mostardi platt

Compliance Emissions Test Report

Performed for: Upper Michigan Energy Resources Corporation
At The: A.J. Mihm Generating Station
Permit No. 34-17
EURICE2 Outlet Duct
Pelkie, Michigan
June 26, 2019

Report Submittal Date
August 7, 2019

Project No. M190803E

Chicago, IL | Crown Point, IN | Concord, NC | Mendota Heights, MN | Denver, CO

Corporate Headquarters
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Elmhurst, Illinois 60126
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1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a nitrogen oxide compliance emissions test program for Upper Michigan Energy Resources Corporation (UMERC) on June 26, 2019 at A.J. Mihm Generating Station on the Reciprocating Internal Combustion Engine 2 (EURICE2) Outlet Duct in Pelkie, Michigan. The purpose of the test program was to meet the initial compliance demonstration requirements for emission rates in accordance with Permit to Install 34-17 and 40 CFR Part 60 Subpart JJJJ. This report summarizes the results of the test program and test methods used.

The test location, test date, and test parameters are summarized below.

Test Location	Test Date	Test Parameters
EURICE2 Outlet Duct	June 26, 2019	Nitrogen Oxides (NO_x), Volumetric Flow and Moisture

A.J. Mihm Generating Station electric generation facility includes three (3) Wärtsilä W18V50SG natural gas-fired, four stroke, lean burn, spark ignition reciprocating internal combustion engines (RICE) coupled to 18,817 kW electric generators, a 1,000 kW natural gas-fired emergency generator, and one natural gas-fired natural gas conditioning heater. The RICE electric generating unit engines utilize pipeline quality natural gas and are equipped with selective catalytic reduction (SCR) for nitrogen oxides (NOx) control and oxidation catalyst systems for carbon monoxide (CO), volatile organic compound (VOC), and organic hazardous air pollutant (HAP) control. Each RICE electric generating unit exhausts into an individual stack.

Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

TEST RESULTS				
Test Location	**Test Date**	**Test Parameter**	**Emission Rate**	**Emission Limit**
EURICE2 Outlet Duct	6/26/19	NO_x	3.2 ppmvd @ 15% O_2	82 ppmvd @ 15% O_2
			2.1 lb/hr	3.0 lb/hr

Plant operating data supplied by plant personnel is included in Appendix A. All testing was performed at full load operating condition.

The identifications of the individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	**Address**	**Contact**
Test Coordinator	WEC Energy Group, Inc 231 W. Michigan Street Milwaukee, Wisconsin 53203	Mr. Justin Kowalski (414) 221-2265 office Justin.kowalski@wecenergygroup.com
Test Facility	Upper Michigan Energy Resources Corporation A.J. Mihm Generating Station 16017 Sarya Road Pelkie, Michigan 49958	
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. Sean Dyra (630) 993-2100 (phone) sdyra@mp-mail.com

The test crew consisted of Messrs. N. Colangelo, C. Goddard and S. Dyra of Mostardi Platt.

2.0 TEST METHODOLOGY

Emission testing was conducted following the methods specified in Code of Federal Regulations, Title 40, Part 60, Appendix A (40CFR60), 40CFR51, and 40CFR63. Schematics of the test section diagrams and sampling trains used are included in Appendix B and C, respectively. Calculation examples and nomenclature are included in Appendix D. Copies of analyzer print-outs and field data sheets for each test run are included in Appendices E and F, respectively.

The following methodologies were used during the test program:

Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1. The characteristics of the measurement location are summarized below.

TEST POINT INFORMATION						
Location	**Diameter (Feet)**	**Area (Square Feet)**	**Upstream Distance (Inches)**	**Downstream Distance (Inches)**	**Test Parameter**	**Number of Sampling Points**
EURICE2 Outlet Duct	5.29	21.979	>0.5	>2.0	Volumetric Flow	16
					NO_x	12 (strat), 3

A null point pitot traverse check was performed utilizing a Type S pitot tube prior to any testing to verify the absence of cyclonic flow at each test location per USEPA Method 1, Section 11.4. The null point at the test location averaged 6.6 degrees which meets the requirements. The results can be found in Appendix E.

Method 2 Volumetric Flowrate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate. An S-type pitot tube, differential pressure gauge, Thermoouple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

Flue gas O_2 was determined in accordance with Method 3A. An ECOM analyzer was used to determine stack gas oxygen content connected to the outlet of the FTIR analyzer.

Flue gas carbon dioxide concentrations were determined in accordance with Method 3A. An MKS MultiGas 2030 FTIR spectrometer was used to determine the CO_2 concentrations, in the manner specified in the Method. Nitrogen content was determined from the difference of CO_2 and O_2.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 375°F. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

All of the equipment used was calibrated in accordance with the specifications of the Method and calibration data are included in Appendix G. Copies of the gas cylinder certifications are included in Appendix I.

Method 7E Nitrogen Oxide (NO_X) Determination

Flue gas nitrogen oxide concentrations and emission rates were determined in accordance with Method 7E. An MKS MultiGas 2030 FTIR spectrometer was used to determine nitrogen oxide concentrations, in the manner specified in the Method.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 375°F. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix G. Copies of calibration gas certifications can be found in Appendix I.

Method 320 Fourier Transform Infrared (FTIR) Detector for Moisture

The Method 320 sampling and measurement system meets the requirements of US EPA Reference Method 320, "Vapor Phase Organic and Inorganic Emissions by Extractive FTIR," 40CFR63, Appendix A. This method applies to the measurement of moisture content in the stack effluent. With this method, gas samples are extracted from the sample locations through heated Teflon sample lines to the analyzers.

FTIR technology works on the principle that most gases absorb infrared light. This is true for all compounds with the exception of homonuclear diatomic molecules and noble gases such as: N2, O2, H2, He, Ne, and Ar. Vibrations, stretches, bends, and rotations within the bonds of a molecule determine the infrared absorption distinctiveness. The absorption creates a "fingerprint" which is unique to each given compound.

The quantity of infrared light absorbed is proportional to the gas concentration. Most compounds have absorbencies at different infrared frequencies, thus allowing the simultaneous analysis of multiple compounds at one time. The FTIR software compares each sample spectrum to a user-selected list of calibration references and concentration data is generated. FTIR data was collected using an MKS MultiGas 2030 FTIR spectrometer. The FTIR was equipped with a temperature-controlled, 5.11 meter multi-pass gas cell maintained at 191°C. Gas flows and sampling system pressures were monitored using a rotameter and pressure transducer.

All data was collected at 0.5 cm^{-1} resolution. Each spectrum was derived from the coaddition of 62 scans, with a new data point generated approximately every one minute. Analyzer data for each run is present is Appendix E.

All QA/QC procedures were within the acceptance criteria allowance of Method 320. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H. As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results to ensure that there are no spectral interferences.

3.0 TEST RESULT SUMMARY

Upper Michigan Energy Resources Corporation
Mihm Generating Station
EURICE2
Gaseous Summary

Test No.	Date	Start Time	End Time	NO_x ppmvd	NO_x ppmvd @ 15% O_2	O_2 % (dry)	Moisture, %	Flowrate, DSCFM	Flowrate, SCFM
1	06/26/19	11:20	12:23	5.4	3.4	11.5	10.1	58,458	65,025
2	06/26/19	12:45	13:47	5.4	3.4	11.5	10.1	58,205	64,744
3	06/26/19	14:05	15:06	4.5	2.8	11.5	10.3	58,416	65,051
Average				5.1	3.2	11.5	10.2	58,360	64,940

Emission Rate Summary

Test No.	Date	Start Time	End Time	Fd Factor, dscf/MMBtu	O2 based NOx lb/MMBtu	NO_x lb/hr
1	06/26/19	11:20	12:23	8,710.0	0.012	2.26
2	06/26/19	12:45	13:47	8,710.0	0.012	2.25
3	06/26/19	14:05	15:06	8,710.0	0.010	1.88
Average				8,710.0	0.011	2.13

4.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to Upper Michigan Energy Resources Corporation. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT

Program Manager

Sean Dyra

Quality Assurance

Scott W. Banach

APPENDICES

Appendix A – Plant Operating Data

A.J. Mihm Generating Station
Compliance Emissions Testing
Summary of Operating Data

EURICE2				
6/26/2019				
Method 2, 3A, 7E, and 320				
Start Time	*1120*	*1245*	*1405*	
End Time	*1223*	*1347*	*1506*	
	Run 1	**Run 2**	**Run 3**	**Average**
Engine (kW)	18,866	18,868	18,875	**18,870**
Engine natural gas use (pound/hour)	6,728	6,691	6,714	**6,711**
SCR/Oxidation catalyst inlet temperature (deg F)	719	723	721	**721**
Pressure drop across the oxidation catalyst (PSI)	0.10	0.10	0.10	**0.10**
Urea injection rate to the SCR (gallons/hour)	6.3	6.2	6.0	**6.2**

EURICE2

SCR/Oxidation Catalyst Inlet Temperature

Start Time	End Time	Value/Average (Deg F)
06-26-2019 11:00 EST	06-26-2019 11:05 EST	714
06-26-2019 11:05 EST	06-26-2019 11:10 EST	714
06-26-2019 11:10 EST	06-26-2019 11:15 EST	714
06-26-2019 11:15 EST	06-26-2019 11:20 EST	715
06-26-2019 11:20 EST	06-26-2019 11:25 EST	716
06-26-2019 11:25 EST	06-26-2019 11:30 EST	716
06-26-2019 11:30 EST	06-26-2019 11:35 EST	716
06-26-2019 11:35 EST	06-26-2019 11:40 EST	716
06-26-2019 11:40 EST	06-26-2019 11:45 EST	716
06-26-2019 11:45 EST	06-26-2019 11:50 EST	716
06-26-2019 11:50 EST	06-26-2019 11:55 EST	716
06-26-2019 11:55 EST	06-26-2019 12:00 EST	720
06-26-2019 12:00 EST	06-26-2019 12:05 EST	721
06-26-2019 12:05 EST	06-26-2019 12:10 EST	723
06-26-2019 12:10 EST	06-26-2019 12:15 EST	723
06-26-2019 12:15 EST	06-26-2019 12:20 EST	723
06-26-2019 12:20 EST	06-26-2019 12:25 EST	723
06-26-2019 12:25 EST	06-26-2019 12:30 EST	723
06-26-2019 12:30 EST	06-26-2019 12:35 EST	723
06-26-2019 12:35 EST	06-26-2019 12:40 EST	723
06-26-2019 12:40 EST	06-26-2019 12:45 EST	723
06-26-2019 12:45 EST	06-26-2019 12:50 EST	724
06-26-2019 12:50 EST	06-26-2019 12:55 EST	723
06-26-2019 12:55 EST	06-26-2019 13:00 EST	723
06-26-2019 13:00 EST	06-26-2019 13:05 EST	723
06-26-2019 13:05 EST	06-26-2019 13:10 EST	723
06-26-2019 13:10 EST	06-26-2019 13:15 EST	723
06-26-2019 13:15 EST	06-26-2019 13:20 EST	723
06-26-2019 13:20 EST	06-26-2019 13:25 EST	723
06-26-2019 13:25 EST	06-26-2019 13:30 EST	723
06-26-2019 13:30 EST	06-26-2019 13:35 EST	723
06-26-2019 13:35 EST	06-26-2019 13:40 EST	723
06-26-2019 13:40 EST	06-26-2019 13:45 EST	723
06-26-2019 13:45 EST	06-26-2019 13:50 EST	723
06-26-2019 13:50 EST	06-26-2019 13:55 EST	722
06-26-2019 13:55 EST	06-26-2019 14:00 EST	722
06-26-2019 14:00 EST	06-26-2019 14:05 EST	721
06-26-2019 14:05 EST	06-26-2019 14:10 EST	721
06-26-2019 14:10 EST	06-26-2019 14:15 EST	721
06-26-2019 14:15 EST	06-26-2019 14:20 EST	721
06-26-2019 14:20 EST	06-26-2019 14:25 EST	721
06-26-2019 14:25 EST	06-26-2019 14:30 EST	721

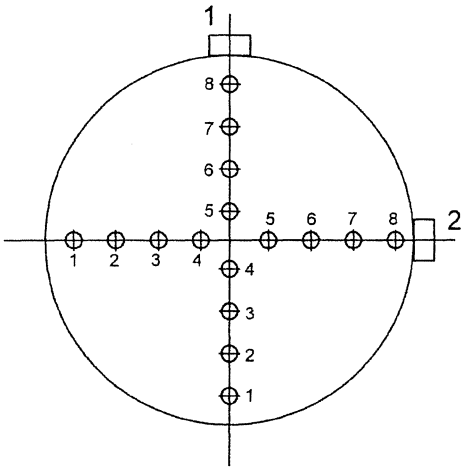
EURICE2

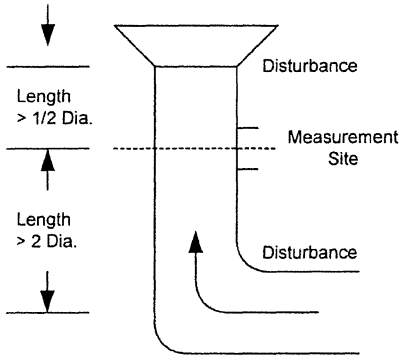
SCR/Oxidation Catalyst Inlet Temperature

Start Time	End Time	Value/Average (Deg F)
06-26-2019 14:30 EST	06-26-2019 14:35 EST	721
06-26-2019 14:35 EST	06-26-2019 14:40 EST	721
06-26-2019 14:40 EST	06-26-2019 14:45 EST	720
06-26-2019 14:45 EST	06-26-2019 14:50 EST	720
06-26-2019 14:50 EST	06-26-2019 14:55 EST	720
06-26-2019 14:55 EST	06-26-2019 15:00 EST	720
06-26-2019 15:00 EST	06-26-2019 15:05 EST	721
06-26-2019 15:05 EST	06-26-2019 15:10 EST	721
06-26-2019 15:10 EST	06-26-2019 15:15 EST	721
06-26-2019 15:15 EST	06-26-2019 15:20 EST	721
06-26-2019 15:20 EST	06-26-2019 15:25 EST	721
06-26-2019 15:25 EST	06-26-2019 15:30 EST	720

Appendix B - Test Section Diagrams

VOLUMETRIC FLOW TRAVERSE FOR ROUND DUCTS





Job: Upper Michigan Energy Resources Corporation
A.J. Mihm Generating Station

Date: 6/26/19

Test Location: EURICE2 Outlet Duct

Duct Diameter: 5.29 Feet

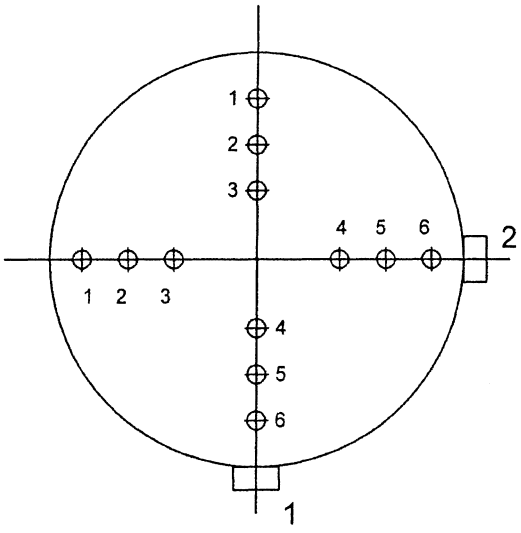
Duct Area: 21.979 Square Feet

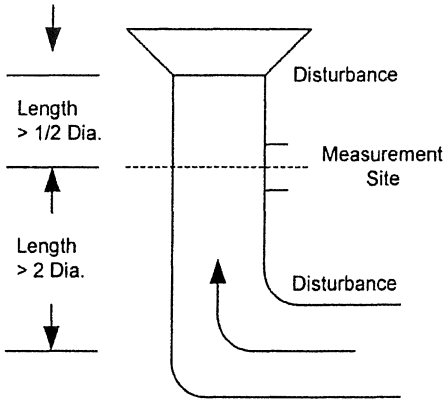
No. Points Across Diameter: 8

No. of Ports: 2

Port Length: 8.0 Inches

STRATIFICATION TRAVERSE FOR ROUND DUCTS





Job: Upper Michigan Energy Resources Corporation
A.J. Mihm Generating Station

Date: 6/26/19

Test Location: EURICE2 Outlet Duct

Duct Diameter: 5.29 Feet

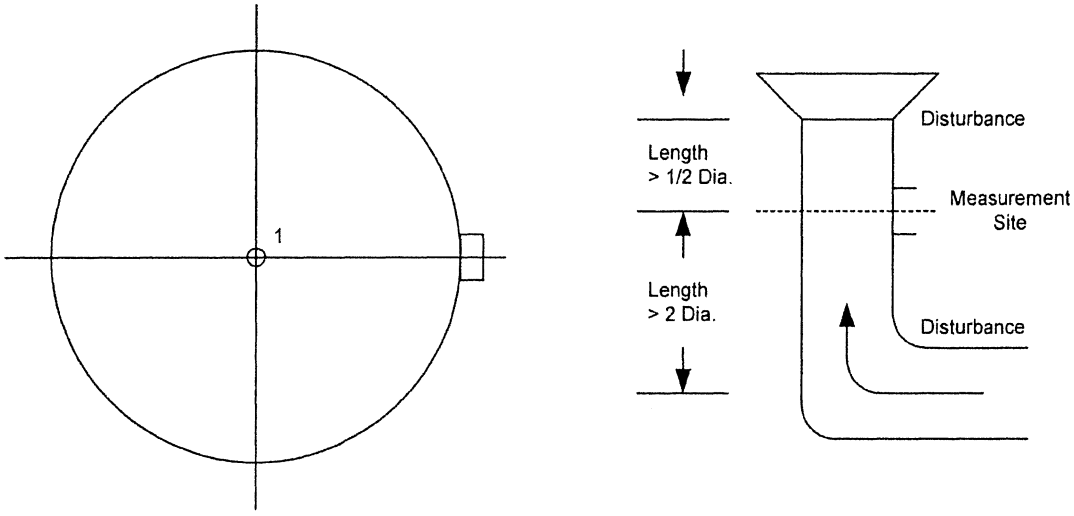
Duct Area: 21.979 Square Feet

No. Points Across Diameter: 6

No. of Ports: 2

Port Length: 8.0 Inches

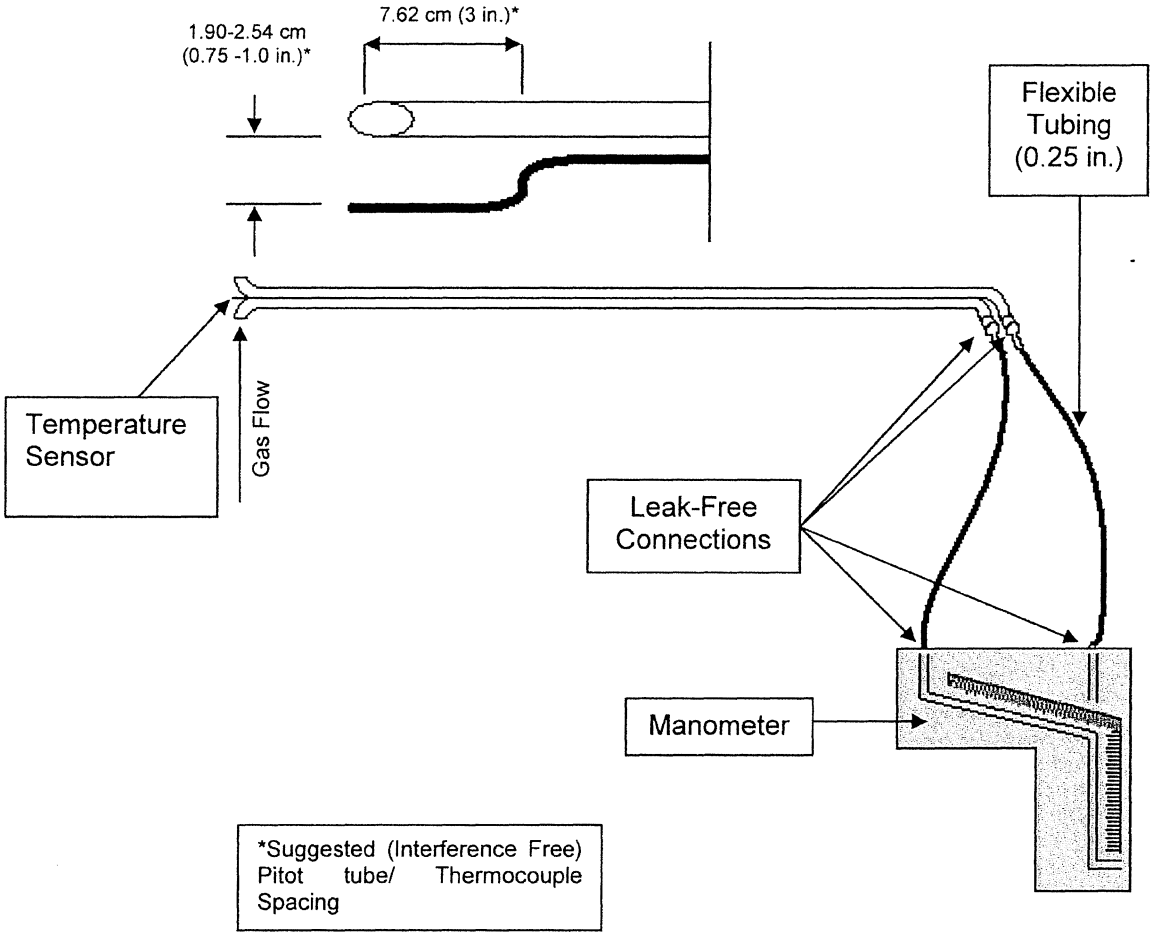
GASEOUS TRAVERSE FOR ROUND DUCTS



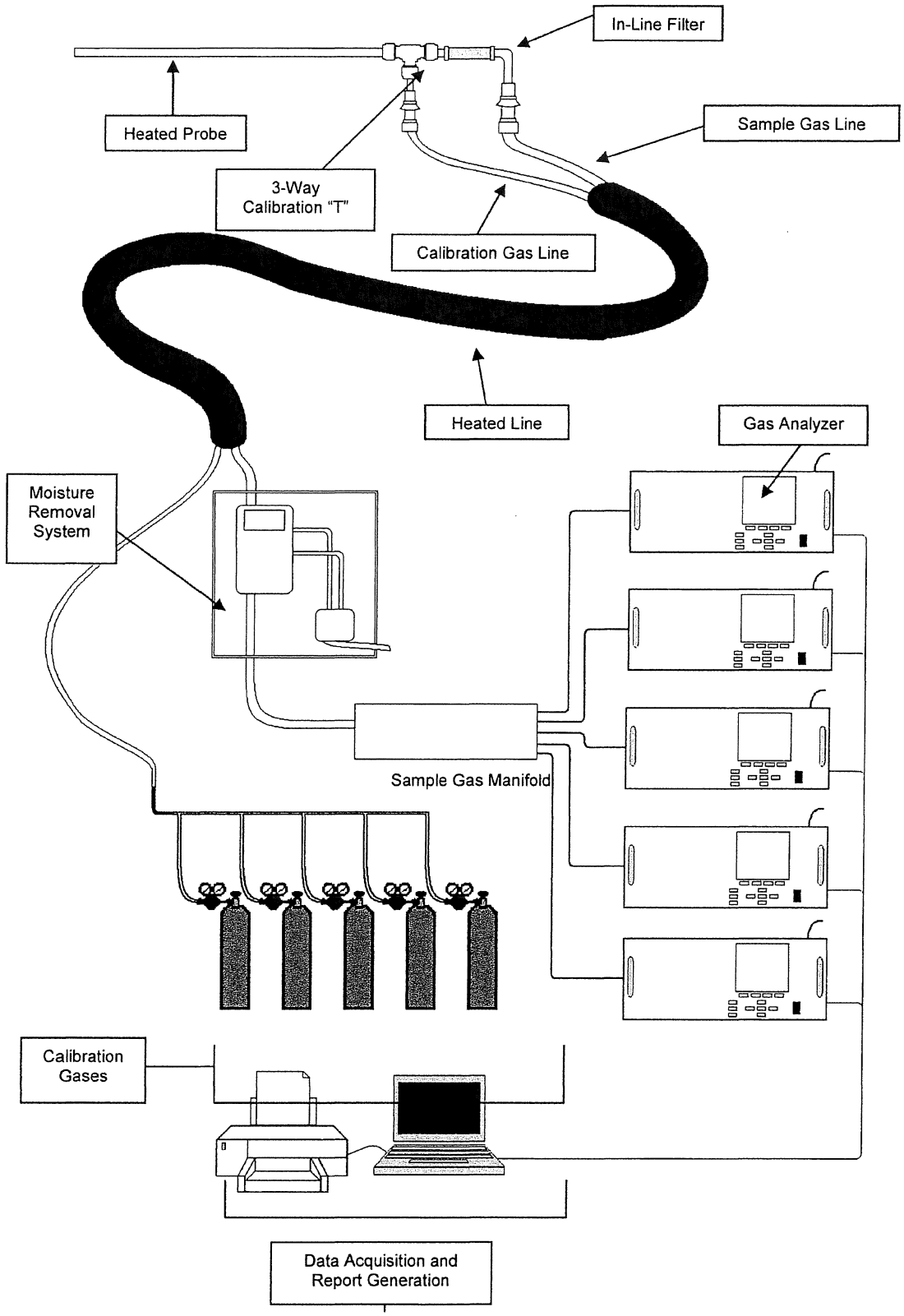
Job:	Upper Michigan Energy Resources Corporation A.J. Mihm Generating Station
Date:	6/26/19
Test Location:	EURICE2 Outlet Duct
Duct Diameter:	5.29 Feet
Duct Area:	21.979 Square Feet
No. Points Across Diameter:	1
No. of Ports:	1
Port Length:	8.0 Inches

Appendix C - Sample Train Diagrams

USEPA Method 2 – Type S Pitot Tube Manometer Assembly



USEPA Method 3A Extractive Gaseous Sampling Diagram



USEPA Method 320 – Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy Sample Train Diagram