EMISSIONS TEST REPORT

for

PARTICULATE MATTER LESS THAN $_{2.5}$ MICRONS ($PM_{2.5}$)

Units 2 & 3

DTE Electric
River Rouge Power Plant (SRN# B2810)
River Rouge, Michigan

December 9 & 30, 2014

Prepared By
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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources, (EMR) Field Services Group performed Particulate Matter less than 2.5 microns ($PM_{2.5}$) emissions testing on Units 2 and 3 exhaust stacks located at the River Rouge Power Plant, in River Rouge, Michigan. The testing was required by the Michigan Department of Environmental Quality (MDEQ) Permit to Install #40-08E to document $PM_{2.5}$ emissions from Units 2 and 3 while burning Recovered Paint Solids (RPS) treated coal during normal operating conditions. The testing was conducted on December 9 & 30, 2014.

A summary of the emission test results are shown below:

$PM_{2.5}$ Emissions Testing Summary
(Recovered Paint Solids)
Units 2 and 3
River Rouge Power Plant
December 9 & 30, 2014

	Unit Load	$PM_{2.5}$ Emissions		Condensable Particulate Emissions	
	(GMW)	(grains/dscf)	(lbs/MMBtu)	(grains/dscf)	(lbs/MMBtu)
Unit 2 (12/30)	249	<0.0004	<0.0010	0.0067	0.0162
Unit 3 (9/11)	332	<0.0002	<0.0004	0.0043	0.0102

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources, (EMR) Field Services Group performed Particulate Matter less than $_{2.5}$ microns ($PM_{2.5}$) emissions testing on Units 2 and 3 exhaust stacks located at the River Rouge Power Plant, in River Rouge, Michigan. The testing was required by the Michigan Department of Environmental Quality (MDEQ) Permit to Install #40-08E to document $PM_{2.5}$ emissions from Units 2 and 3 while burning Recovered Paint Solids (RPS) treated coal during normal operating conditions. The testing was conducted on December 9 & 30, 2014.

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 1-5, 201A, and 202.

The fieldwork was performed in accordance with EPA Reference Methods and EMR Intent to Test[1], which was approved in a letter by Mr. Mark Dziadosz from the Michigan Department of Environmental Quality – Air Quality Division (MDEQ-AQD), dated September 8, 2014[2]. The following EMR personnel participated in the testing program: Mr. Mark Grigereit, Principal Engineer, Mr. Mark Westerberg Environmental Specialist, Mr. Thomas Snyder, and Mr. Fred Meinecke, Senior Environmental Technicians. Mr. Grigereit was the project Leader. Mr. Johnnie Campbell, Senior Environmental Specialist at RRPP, provided process coordination for the testing program.

2.0 SOURCE DESCRIPTION

The River Rouge Power Plant (RRPP), located at 1 Belanger Park Dr. River Rouge, Michigan, employs the use of two (2) coal-fired boilers. Unit 2 is a Combustion Engineering Boiler, nominally rated at 266 gross megawatts (GMW). Unit 3 is a Foster-Wheeler Boiler, nominally rated at 278 GMW. Particulate emissions from Unit 2 & Unit 3 are controlled via Wheelabrator-Fry electrostatic precipitators (ESP). The air pollution control equipment have design collection efficiencies of 99.9%.

See Figures 1 & 2 for diagrams of each units' sampling locations and stack dimensions.

Testing occurred while Units 2 and 3 operated at greater than 90% of normal full load. The percentage of mid sulfur eastern coal was varied (marker) with the addition of RPS in order to identify when RPS treated coal entered the boiler and testing could commence.

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[1] MDEQ, Test Plan, Submitted August 25, 2014. (Attached-Appendix A)

[2] MDEQ, Approval Letter. (Attached-Appendix A)

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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* or listed as an approved *"Other Test Method"*. 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	Oxygen & CO_2	Instrumental Analyzer Method
USEPA Method 4	Moisture Content	Field data analysis and reduction
USEPA Method 201A	$PM_{2.5}$	Gravimetric Analysis
USEPA Method 202	PM Condensables	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." During the emissions testing, four (4) sampling ports were utilized, sampling at three (3) points per port for a total of twelve (12) sampling points. Velocity traverses were conducted in conjunction with all testing method sample collection. See Figures 1 & 2 for diagrams of the traverse/sampling points used.

A cyclonic flow check was performed on both exhaust stack during their initial flow monitor certification RATAs. Testing at all sampling locations demonstrated that no cyclonic flow was present.

3.1.2 *Method 2 Sampling Equipment*

The EPA Method 2 sampling equipment consisted of a 0-10.0" incline manometer, S-type pitot tube (C_p = 0.798) and a type-K calibrated thermocouple.

3.2 OXYGEN AND CARBON DIOXIDE (USEPA Method 3A)

3.2.1 *Sampling Method*

Stack gas 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 O_2 / CO_2 analyzers utilize paramagnetic sensors.

3.2.2 *O_2 / CO_2 Sampling Train*

The Method 3A sampling system consisted of continuously collecting a gas sample from the exhaust of the dry gas meter during each test. The sample was drawn through a Teflon line into a Universal gas conditioner and into a Servomex 1400 O_2/CO_2 gas analyzer.

3.2.3 *Sampling Train Calibration*

The O_2 / CO_2 analyzer was calibrated according to procedures outlined in USEPA Method 7E. Zero, span, and mid range calibration gases were introduced directly into the analyzer to verify the instruments linearity. The O_2/CO_2 concentrations are recorded on the field data sheets.

3.3 MOISTURE DETERMINATION (USEPA Method 4)

3.3.1 *Sampling Method*

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

3.4 $PM_{2.5}$ AND CONDENSIBLE PM (USEPA METHODS 201A/202)

3.4.1 *PM_{10} / $PM_{2.5}$ Sampling (Method 201A)*

USEPA "Method 201A, "Determination of PM_{10} and $PM_{2.5}$ Emissions from Stationary Sources" was used to measure the $PM_{2.5}$ emissions (see Figure 3 for a schematic of the sampling train). Triplicate, 120-minute test runs were conducted on Unit 3. Triplicate, 60-minute test runs were conducted on Unit 2.

The Method 201A sampling train (Figure 3) consisted of the following:

(1) $PM_{2.5}$ Cyclone with nozzle
(2) 47 mm quartz filter capable of capturing 0.3um size particulate
(3) Stainless steel probe with glass liner with attached s-type pitot tube and Type K thermocouple
(4) Method 202 glassware
(5) Method 5 umbilical and meter box.

Prior to performing each test run the entire sampling train was leak checked. At the completion of each test the cyclone was removed and a final leak was performed at the outlet of the probe. After the cyclone cooled, it was disassembled and the two sections of the cyclone were rinsed with acetone and the filter was placed into a Petri dish which was sealed. The two collected fractions were as follows:

(1) PM $<_{2.5}$ microns – Back half of $PM_{2.5}$

(2) 47mm filter

The acetone rinses were collected into pre-cleaned sample containers. The containers were labeled with the test number, sample fraction, 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 then desiccated for 24 hours and weighed to a constant weight. 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.

3.4.2 Condensable Particulate Sampling Method (Method 202)

USEPA Method 202, "Dry Impinger method for Determining Condensable Particulate Emissions from Stationary Sources" was used to measure the condensable Particulate Matter Less Than $_{2.5}$ Microns (CPM) (see Figure 3 for a schematic of the sampling train). This method includes procedures for measuring both organic and

inorganic CPM. The Method 202 samples were collected in conjunction with the Method 201A samples as part of the sampling train.

The Method 202 impinger configuration (Figure 3 - after the Method 201A cyclone assembly) consisted of the following:

(1) Method 23 type condenser (capable of cooling the stack gas to less than 85 °F)
(2) Condensate dropout pot belly impinger (dry)
(3) Modified Greenburg-Smith impinger (dry) with no taper as a backup impinger
(4) 82.5mm glass filter holder with a Teflon filter (maintained at a temperature $\leq$ 85 °F)
(5) Modified Greenburg-Smith impinger containing 100 millimeters (ml) of distilled de-ionized (DDI) water
(6) Modified Greenburg-Smith impinger containing approximately 300 grams of silica gel desiccant.

The condensate dropout impinger and backup impinger were placed in an insulated box with water at $\leq$ 85 °F. The water and silica gel impingers were placed in an ice water bath to maintain the exit gas temperature from the silica gel impinger below 68 °F.

All Method 202 glassware was pre-cleaned prior to testing with soap and water, and rinsed using tap water, distilled de-ionized water, and acetone. After cleaning, the glassware was baked at 300 °C for 3 hours. Prior to each sampling run, the train glassware was rinsed thoroughly with distilled de-ionized ultra-filtered water.

As soon as possible after the post-test leak check was completed, the Method 201A filter and probe were detached from the Method 202 condenser and impinger train. The Method 202 impinger train was then carefully disassembled. The liquid volume of each impinger was measured (by weight) and recorded on the field data sheet. The silica gel was re-weighed, and any increase was recorded on the field data sheets. Moisture from the condensate dropout impinger was added to the second impinger. The Method 202 impinger train was purged with ultra-high purity compressed nitrogen at 14 liters per minute for one hour. During the purge the condenser recirculation pump was operated and the first two impingers were heated/cooled to maintain the gas temperature exiting the CPM filter below 85 °F. If insufficient water was collected in the dry impinger to allow the modified insert tip to extend below the water level, 50-100 ml of de-gassed, DDI water was added to the impinger and noted on the sampling data sheet.

Contents from the dropout impinger and the impinger prior to the CPM filter were collected into a pre-cleaned sample container. The condenser, impingers and front-half of the CPM filter holder were rinsed with DDI water and the rinses added to the sample container. The condenser, impingers and front-half of the CPM filter holder were then rinsed with acetone followed by two rinses with hexane. The acetone and hexane rinses were collected into a pre-cleaned sample container. The CPM filter was recovered and placed into a labeled container. All containers were 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.

Collected blanks consisted of an acetone rinse blank, a DDI water rinse blank and a hexane rinse blank taken directly from the bottles used during recovery of the samples. Additionally, a field train blank was assembled and recovered following the same procedures used to prepare and recover the test samples.

Analysis of the Method 202 samples and blanks were conducted by Maxxam Analytics of Mississauga, Ontario. All analysis followed the procedures listed in Method 202. A complete laboratory report is located in Appendix C.

Field data sheets for the Method 201A/202 sampling can be found in Appendix B.

3.4.3 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in EPA Methods 201A/202.

3.4.4 Data Reduction

$PM_{2.5}$ sampling was performed utilizing Environmental Supply Company software. Emission rates were calculated utilizing this software as well. The CPM results for each test were blank corrected, as allowed by the Method, using either the blank train result or 2.0 milligrams (mg) which ever value was lower. Emissions data collected during the emissions testing was reported as grains per dry standard cubic foot (grains/DSCF), pounds per hour (lb/hr), and pounds per million British thermal unit (lbs/MMBtu).

4.0 OPERATING PARAMETERS

The test program included the collection of boiler load, precipitator, and stack emissions data during each test run. Parameters recorded included boiler load (K#/hr) and CEMs data (SO_2, NO_x, CO_2, and Opacity).

Coal samples were collected once each day during the testing and analyzed for heat content, percent sulfur, and metals.

Operational data and results of the fuel analysis are located in Appendix F.

5.0 DISCUSSION OF RESULTS

The results of the $PM_{2.5}$ emissions testing from Units 2 and 3 at River Rouge Power Plant are presented in Tables No 1 & 2.

Tables No. 1 & 2 present the $PM_{2.5}$ Emission Test Results for the December 9 and 30 emissions testing. Emissions test results are presented in grains per dry standard cubic foot (grains/DSCF), pounds per hour (lbs/hr), and pounds per Million British thermal units (lbs/MMBtu). Auxiliary test data presented for each test includes unit load in gross MegaWatts (GMW), opacity in percent (%), stack temperature in degrees Fahrenheit (^{o}F), 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). The particulate emissions in lbs/MMBtu were calculated using the fuel factor (Fd) derived from the coal analysis.

There is not a specific limit for $PM_{2.5}$ emissions in PTI 40-08E.

The first test run on Unit 2, performed December 30, was voided due to the impinger/Teflon sampling line freezing up during the testing. Additionally, water was visible in the CPM filter housing. Emissions were calculated based on three subsequent test runs (Runs 2-4). Due to limited amounts of RPS treated coal, the duration of each test run was reduced to 60 minutes in an effort to complete 3 test runs.

The first test run on Unit 3, performed December 9, was voided due to a broken probe liner. Emissions were calculated based on three subsequent test runs (Runs 2-4).

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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."

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Table No. 1
$PM_{2.5}$ EMISSION TEST RESULTS - (RPS)
River Rouge Power Plant - Unit 2
December 30, 2014

Test	Test Time	Unit Load (GMW)	Stack Temperature (°F)	CO_2 (%)	Stack Velocity (ft/min)	Exhaust Gas Flowrates (SCFM)	Exhaust Gas Flowrates (DSCFM)	$PM_{2.5}$ Emissions (grains/dscf)	$PM_{2.5}$ Emissions (lbs/hr)	$PM_{2.5}$ Emissions (lbs/MMBtu)	Condensible PM Emissions (grains/dscf)	Condensible PM Emissions (lbs/hr)	Condensible PM Emissions (lbs/MMBtu)	Opacity (%)
$PM_{2.5}$ - 2	12:01-13:18	237	248	8.9	1,746	746,907	697,371	<0.0004	<2.28	<0.0009	0.0053	31.51	0.0128	4.2
$PM_{2.5}$ - 3	13:55-15:06	234	248	9.3	1,636	699,364	653,688	<0.0004	<2.27	<0.0010	0.0075	41.75	0.0180	4.9
$PM_{2.5}$ - 4	15:43-16:50	233	250	9.3	1,665	709,902	669,870	<0.0004	<2.26	<0.0010	0.0074	42.50	0.0179	5.2
		235	*249*	*9.2*	*1,682*	*718,724*	*673,643*	*<0.0004*	*<2.27*	*<0.0010*	*0.0067*	*38.59*	*0.0162*	*4.8*

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Table No. 2
$PM_{2.5}$ EMISSION TEST RESULTS - (RPS)
River Rouge Power Plant - Unit 3
December 9, 2014

Test	Test Time	Unit Load (GMW)	Stack Temperature (°F)	CO_2 (%)	Stack Velocity (ft/min)	Exhaust Gas Flowrates (SCFM)	Exhaust Gas Flowrates (DSCFM)	$PM_{2.5}$ Emissions (grains/dscf)	$PM_{2.5}$ Emissions (lbs/hr)	$PM_{2.5}$ Emissions (lbs/MMBtu)	Condensible PM Emissions (grains/dscf)	Condensible PM Emissions (lbs/hr)	Condensible PM Emissions (lbs/MMBtu)	Opacity (%)
$PM_{2.5}$ - 2	9:31-11:46	276	329	11.5	2,578	755,642	700,265	<0.0002	<1.06	<0.0004	0.0041	24.43	0.0096	2.8
$PM_{2.5}$ - 3	12:16-14:44	275	334	11.7	2,797	815,165	756,085	<0.0002	<1.10	<0.0004	0.0043	27.91	0.0101	2.9
$PM_{2.5}$ - 4	15:16-17:39	275	332	11.7	2,731	797,265	742,280	<0.0002	<1.09	<0.0004	0.0046	29.25	0.0108	2.9
		275	*332*	*11.6*	*2,702*	*789,357*	*732,877*	*<0.0002*	*<1.08*	*<0.0004*	*0.0043*	*27.20*	*0.0102*	*2.9*

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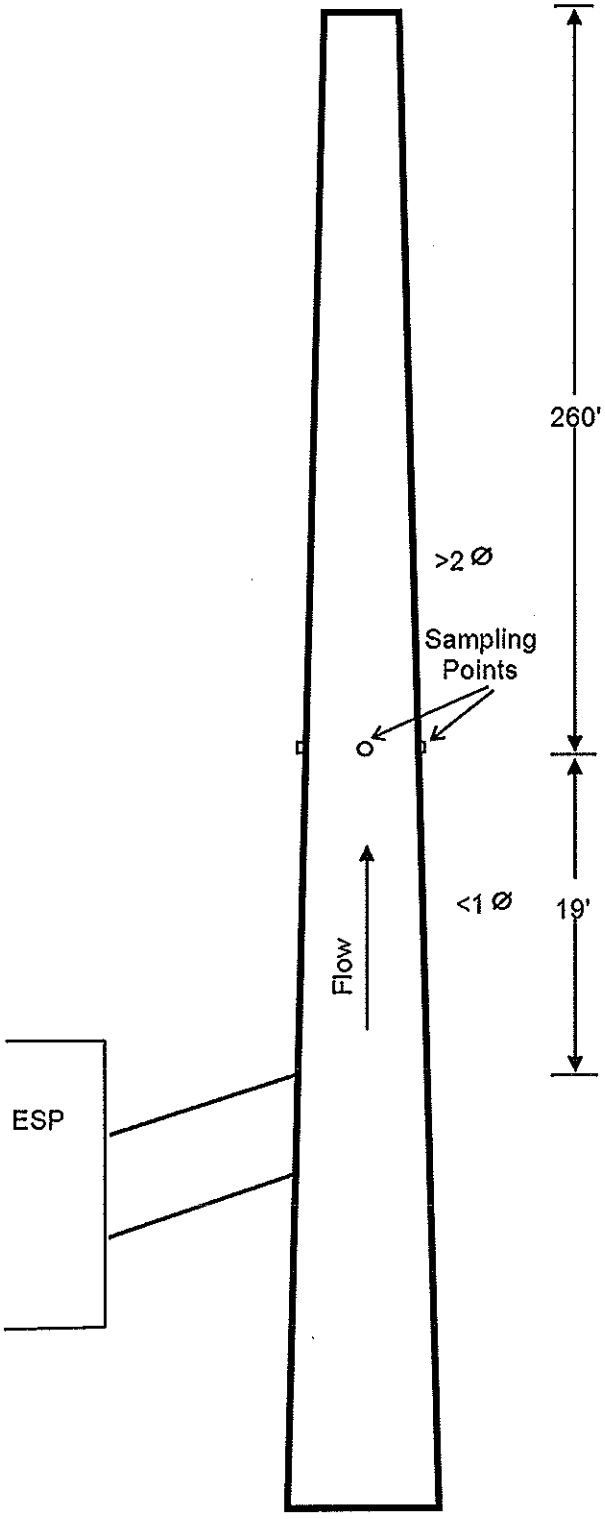
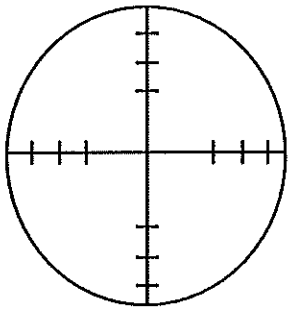
Figure 1 – Sampling Location
River Rouge Power Plant - Unit 2
December 9 & 30, 2014



Stack Diameter 320.3"



Velocity Measurement Points

Points	Distance From Inner Wall
1	14 1/8
2	46 3/4
3	94 3/4

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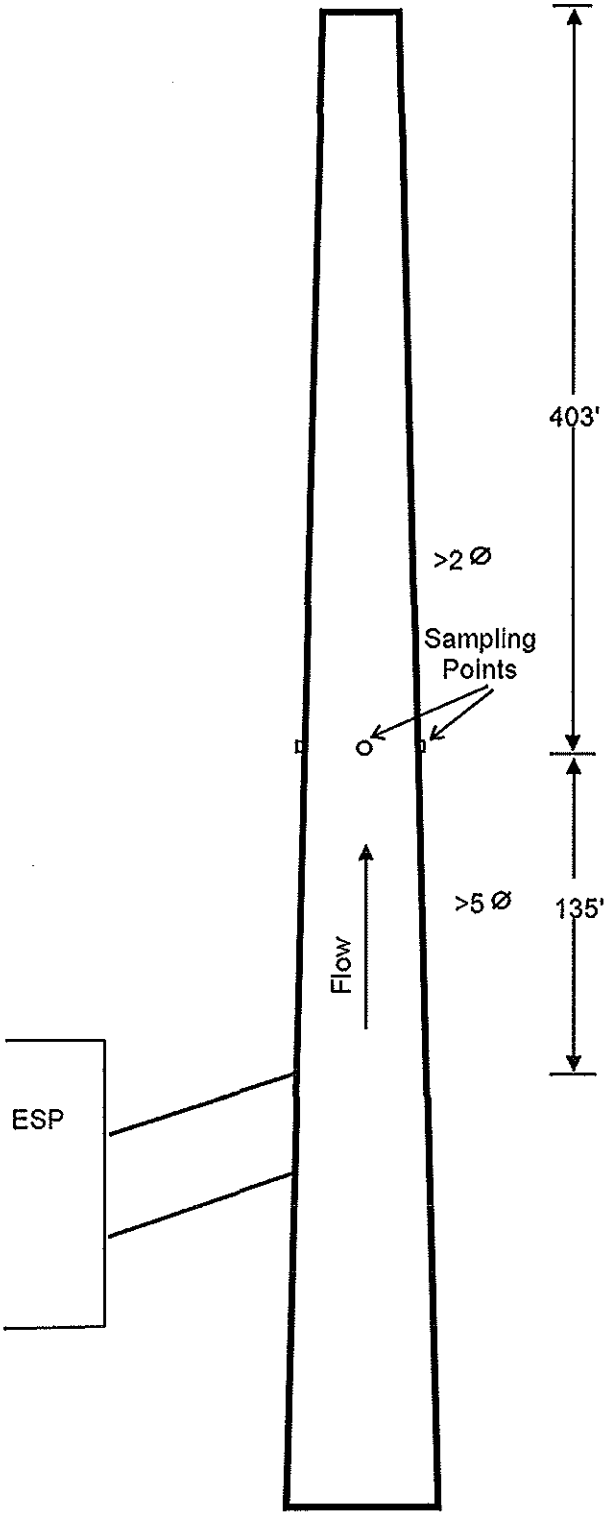
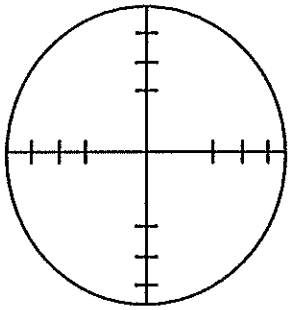
Figure 2 – Sampling Location
River Rouge Power Plant – Unit 3
December 9 & 30, 2014



Stack Diameter 282"



Velocity Measurement Points

Points	Distance From Inner Wall
1	12 3/8
2	41 1/8
3	83 1/2

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Figure 3 – EPA Method 201A/202
River Rouge Power Plant
December 9 & 30, 2014

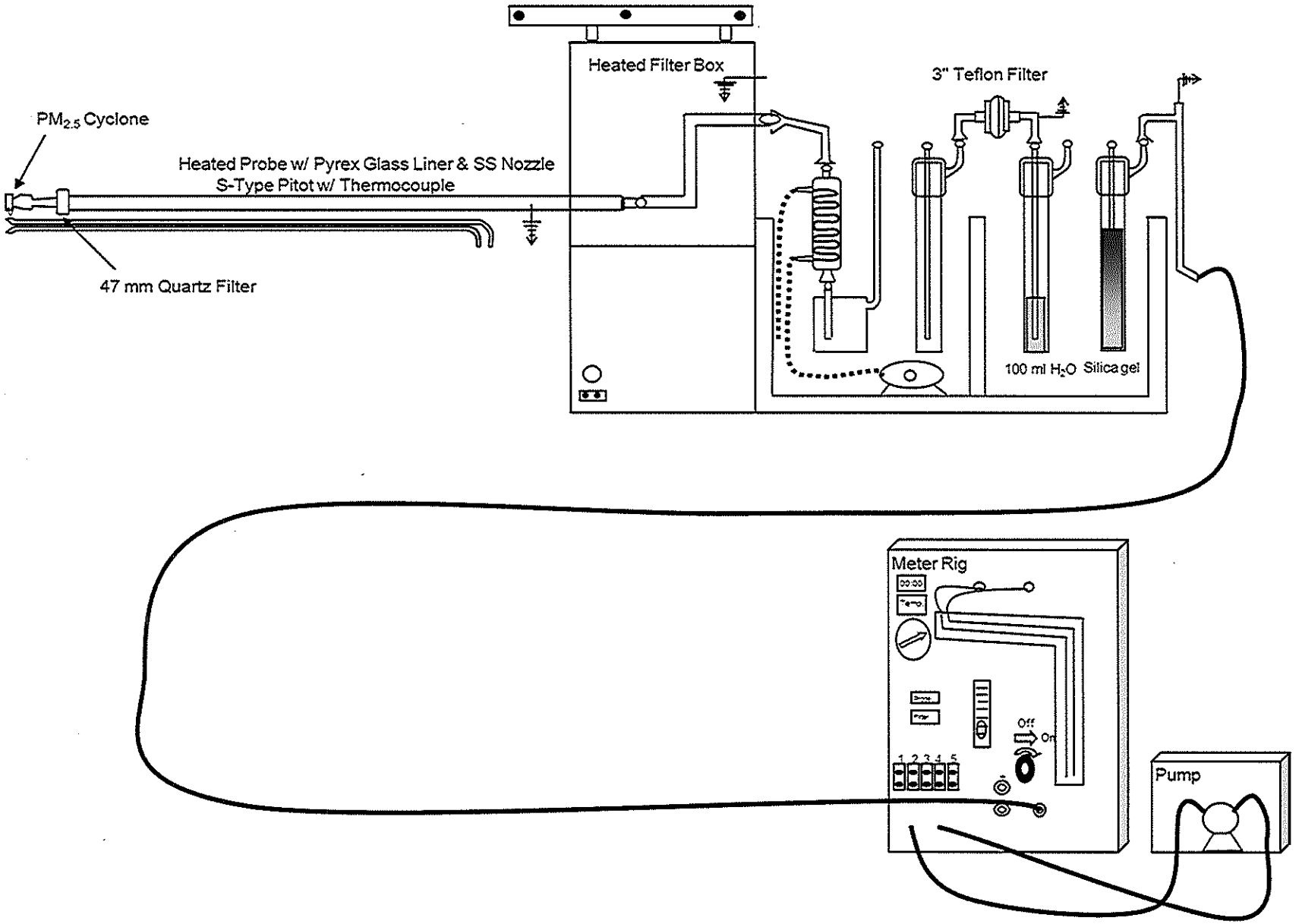

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Figure 4 – EPA Method 3A
River Rouge Power Plant
December 9 & 30, 2014