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COMPLIANCE TEST REPORT

for

RELATIVE RESPONSE AUDIT (RRA) –*REVISION 1*

PARTICULATE MATTER CONTINUOUS EMISSIONS MONITORING SYSTEM (PM CEMS)

UNIT 4 – FGD Stack

Monroe Power Plant
Monroe, Michigan

March 29-30, 2016

Prepared By
Environmental Management & Resources
Environmental Field Services Group
DTE Corporate Services, LLC
7940 Livernois H-136
Detroit, MI 48210

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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EMR) Field Services Group performed a Relative Response Audit (RRA) on the Particulate Matter Continuous Emissions Monitoring System (PM CEMS). The RRA was performed on the Unit 4 FGD exhaust stack located at the Monroe Power Plant, in Monroe, Michigan. The testing is required by the Michigan Department of Environmental Quality (MDEQ) Permit to Install #27-13. Testing was performed in accordance with Procedure 2 of 40 CFR Part 60, Appendix F. The testing was conducted on March 29 & 30, 2016.

A summary of the emission test results are shown below. Criterion for acceptable RRA results are located in Procedure 2 Sec 10.4(6)(i-iii):

Relative Response Audit
Unit 4 FGD Stack
Monroe Power Plant
March 29 & 30, 2016

	PM CEMS (mg/acm)[1]	RM PM (mg/acm)[1]	PM CEMS (correlation)	Correlation (-25% Emission Limit)	Correlation (+25% Emission Limit)
Run 1 (3/29)	2.3	2.97	1.90	0.23	3.56
Run 2 (3/29)	2.1	3.38	1.87	0.20	3.54
Run 3 (3/30)	2.4	2.45	1.91	0.25	3.58
PM CEMS < Greatest PM CEMS Response on correlation regression line				***≤49.4 mg/acm***	***Pass***
2 of 3 PM CEMS within PM CEMS output range of correlation regression line				***≥3.0 mg/acm***	***Does Not Meet***
2 of 3 PM CEMS and RM w/in 25% of numerical emission limit on correlation regression line					***Pass***

[1]mg/acm @ 160° C

Following the RRA, the new test data was incorporated with the original correlation test data for the purpose of calculating a new correlation curve for the PM CEMS. The new curve was effective at the conclusion of the RRA testing on March 30, 2016.

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EMR) Field Services Group performed a Relative Response Audit (RRA) on the Particulate Matter Continuous Emissions Monitoring System (PM CEMS).The RRA was performed on the Unit 4 FGD exhaust stack located at the Monroe Power Plant, in Monroe, Michigan. The testing is required by the Michigan Department of Environmental Quality (MDEQ) Permit to Install #27-13. Testing was performed in accordance with Procedure 2 of 40 CFR Part 60, Appendix F. The testing was conducted on March 29 & 30, 2016.

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 1-5B. Criterion for acceptable RRA results are located in Part 60, Appendix F Procedure 2 Sec 10.4(6)(i-iii).

The fieldwork was performed in accordance with EPA Reference Methods and EMR's Intent to Test.[1] The EMR Field Services personnel participated in the testing program included: Mr. Mark Grigereit, Principal Engineer, Mr. Fred Meinecke, Senior Environmental Technician, and Mr. Thomas Snyder, Senior Environmental Technician. Mr. Grigereit was the project leader. Coordination with the facility was performed by Ms. Kayla Maas, Environmental Engineer. Mr. Brian Carley and Mr. Tom Gasloli with the Air Quality Division of the Michigan Department of Environmental Quality (MDEQ) observed of the emissions testing.

2.0 SOURCE DESCRIPTION

The Monroe Power Plant is a DTE Energy facility located at 3500 E. Front Street in Monroe, Michigan, The plant has four (4) coal-fired electric generating units, referred to as Units 1, 2, 3, and 4. These units were placed in service between 1971 and 1974, and have a total electric generating capacity of 3,135 megawatts (gross). The boiler (Babcock & Wilcox) for each unit is a similar supercritical pressure, pulverized coal-fired cell burner boiler. Units 1-4 exhaust into dedicated, separate stacks.

Units 1 and 4 have General Electric turbine generators, each having a current capability of 817 gross megawatts (GMW). Units 2 and 3 have Westinghouse turbine generators, each having a current capability of 823 GMW.

[1] MDEQ, Test Plan, Submitted January 22, 2016. (Attached-Appendix A)
[2] MDEQ, Approval Letter. Received January 29, 2016(Attached-Appendix A)

The boiler exhausts are each equipped with Research Cottrell electrostatic precipitators (ESPs), with particulate removal efficiencies of 99.6%. There is a sulfur trioxide flue gas conditioning system on each unit that is only used on an "as needed basis" to lower the resistivity of the fly ash for better collection by the ESPs. None of the four units is equipped with sulfuric acid mist control equipment.

Units 1 - 4 each have Selective Catalytic Reduction (SCR) systems to control 90% of the NO_x emissions prior to their respective ESP's. Each unit has wet Flue Gas Desulfurization (FGD) Scrubbers to control sulfur dioxide (SO_2), and other acid gases. The typical coal blend for each unit is a 65% low-sulfur western (LSW) / 35% mid-sulfur eastern (MSE). The boilers at Monroe Power Plant employ the use of continuous soot-blowing.

The exhaust stacks for Units 1-4 are each 580 feet tall with an internal diameter of 28 feet. See Figure 1 for a diagram of Units' sampling locations and stack dimensions.

Monroe Power Plant utilizes Sick AG model FWE200 dust measuring systems. The analyzers utilize a measuring technique based off of scattered light principal. The FWE200 model is specific for low to medium dust collections after a wet scrubber. The following unit was audited:

Unit	Analyzer	Manufacturer/ Model	Analyzer Range	Serial Number
Unit 4	PM	Sick/ Dusthunter FEW200	200 mg/acm	14378520

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3.0 SAMPLING AND ANALYTICAL PROCEDURES

DTE Energy obtained emissions measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources*. The sampling and analytical methods used in the testing program are indicated in the table below

Sampling Method	Parameter	Analysis
USEPA Methods 1-2	Exhaust Gas Flow Rates	Field data analysis and reduction
USEPA Method 3A	O_2 & CO_2	Instrumental Analyzer Method
USEPA Method 4	Moisture Content	Field data analysis and reduction
USEPA Method 5B	Particulate Matter (Non-Sulfuric Acid)	Gravimetric Analysis

3.1 STACK GAS VELOCITY AND FLOWRATES (USEPA Methods 1-2)

3.1.1 *Sampling Method*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources," and Method 2, "Determination of Stack Gas Velocity and Volumetric Flowrate." Four (4) sampling ports were utilized on each unit's exhaust stack, sampling at three (3) points per port for a total of twelve (12) points. Velocity traverses were conducted simultaneously with the particulate sampling. See Figure 2 for a diagram of the traverse/sampling points used.

Cyclonic flow checks were performed on each stack during the initial flow monitor certification RATAs. Testing at the sampling location demonstrated that no cyclonic flow was present at either location. No changes to the stacks have occurred since the cyclonic flow checks were performed. Additionally, verifications of null angle at 0° were observed while performing static pressure checks on each unit.

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3.1.2 *Method 2 Sampling Equipment*

The EPA Method 2 sampling equipment consisted of a 0-10" incline manometer, S-type Pitot tube (C_p = 0.836) and a Type-K calibrated thermocouple.

3.2 OXYGEN & CARBON DIOXIDE (USEPA Method 3A)

3.2.1 *Sampling Method*

Oxygen (O_2) and carbon dioxide (CO_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The analyzers utilize paramagnetic sensors.

3.2.2 *O_2/CO_2 Sampling Train*

The EPA Method 3A sampling system (Figure 3) consisted of the following:

(1) PTFE sampling line
(2) Universal® gas conditioner with particulate filter
(3) PTFE connecting line
(4) Servomax 1400 O_2/CO_2 gas analyzer
(5) Appropriate USEPA Protocol 1 calibration gases
(6) Data Acquisition System

3.2.3 *Sampling Train Calibration*

The O_2 and CO_2 analyzers were calibrated according to procedures outlined in USEPA Methods 3A. Zero, span, and mid-range calibration gases were introduced directly into the analyzer to verify the instruments linearity, prior to sampling, and again at the completion of each test run.

3.3 MOISTURE DETERMINATION (USEPA Method 4)

3.3.1 *Sampling Method*

Determination of the moisture content of the exhaust gas was performed using USEPA Method 4, "Determination of Moisture Content in Stack Gases". The moisture was collected in the Method 5B glass impingers, and the percentage of water was then derived from calculations outlined in USEPA Method 4.

3.4 PARTICULATE MATTER (USEPA Method 5B)

3.4.1 *Filterable Particulate Sampling Method*

USEPA Method 5B, "Determination of Non-Sulfuric Acid Particulate Emissions from Stationary Sources" was used to measure the filterable (front-half) particulate

emissions (see Figure 4 for a schematic of the sampling train). Triplicate, 180-minute test runs were conducted.

The Method 5B modular isokinetic stack sampling system consisted of the following:

(1) PTFE coated stainless-steel button-hook nozzle
(2) Heated glass-lined probe
(3) Heated 3" glass filter holder with a quartz filter (Maintained at a temperature of 320 ± 25 °F)
(4) Set of impingers for the collection of condensate for moisture determination
(5) Length of sample line
(6) Environmental Supply® control case equipped with a pump, dry gas meter, and calibrated orifice.

The quartz filters used in the sampling were initially baked for 3 hours at 320 °F, desiccated for 24 hours and weighed to a constant weight as described in Method 5B to obtain the initial tare weight.

After completion of the final leak test for each test run, the filter was recovered, and the probe, nozzle and the front half of the filter holder assembly were brushed and rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The container was labeled with the test number, test location, test date, and the level of liquid marked on the outside of the container. Immediately after recovery, the sample containers were placed in a cooler for storage.

At the laboratory the acetone rinses were transferred to clean pre-weighed beakers, and evaporated to dryness at ambient temperature and pressure. The beakers and filters were baked for 6 hours at 320 °F, desiccated for 24 hours and weighed to a constant weight (within 0.5 mg). The data sheets containing the initial and final weights on the filters and beakers can be found in Appendix C.

Collected field blanks consisted of a blank filter and acetone solution blank. The acetone blank was collected from the rinse bottle used in sample recovery. The blank filter and acetone were collected and analyzed following the same procedures used to recover and analyze the field samples. Field data sheets for the Method 5B sampling can be found in Appendix B.

3.4.2 *Quality Control and Assurance*

All sampling and analytical equipment was calibrated according to the guidelines referenced in EPA Method 5B. All Method 1-4, and 5B calibration data is located in Appendix D.

3.4.3 *Data Reduction*

The filterable PM emissions data collected during the testing were calculated and reported as mg/acm @ 160°C.

4.0 OPERATING PARAMETERS

The test program included the collection of PM CEMs emission data and Load during each PM emissions test. Data collected during the testing is presented in Appendix E.

5.0 DISCUSSION OF RESULTS

Table 1 presents the Unit 4 Reference Method particulate emission testing results (RM PM), particulate matter continuous emissions monitoring system (PM CEMS) results, PM CEMS correlation (expected point on the correlation regression line) value, and ±25% of the emission limit along the correlation regression line). Particulate emissions are presented in milligram per actual cubic meter corrected to 160°C (mg/acm).

In order to pass an RRA, All of the following criteria must be met: Procedure 2 10.4(6)(i-iii).

i) For all three data points, the PM CEMS response value can be no greater that the greatest PM CEMS response value used to develop you correlation curve.

ii) For two of the three data points, the PM CEMS response value must lie within the PM CEMS output range used to develop your correlation curve.

iii) At least two of the three sets of PM CEMS and Reference Method measurements must fall within the same specified area on a graph of the correlation regression line as required for the RCA and described in paragraph (5)(iii). "The specific area on the graph of the correlation regression line is defined by two lines parallel to the correlation regression line, offset at a distance of ±25% of the numerical emission limit value from the correlation regression line.

Two of the three requirements were successfully met (Requirements i & iii). The requirement that two of the three RRA data points must fall within the PM CEMS output range used to develop the correlation curve was not meet. The PM CEMS response was less than the PM

CEMS lowest points used in developing the correlation curve (3.0 mg/acm @160 °F). The Units' Permit Limit for particulate is 0.011 lb/MMBtu was not exceeded, with an average Emissions Rate of 0.005 lb/MMBtu.

Testing results are located in Table 1 "Unit 4 PM CEMS RRA Results" and Table 2 "Unit 4 PM CEMS RRA – Summary Graph)." Following testing the new data was incorporated with the original correlation test data for the purpose of calculating a new correlation curve for the PM CEMS. This improves the accuracy of the PM CEMS in the lower measurement range. The new curve, including the RRA test data, is reflected in Table 3.

The auxiliary test data presented in the results table for each test includes the unit load in gross megawatts (GMW), stack temperature in degrees Fahrenheit (°F), stack gas moisture in percent (%), stack gas velocity in feet per minute (ft/min), and stack gas flow rate in actual cubic feet per minute (acfm), standard cubic feet per minute (scfm) and dry standard cubic feet per minute (dscfm).

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6.0 CERTIFICATION STATEMENT

"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally accepted in the trade."

Heidi Anderson
FOR Mark Grigereit, QSTI

This report prepared by: Heidi Anderson
FOR Mr. Mark Grigereit, QSTI
Principal Engineer, Field Services Group
Environmental Management and Resources
DTE Energy

This report reviewed by: Thomas Durham
Mr. Thomas Durham
Manager, Field Services Group
Environmental Management and Resources
DTE Energy

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RESULTS TABLES

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TABLE NO. 1
PARTICULATE MATTER CONTINUOUS EMISSIONS MONITORING SYSTEM
RELATIVE RESPONSE AUDIT RESULTS
Monroe Power Plant - Unit 4 FGD Stack
March 29 & 30, 2016

Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Stack Moisture (%)	Stack Velocity (ft/min)	Exhaust Gas Flowrates (ACFM)	(SCFM)	(DSCFM)	PM CEMS (mg/acm[1])	RM PM (mg/acm[1])	PM CEMS (correlation)	Correlation (-25% Emission limit[2])	Correlation (+25% Emission limit[2])
RRA-1	**29-Mar-16**	7:40-10:49	763.0	119.8	13.6	3,831	2,358,917	2,119,906	1,831,926	2.3	2.97	1.90	0.23	3.56
RRA-2	**29-Mar-16**	11:15-14:24	762.9	119.4	13.6	3,809	2,345,494	2,109,359	1,823,544	2.1	3.38	1.87	0.20	3.54
RRA-3	**30-Mar-16**	8:01-11:14	766.6	119.7	13.6	3,828	2,357,203	2,112,259	1,825,307	2.4	2.45	1.91	0.25	3.58

(1) concentration corrected to 160°C

(2) ±25% emission limit (6.662 mg/acm)

TABLE No. 2
MONROE POWER PLANT
UNIT 4
PM CEMS RRA
SUMMARY GRAPH
March 29-30, 2016

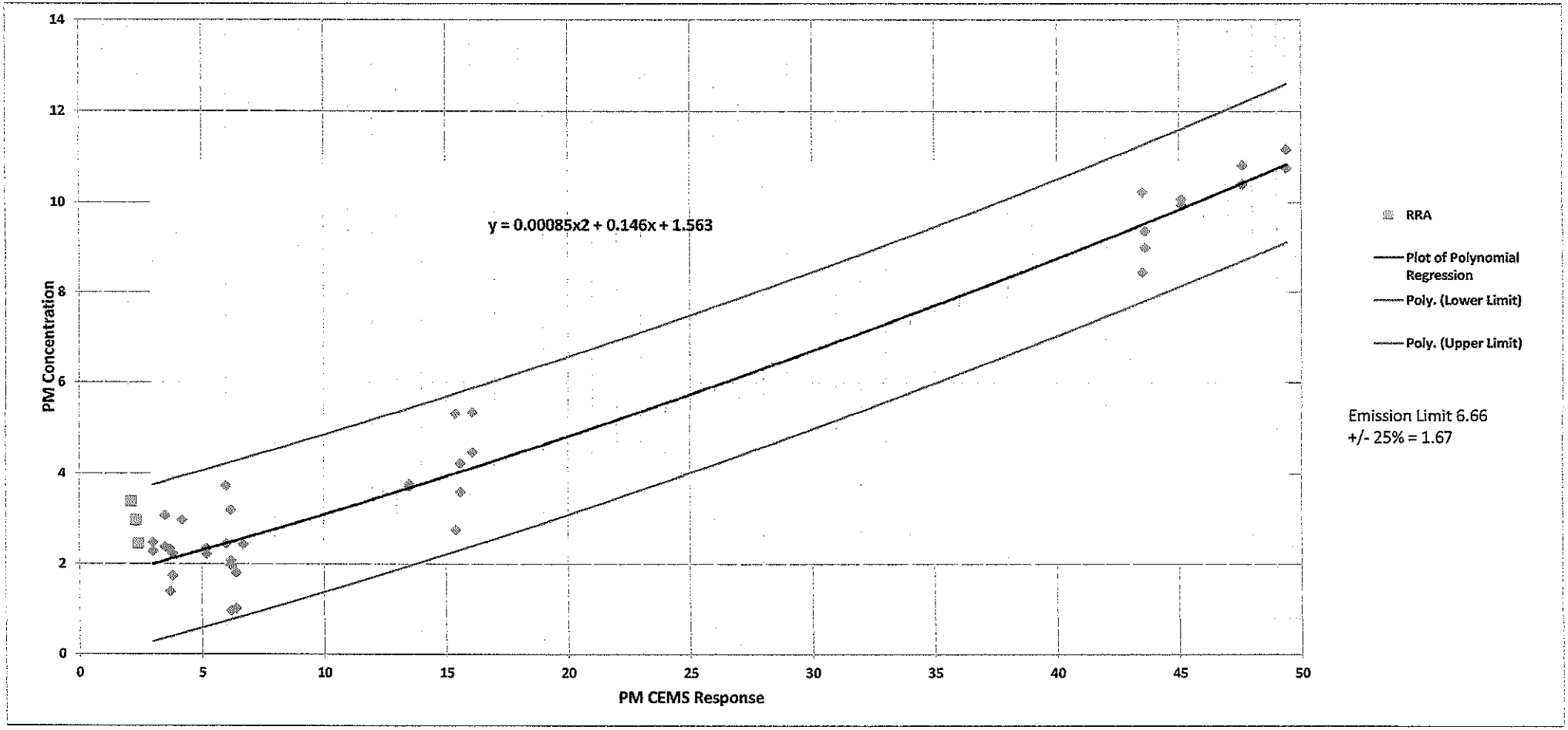
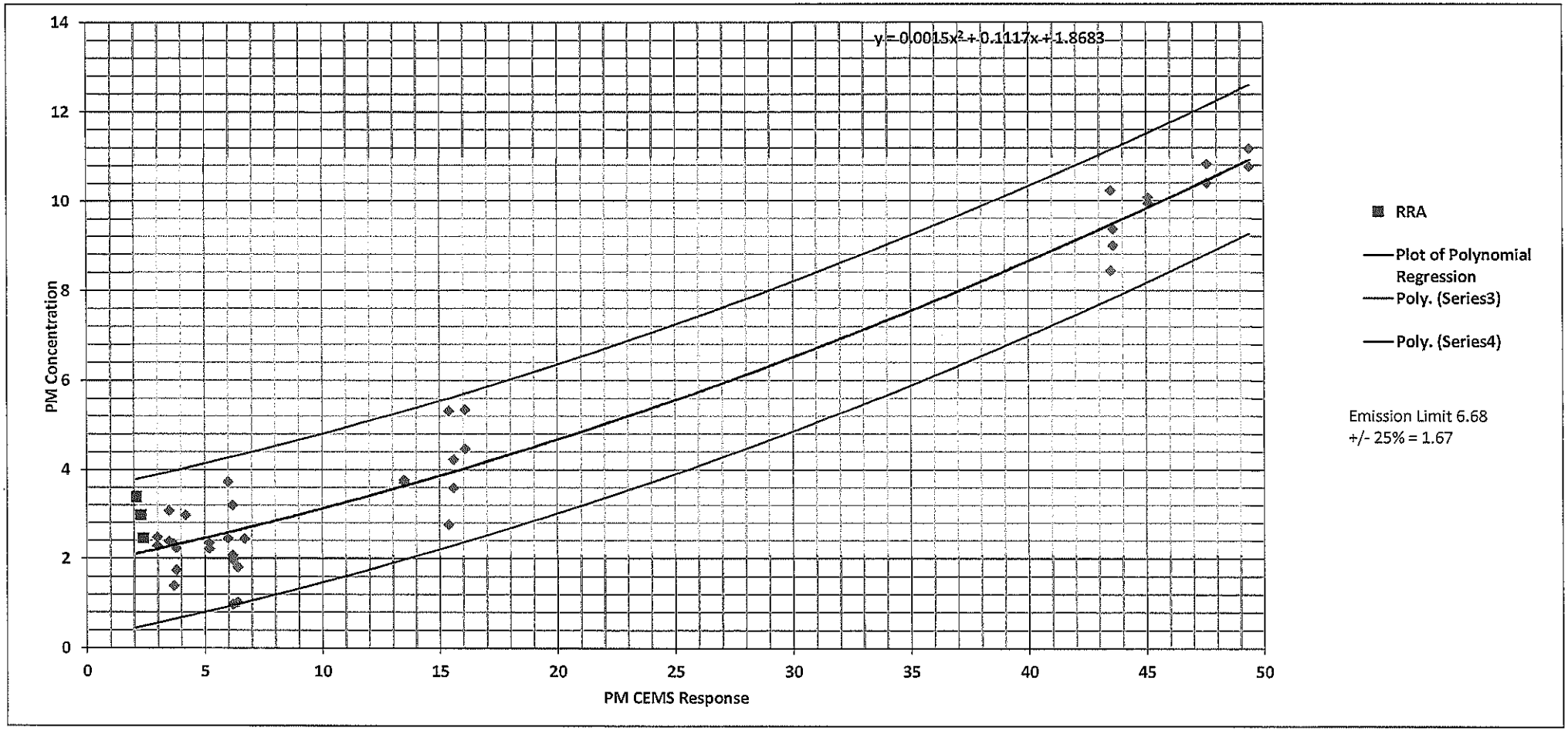


TABLE No. 3
MONROE POWER PLANT
UNIT 4
PM CEMS RRA
SUMMARY GRAPH - NEW CURVE
March 29-30, 2016



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FIGURES

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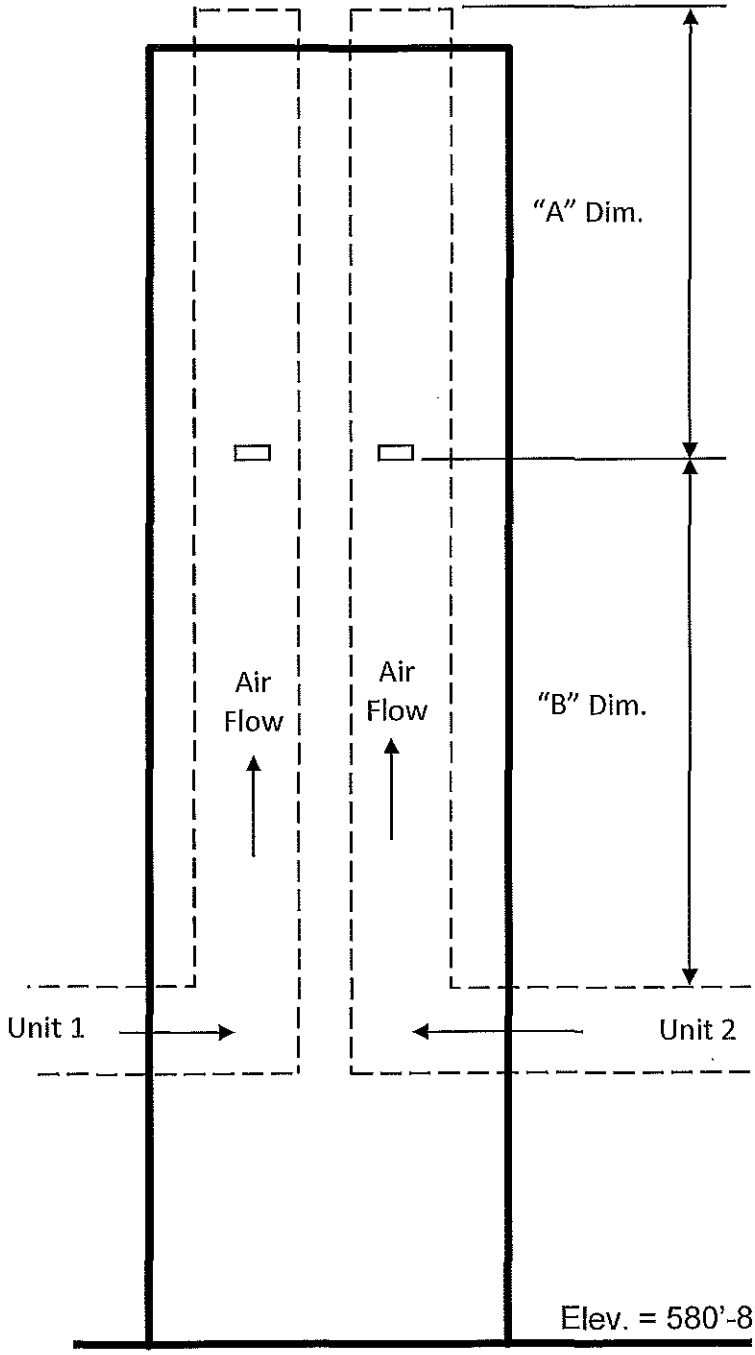
Figure 1 – Sampling Location
Monroe Power Plant – Units 3 & 4
March 29-30, 2016



Details

"A" Dim = Upstream Distance
"A" Dim = 201.6'
"B" Dim = Downstream Distance
"B" Dim = 233.8'

Dia. @ Sample Location = 28'-0"

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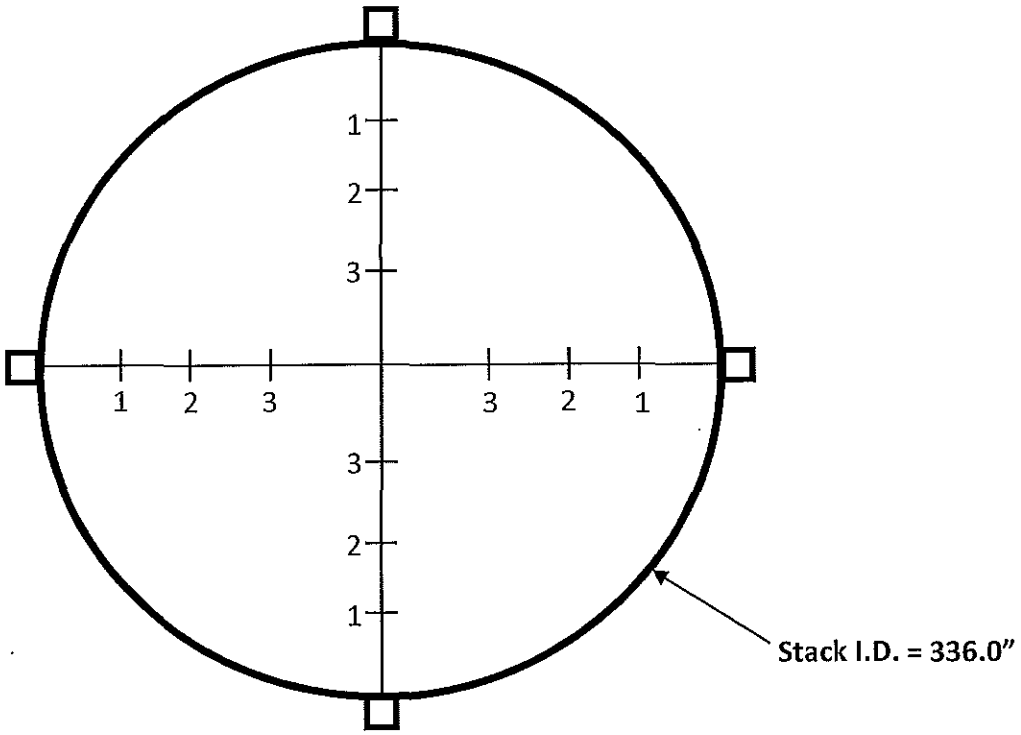
Figure 2 – Sampling Points
Monroe Power Plant – Unit 4
March 29-30, 2016



VELOCITY / PM MEASUREMENT POINTS

Point	Distance from Inside Wall
1	14.78"
2	49.06"
3	99.46"

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Figure 3 – EPA Method 3A
Monroe Power Plant – Unit 4
March 29 & 30, 2016

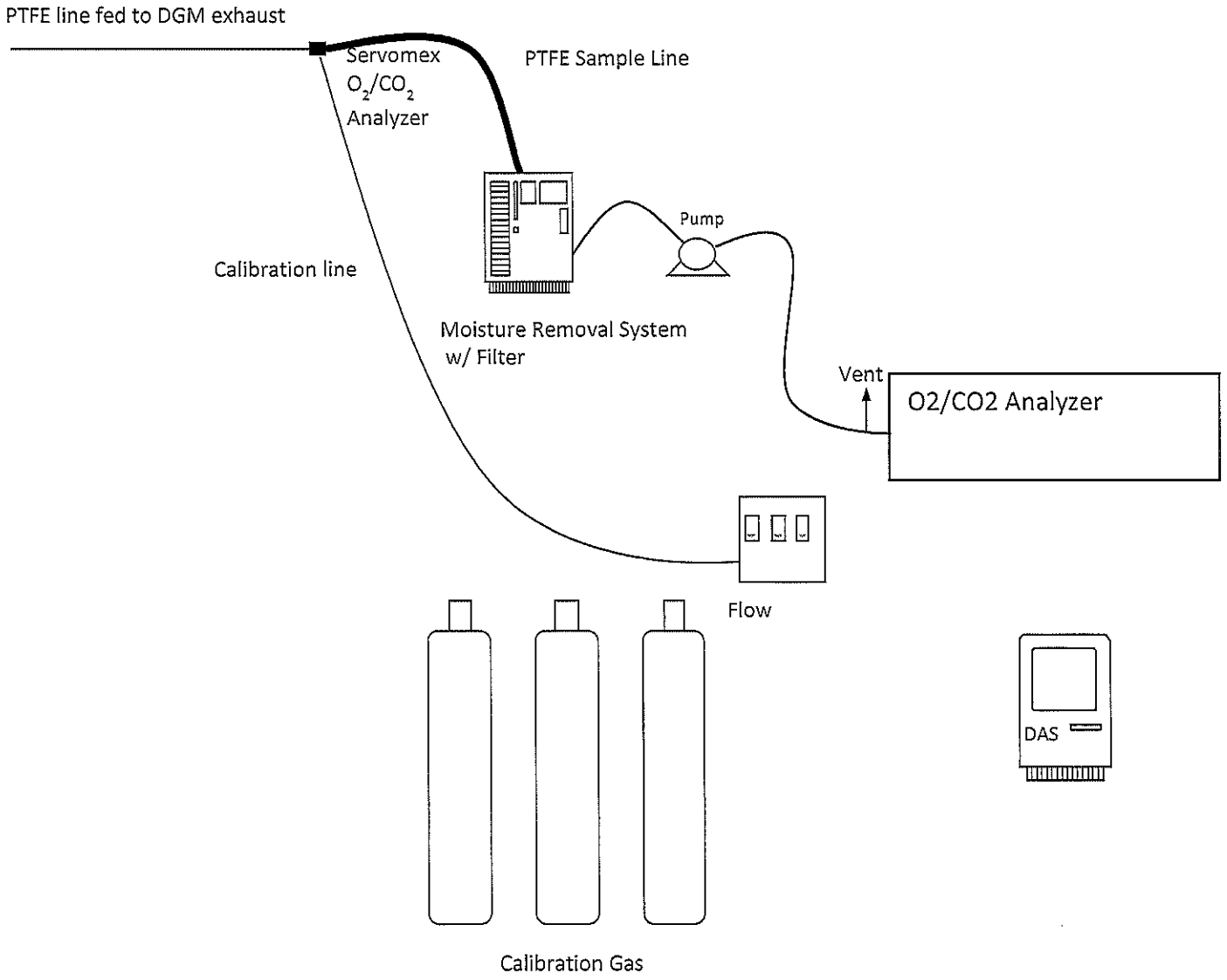

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Figure 4 – EPA Method 5B
Monroe Power Plant – Unit 4
March 29-30, 2016