field Data Sheets

Field data sheets are presented in Appendix B.

5.11 Laboratory Quality Assurance / Quality Control Procedures

The method specific quality assurance and quality control procedures in each method employed during this test program were followed, without deviation. Refer to Appendix C for the laboratory data sheets.

5.11.1 QA/QC Blanks

Reagent and media blanks were analyzed for the parameters of interest. The results of the blanks analysis are presented in the Table 5-2. A slight positive bias may be present in the results due to some apparent contamination of the acetone.

Laboratory QA/QC and blank results data are contained in Appendix C.

Table 5-2
QA/QC Blanks

Sample Identification	Result	Comment
Method 5 Filter Blank	-0.1 mg	Reporting limit is 0.1 mg
Method 5 Acetone Blank	5.2 mg	Sample volume was 200 milliliters; Acetone blank corrections were applied