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REPORT ON MERCURY RELATIVE ACCURACY TEST AUDIT

Monroe Power Plant

Unit 1 Stack & Unit 2 Stack

DTE Electric Company
One Energy Plaza
Detroit, Michigan 48226

DTE Energy – Monroe Power Plant
3500 East Front Street
Monroe, Michigan 48161
Client Reference No. 4701845689

CleanAir Project No. 15123
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COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Report Submittal:

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January 15, 2024

Date

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REPORT REVISION HISTORY

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ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)
acfm (actual cubic feet per minute)
ACI (activated carbon injection)
ADL (above detection limit)
AIG (ammonia injection grid)
APC (air pollution control)
AQCS (air quality control system(s))
ASME (American Society of Mechanical Engineers)
ASTM (American Society for Testing and Materials)
BDL (below detection limit)
Btu (British thermal units)
CAM (compliance assurance monitoring)
CARB (California Air Resources Board)
CCM (Controlled Condensation Method)
CE (capture efficiency)
°C (degrees Celsius)
CEMS (continuous emissions monitoring system(s))
CFB (circulating fluidized bed)
CFR (Code of Federal Regulations)
cm (centimeter(s))
COMS (continuous opacity monitoring system(s))
CT (combustion turbine)
CTI (Cooling Technology Institute)
CTM (Conditional Test Method)
CVAAS (cold vapor atomic absorption spectroscopy)
CVAFS (cold vapor atomic fluorescence spectrometry)
DI H_2O (de-ionized water)
%dv (percent, dry volume)
DLL (detection level limited)
DE (destruction efficiency)
DCI (dry carbon injection)
DGM (dry gas meter)
dscf (dry standard cubic feet)
dscfm (dry standard cubic feet per minute)
dscm (dry standard cubic meter)
ESP (electrostatic precipitator)
FAMS (flue gas adsorbent mercury speciation)
°F (degrees Fahrenheit)
FB (field blank)
FCC (fluidized catalytic cracking)
FCCU (fluidized catalytic cracking unit)
FEGT (furnace exit gas temperatures)
FF (fabric filter)
FGD (flue gas desulfurization)
FIA (flame ionization analyzer)
FID (flame ionization detector)
FPD (flame photometric detection)
FRB (field reagent blank)
FSTM (flue gas sorbent total mercury)
ft (feet or foot)
ft^2 (square feet)
ft^3 (cubic feet)
ft/sec (feet per second)
FTIR (Fourier Transform Infrared Spectroscopy)
FTRB (field train reagent blank)
g (gram(s))
GC (gas chromatography)
GFAAS (graphite furnace atomic absorption spectroscopy)
GFC (gas filter correlation)
gr/dscf (grains per dry standard cubic feet)
> (greater than)/ ≥ (greater than or equal to)
g/s (grams per second)
H_2O (water)
HAP(s) (hazardous air pollutant(s))
HI (heat input)
hr (hour(s))
HR GC/MS (high-resolution gas chromatography and mass spectrometry)
HRVOC (highly reactive volatile organic compounds)
HSRG(s) (heat recovery steam generator(s))
HVT (high velocity thermocouple)
IC (ion chromatography)
IC/PCR (ion chromatography with post column reactor)
ICP/MS (inductively coupled argon plasma mass spectroscopy)
ID (induced draft)
in. (inch(es))
in. H_2O (inches water)
in. Hg (inches mercury)
IPA (isopropyl alcohol)
ISE (ion-specific electrode)
kg (kilogram(s))
kg/hr (kilogram(s) per hour)
< (less than)/ ≤ (less than or equal to)
L (liter(s))
lb (pound(s))
lb/hr (pound per hour)
lb/MMBtu (pound per million British thermal units)
lb/TBtu (pound per trillion British thermal units)
lb/lb-mole (pound per pound mole)
LR GC/MS (low-resolution gas chromatography and mass spectrometry)
m (meter)
m^3 (cubic meter)
MACT (maximum achievable control technology)
MASS® (Multi-Point Automated Sampling System)
MATS (Mercury and Air Toxics Standards)
MDL (method detection limit)
µg (microgram(s))
min. (minute(s))
mg (milligram(s))
ml (milliliter(s))
MMBtu (million British thermal units)
MW (megawatt(s))
NCASI (National Council for Air and Stream Improvement)
ND (non-detect)
NDIR (non-dispersive infrared)
NDO (natural draft opening)
NESHAP (National Emission Standards for Hazardous Air Pollutants)
ng (nanogram(s))
Nm^3 (Normal cubic meter)
% (percent)
PEMS (predictive emissions monitoring systems)
PFGC (pneumatic focusing gas chromatography)
pg (picogram(s))
PJFF (pulse jet fabric filter)
ppb (parts per billion)
PPE (personal protective equipment)
ppm (parts per million)
ppmdv (parts per million, dry volume)
ppmwv (parts per million, wet volume)
PSD (particle size distribution)
psi (pound(s) per square inch)
PTE (permanent total enclosure)
PTFE (polytetrafluoroethylene)
QA/QC (quality assurance/quality control)
QI (qualified individual)
QSTI (qualified source testing individual)
QSTO (qualified source testing observer)
RA (relative accuracy)
RATA (relative accuracy test audit)
RB (reagent blank)
RE (removal or reduction efficiency)
RM (reference method)
scf (standard cubic feet)
scfm (standard cubic feet per minute)
SCR (selective catalytic reduction)
SDA (spray dryer absorber)
SNCR (selective non-catalytic reduction)
STD (standard)
STMS (sorbent trap monitoring system)
TBtu (trillion British thermal units)
TEOM (Tapered Element Oscillating Microbalance)
TEQ (toxic equivalency quotient)
ton/hr (ton per hour)
ton/yr (ton per year)
TSS (third stage separator)
USEPA or EPA (United States Environmental Protection Agency)
UVA (ultraviolet absorption)
WFGD (wet flue gas desulfurization)
%wv (percent, wet volume)

1. PROJECT OVERVIEW

TEST PROGRAM SUMMARY

DTE Energy (DTE) contracted CleanAir Engineering (CleanAir) to perform a relative accuracy test audit (RATA) on a sorbent trap mercury (Hg) monitoring system (STMS) used for mercury compliance monitoring on the Units 1 and 2 Stacks at the Monroe Power Plant (MONPP) located in Monroe, Michigan.

The purpose of the test program was to complete an annual RATA on the STMS as required by 40 CFR 63, Subpart UUUUU, National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units. The STMS is a CleanAir MET-80 STMS sorbent trap monitoring system that meets or exceeds 40 CFR 60, Appendix B, Performance Specification 12B (PS 12B) requirements.

All testing was performed in accordance with the regulations set-forth by the United States Environmental Protection Agency (USEPA) and the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The reference method (RM) was USEPA Method 30B, detailed in 40 CFR 60, Appendix A.

All RATA testing was performed while the units were operating at an appropriate operating level based on the unit condition on the day of each test.

A summary of the test program results is presented below. Section 2 Results provide a more detailed account of the test conditions and data analysis. The appendices contain detailed sampling and analytical parameters that were used to calculate both the reference method and the STMS results in Table 1-1.

Table 1-1:
Summary of RATA Results

Source Constituent	Reference Method	Applicable Specification[1]	Regulation	Relative Accuracy (%)	Limit[2]
Unit 1 Stack (Probe 1)					
Hg (µg/dscm)	EPA 30B	PS12B	40 CFR 63, Subpart UUUUU	17.0	≤20% RM_{avg}
Unit 2 Stack (Probe 1)					
Hg (µg/dscm)	EPA 30B	PS12B	40 CFR 63, Subpart UUUUU	18.9	≤20% RM_{avg}

[1] Relative accuracy is expressed in terms of comparison to the reference method (% RM) - % or absolute µg/dscm difference.

[2] Specification limits included in Appendix B, Performance Specification 12B, Section 8.3.3 and Table 12B-1.

TEST PROGRAM DETAILS

MERCURY MONITORING SYSTEM INFORMATION

The mercury monitoring system is a CleanAir MET-80 STMS that samples flue gas at the EPA monitoring level of the Units 1 and 2 Stacks. A summary of STMS information including serial number is shown in Tables 1-2 and 1-3.

Table 1-2:
Unit 1 Mercury Monitoring System Information

Facility:	DTE Energy - Monroe Power Plant
Pollutant:	Mercury (Hg) Total Vapor Phase
Measurement Technology:	Hg Sorbent Trap Monitoring System
Manufacturer:	Clean Air Engineering
Model No.	MET-80XR2
Serial No.	1080MF-082212-B

Table 1-3:
Unit 2 Mercury Monitoring System Information

Facility:	DTE Energy - Monroe Power Plant
Pollutant:	Mercury (Hg) Total Vapor Phase
Measurement Technology:	Hg Sorbent Trap Monitoring System
Manufacturer:	Clean Air Engineering
Model No.	MET-80XR2
Serial No.	1080MF-082212-A

PARAMETERS

The test program included reference method measurements of total vapor-phase Hg using EPA Method 30B sampling and analysis procedures.

A summary of test parameters and methods is shown in Table 1-4.

Table 1-4:
Parameters and Test Methods Summary

Parameter	Test Method/Procedure
Mercury (Hg)	40 CFR 60, App A, M30B
Hg Relative Accuracy	MDEQ Air Pollution Control Rules, Part 11, R 336.2158 and Table 111 40 CFR 60, App B, PS 2 and PS 12B 40 CFR 63, Subpart UUUUU, App A, Section 4

SCHEDULE

Testing was performed on December 13 and 14, 2024. Tables 1-5 and 1-6 outline the on-site schedule followed during the test program.

Table 1-5:
Unit 1 Test Schedule

	PS 12B				RM 30B			
Run	Date/Time Start	Date/Time End	Trap A	Trap B	Date/Time Start	Date/Time End	Trap C	Trap D
1**	12/13/2023 06:59	12/13/2023 07:44	OL708911	OL708923	12/13/2023 06:59	12/13/2023 07:44	OL701565	OL701625
2	12/13/2023 08:07	12/13/2023 08:52	OL643411	OL708927	12/13/2023 08:07	12/13/2023 08:52	OL701648	OL701715
3	12/13/2023 09:04	12/13/2023 09:49	OL708819	OL708943	12/13/2023 09:04	12/13/2023 09:49	OL701533	OL701641
4	12/13/2023 10:01	12/13/2023 10:46	OL708761	OL708919	12/13/2023 10:01	12/13/2023 10:46	OL645181	OL705738
5	12/13/2023 10:57	12/13/2023 11:42	OL708762	OL708904	12/13/2023 10:57	12/13/2023 11:42	OL645163	OL701712
6	12/13/2023 11:53	12/13/2023 12:38	OL708853	OL708993	12/13/2023 11:53	12/13/2023 12:38	OL645168	OL701535
7	12/13/2023 12:50	12/13/2023 13:35	OL643414	OL643498	12/13/2023 12:50	12/13/2023 13:35	OL701519	OL701673
8	12/13/2023 13:45	12/13/2023 14:30	OL643479	OL643495	12/13/2023 13:45	12/13/2023 14:30	OL701513	OL701714
9	12/13/2023 14:41	12/13/2023 15:26	OL708942	OL708954	12/13/2023 14:41	12/13/2023 15:26	OL701572	OL701695
10	12/13/2023 15:41	12/13/2023 16:26	OL708822	OL708901	12/13/2023 15:41	12/13/2023 16:26	OL701669	OL701707

** Indicates data from this run are valid but excluded from the RA determination.

Table 1-6:
Unit 2 Test Schedule

	PS 12B				RM 30B			
Run	Date/Time Start	Date/Time End	Trap A	Trap B	Date/Time Start	Date/Time End	Trap C	Trap D
1	12/14/2023 08:08	12/14/2023 08:53	OL643468	OL708870	12/14/2023 08:08	12/14/2023 08:53	OL701609	OL701694
2**	12/14/2023 09:05	12/14/2023 09:50	OL708894	OL708973	12/14/2023 09:05	12/14/2023 09:50	OL701633	OL701679
3	12/14/2023 10:01	12/14/2023 10:46	OL708864	OL708920	12/14/2023 10:01	12/14/2023 10:46	OL701575	OL701718
4	12/14/2023 10:56	12/14/2023 11:41	OL708917	OL668976	12/14/2023 10:56	12/14/2023 11:41	OL671789	OL701561
5	12/14/2023 11:52	12/14/2023 12:37	OL708820	OL708909	12/14/2023 11:53	12/14/2023 12:38	OL671892	OL701742
6	12/14/2023 12:48	12/14/2023 13:33	OL708910	OL708906	12/14/2023 12:48	12/14/2023 13:33	OL645211	OL701570
7	12/14/2023 13:43	12/14/2023 14:28	OL708830	OL708878	12/14/2023 13:43	12/14/2023 14:28	OL701511	OL701532
8	12/14/2023 15:01	12/14/2023 15:46	OL708826	OL708912	12/14/2023 15:01	12/14/2023 15:46	OL701510	OL701646
9	12/14/2023 15:55	12/14/2023 16:40	OL708831	OL708865	12/14/2023 15:55	12/14/2023 16:40	OL701518	OL701612
10	12/14/2023 16:50	12/14/2023 17:35	OL708861	OL708875	12/14/2023 16:50	12/14/2023 17:35	OL701515	OL701684

** Indicates data from this run are valid but excluded from the RA determination.

DISCUSSION

Program Design

CleanAir performed the RM 30B sampling during the RATA tests. The RM 30B sorbent traps were manufactured by the Ohio Lumex Company. These traps contained two sections and included an iodinated, activated charcoal sorbent. A minimum of three traps, each spiked with 10 ng of mercury, were used to complete a spike recovery study in accordance with RM 30B requirements. The test run duration was 45 minutes to meet minimum sample mass (5 ng) and spike recovery study volume requirements.

MONPP technicians performed sorbent trap exchanges for the Unit 1 Hg STMS during the test program. The STMS traps contained the same type of sorbent (iodinated, activated charcoal) as is used during normal operation, except for the sorbent bed size being smaller (400 mg versus normally 1000 mg) to accommodate the short duration of the RATA runs. All PS 12B traps were spiked with 10 ng of mercury.

CleanAir performed sorbent trap analyses for both the EPA Method 30B and Performance Specification 12B (PS 12B) sorbent traps. Analysis was performed on-site using an Ohio Lumex model RA-915+ analyzer with RP-M324 detector, which utilizes thermal desorption with Zeeman atomic absorption spectrometry.

RATA Determination

All test runs included collection and analysis of traps in pairs. Only relative accuracy runs which met all QA/QC criteria for both traps were used. The average concentration of each pair of associated traps is reported in units of µg/dscm. The relative accuracy was calculated following the procedures specified in PS 12B, Section 8.3.

RATA Results Criteria

The criteria to evaluate the relative accuracy (RA) of the STMs is detailed in 40 CFR 63, Subpart UUUUU, Appendix A, Table A-2. A total of 10 sample runs were performed. The relative accuracy was based on nine valid sample runs following provisions allowed in 40 CFR 60, Appendix A, Performance Specification 12B, Section 8.3. The RA (6.75) passed the specification criteria of ≤ 20% RM_{avg}.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices.

Table 2-1:
MONPP Unit 1 – Mercury RATA Results Generated by DTE

RATA Set Label			P1_Q4_2023_RATA			
Run #	Start Date/Time	Duration	Ref Value	CEM Value	Run Used	Load
1	12/13/2023 06:59	45	0.245	0.174	N	474
2	12/13/2023 08:07	45	0.234	0.193	Y	672
3	12/13/2023 09:04	45	0.235	0.193	Y	761
4	12/13/2023 10:01	45	0.219	0.181	Y	758
5	12/13/2023 10:57	45	0.168	0.159	Y	736
6	12/13/2023 11:53	45	0.151	0.144	Y	643
7	12/13/2023 12:50	45	0.14	0.146	Y	531
8	12/13/2023 13:45	45	0.145	0.136	Y	413
9	12/13/2023 14:41	45	0.168	0.172	Y	413
10	12/13/2023 15:41	45	0.146	0.155	Y	442
Test #			1			
Average Load			597			
Operational Level			M			
Mean Of CEM			0.164			
Mean Of Reference			0.178			
Mean Of Difference			0.014			
Standard Deviation Of Difference			0.021			
Coefficient Of Confidence			0.016			
Relative Accuracy			16.98			
T-Value			2.306			
Bias Adjustment Factor			1			
Result			Passed			
RATA Frequency			4QTRS			
Testers						

Table 2-2:
MONPP Unit 2 – Mercury RATA Results Generated by DTE

RATA Set Label			P1_Q4_2023_RATA			
Run #	Start Date/Time	Duration	Ref Value	CEM Value	Run Used	Load
1	12/14/2023 08:08	45	0.25	0.221	Y	659
2	12/14/2023 09:05	45	0.281	0.229	N	736
3	12/14/2023 10:01	45	0.203	0.162	Y	573
4	12/14/2023 10:56	45	0.177	0.141	Y	507
5	12/14/2023 11:52	45	0.173	0.145	Y	520
6	12/14/2023 12:48	45	0.174	0.14	Y	388
7	12/14/2023 13:43	45	0.141	0.132	Y	385
8	12/14/2023 15:01	45	0.142	0.134	Y	385
9	12/14/2023 15:55	45	0.149	0.145	Y	423
10	12/14/2023 16:50	45	0.169	0.162	Y	525
Test #			1			
Average Load			485			
Operational Level			L			
Mean Of CEM			0.153			
Mean Of Reference			0.175			
Mean Of Difference			0.022			
Standard Deviation Of Difference			0.015			
Coefficient Of Confidence			0.011			
Relative Accuracy			18.93			
T-Value			2.306			
Bias Adjustment Factor			1			
Result			Passed			
RATA Frequency			4QTRS			
Testers						

Table 2-3:
Summary of RM 30B QA/QC Results – Unit 1 STMS (Probe 1)

			QA/QC and Performance											
			%Breakthrough			%Spike Recovery		Spike Recovery Study - Volume % Diff		Spike Recovery Study - Volume (dscm)		Pre-Test Leak Check	Post-Test Leak Check	
Run No.	Start Date/Time (EST)	Valid?[1]	Trap A	Trap B	Paired Trap Agreement	Trap A	Trap B	Trap A	Trap B	Trap A	Trap B	Trap A Trap B	Trap A	Trap B
1	12/13/2023 06:59	*PASS*	0.0%	0.0%	0.012 (µg/dscm)	n/a	n/a	-0.1%	-0.1%	0.051599	0.051592	PASS	PASS	
2	12/13/2023 08:07	*PASS*	0.0%	0.0%	0.002 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.051586	0.051581	PASS	PASS	
3	12/13/2023 09:04	*PASS*	0.0%	0.0%	0.004 (µg/dscm)	n/a	n/a	-0.1%	0.0%	0.051598	0.05159	PASS	PASS	
4	12/13/2023 10:01	*PASS*	0.0%	0.0%	0.002 (µg/dscm)	101.1% *	n/a	n/a	-0.1%	0.051581	0.051601	PASS	PASS	
5	12/13/2023 10:57	*PASS*	0.0%	0.0%	0.013 (µg/dscm)	93.3% *	n/a	n/a	-0.1%	0.051568	0.051595	PASS	PASS	
6	12/13/2023 11:53	*PASS*	0.0%	0.0%	0.016 (µg/dscm)	91.5% *	n/a	n/a	0.0%	0.051546	0.051571	PASS	PASS	
7	12/13/2023 12:50	*PASS*	0.0%	0.0%	0.004 (µg/dscm)	n/a	n/a	0.1%	0.0%	0.051537	0.051566	PASS	PASS	
8	12/13/2023 13:45	*PASS*	0.0%	0.0%	0.008 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.051546	0.051568	PASS	PASS	
9	12/13/2023 14:41	*PASS*	0.0%	0.0%	0.003 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.051541	0.051565	PASS	PASS	
10	12/13/2023 15:41	*PASS*	0.0%	0.0%	0.005 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.051565	0.051561	PASS	PASS	
						95.3%				0.05157				
						PASS								

[1] "*PASS*" indicates the sample run is valid and all required QA/QC specifications were met.

Table 2-4:
Summary of RM 30B QA/QC Results – Unit 2 STMS (Probe 1)

			QA/QC and Performance											
			%Breakthrough			%Spike Recovery		Spike Recovery Study - Volume % Diff		Spike Recovery Study - Volume (dscm)		Pre-Test Leak Check		Post-Test Leak Check	
Run No.	Start Date/Time (EST)	Valid?[1]	Trap A	Trap B	Paired Trap Agreement	Trap A	Trap B	Trap A	Trap B	Trap A	Trap B	Trap A	Trap B	Trap A	Trap B
1	12/14/2023 08:08	*PASS*	0.0%	0.0%	0.003 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.05155	0.05157	PASS		PASS	
2	12/14/2023 09:05	*PASS*	0.0%	0.0%	0.010 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.05156	0.05156	PASS		PASS	
3	12/14/2023 10:01	*PASS*	0.0%	0.0%	0.003 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.05156	0.05157	PASS		PASS	
4	12/14/2023 10:56	*PASS*	0.0%	0.0%	0.009 (µg/dscm)	104.5% *	n/a	n/a	0.0%	0.05156	0.05156	PASS		PASS	
5	12/14/2023 11:53	*PASS*	0.0%	0.0%	0.003 (µg/dscm)	101.7% *	n/a	n/a	0.0%	0.05156	0.05157	PASS		PASS	
6	12/14/2023 12:48	*PASS*	0.0%	0.0%	0.007 (µg/dscm)	103.5% *	n/a	n/a	0.0%	0.05155	0.05156	PASS		PASS	
7	12/14/2023 13:43	*PASS*	0.0%	0.0%	0.002 (µg/dscm)	n/a	n/a	-0.7%	-0.7%	0.05192	0.05194	PASS		PASS	
8	12/14/2023 15:01	*PASS*	0.0%	0.0%	0.002 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.05154	0.05156	PASS		PASS	
9	12/14/2023 15:55	*PASS*	0.0%	0.0%	0.006 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.05154	0.05156	PASS		PASS	
10	12/14/2023 16:50	*PASS*	0.0%	0.0%	0.011 (µg/dscm)	n/a	n/a	0.0%	0.0%	0.05154	0.05157	PASS		PASS	
						103.2%				0.05156					
						PASS									

[1] "*PASS*" indicates the sample run is valid and all required QA/QC specifications were met.

End of Section

3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

DTE Energy (DTE) owns and operates the Monroe Power Plant located in Monroe, Michigan. The station consists of a total of four coal-fired units identified as Units 1, 2, 3, and 4. The RATA testing outlined in this report was performed on Units 1 and 2.

All four units are coal-fired boilers that use a bituminous/subbituminous coal blend. The units are nominally rated at 835 Megawatts (Unit 1), 820 Megawatts (Unit 2), and 825 Megawatts (Units 3 and 4). Each unit is equipped with a flue gas desulphurization (FGD) Scrubber for SO_2 control, selective catalytic reduction (SCR) for NO_x minimization and electrostatic precipitators (ESP) for particulate control. Units 1 and 2 exhaust into separate flues that are contained in a common stack (Unit 1/2 stack). Units 3 and 4 also have separate flues and exhaust into a common stack (Unit 3/4 stack).

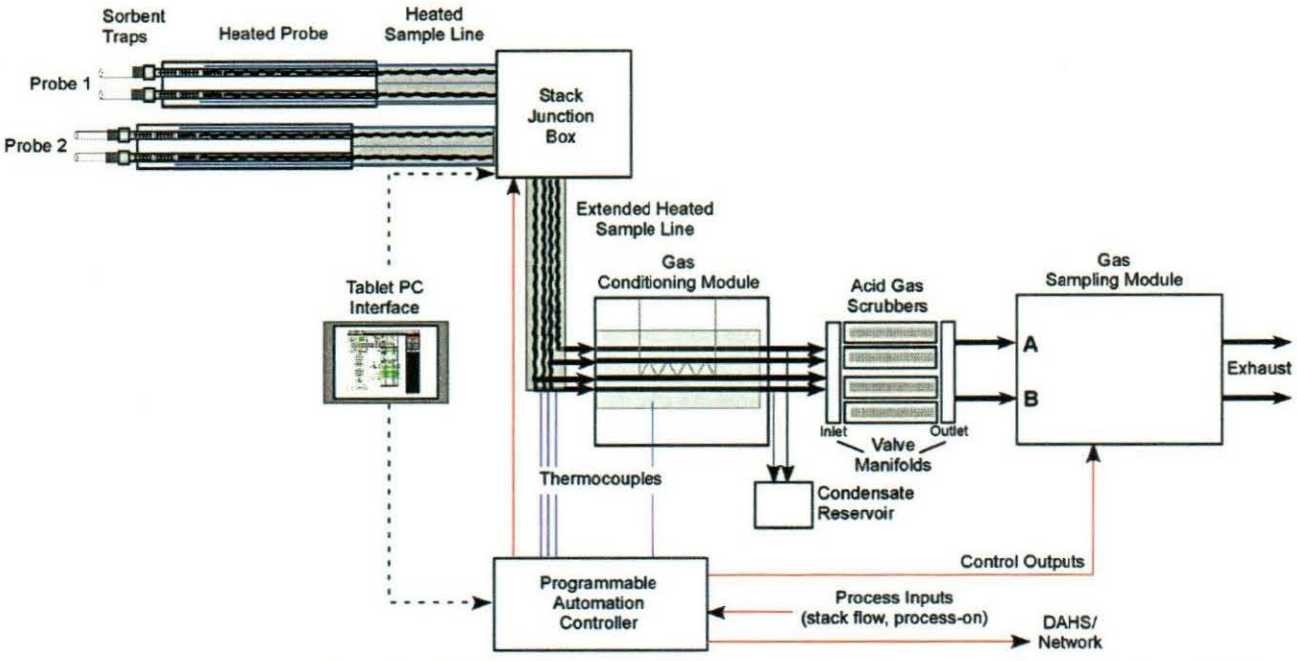
The sorbent trap probes for the Unit 1 STMS are installed at the 952 ft. elevation monitoring platform inside the annulus of the Unit 1/2 stack. Sample gas is transported through an extended heated sample line to an environmentally controlled shelter at grade where the autosampler cabinet is located. The reference method sampling was performed using an available EPA sampling port located on the same elevation as the STMS monitoring location.

STMS DESCRIPTION

The STMS consists of a Clean Air Engineering MET-80 dual-probe sorbent trap monitoring system (Model: MET-80XR2). Aside from the sorbent traps, the MET-80 system consists of five major hardware components; two independent sorbent trap probes each with integrated heated sample lines (HSL) attached to a stack junction box (SJB), a single extended heated sample line containing six (four used and two spare) Teflon pathways for transport of sample gas, an automated gas sampler, and a logic control system. The automated gas sampler and logic control system are enclosed in an instrument rack and located in an environmentally controlled CEM shelter at the base of the stack.

The dual probe system is designed to sample through one sample probe based on process input conditions and switch to the second probe when desired based on an input from the DAHS. The sample probes are identified as Probe 1 and Probe 2, and both contain a dual path (A and B). The two probes are not collocated and are installed in two independent port locations at the monitoring level. A schematic of the system is shown in Table 3-1.

Figure 3-1:
MET-80XR Dual Probe STMS Schematic (Units 1 & 2 Stacks)



The four sample paths remain independent through the extended heated sample line and through the gas conditioner where the moisture is removed from the sample gas. After the gas conditioning module, an automated valve manifold selects the required sample probe for monitoring. Two sample paths leave the valve manifold and pass through a scrubber material for collection or residual moisture and acid gases. The sample gas then enters the gas sampling module where the sample volume is measured using thermal mass flow meter technology.

The gas sampling module contains two mass flow meters per pathway (A and B). The dual range meters allow for a wide sample flow rate range (nominally 50 cc/min to 2000 cc/min). Sample gas flows through only one mass flow meter per side (A or B) depending on the target flow that is selected by the user and required for proportional sampling.

EPA Performance Specification 12B requires that a sample gas be withdrawn proportionally to changes in the flue gas flow rate. The MET-80 system uses a programmable automation controller (PAC) and a plant-supplied digital flow signal to adjust the sampling rate set-point, while the controller continuously adjusts the control valves in the GSM to maintain the sample flow rate.

During long term monitoring, each trap consists of three equal-mass sections (~1000 mg) of iodinated activated charcoal. The charcoal sorbent is pre-checked to certify that mercury background levels are below the detection limit of the laboratory instruments. Each trap is uniquely numbered with a barcode and printed on the outside of the glass tube. The third sorbent section is pre-spiked with a known quantity of elemental mercury.

TEST LOCATION

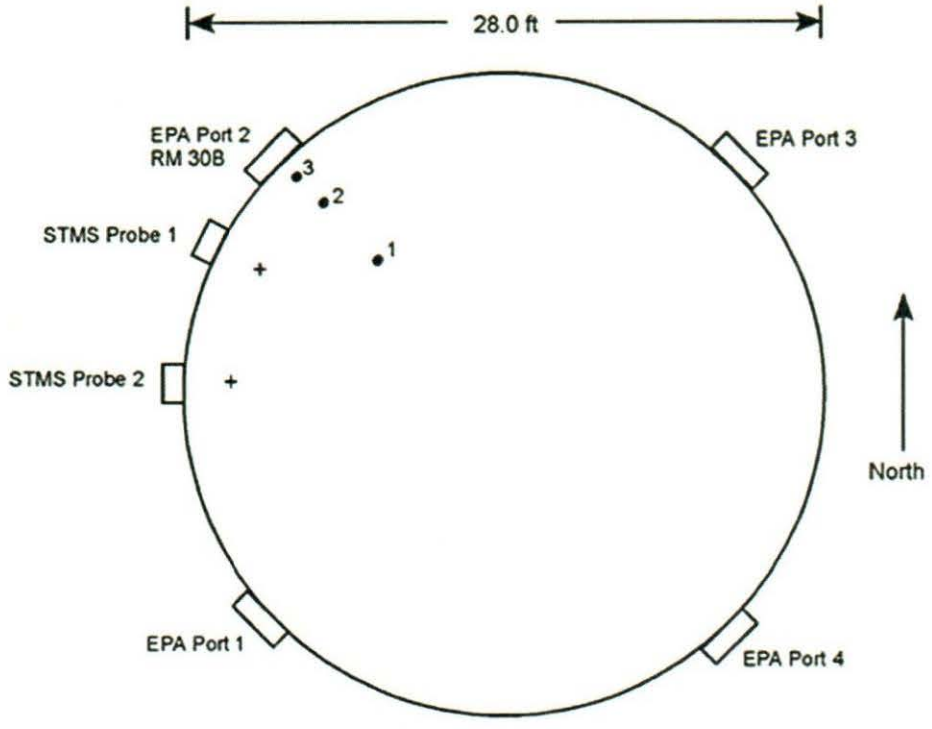
Based on facility Hg process monitor data just prior to the RATA and EPA M30B RA Runs 1 and 2, the mercury concentration was below 3 µg/dscm at the time of the RATA, therefore the sampling location was exempt from stratification testing (EPA M30B, Section 8.1.3.4). Reference method sampling was performed at three sample points located at 0.4, 1.2 and 2.0 meters from the stack wall in accordance with EPA M30B, Section 8.1.3.2.2.

Table 3-1 outlines the sampling point configurations. Figures 3-1 and 3-2 illustrate the sampling points and orientation of sampling ports for the test program.

Table 3-1:
Sampling Information

Source / Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Unit 1 and Unit 2 Stacks / Vapor-phase Hg	USEPA RM 30B	1-10	1	3	15	45	3-1

Figure 3-2:3-
Units 1 & 2 Stacks Sample Point Layout (EPA Method 30A, Section 8.1.3.4 and 8.1.3.2.2)



Sampling Point	Port to Point Distance (meters)
1	2.0
2	1.2
3	0.4

Duct diameters upstream from flow disturbance (A): >2 Limit: 0.5
Duct diameters downstream from flow disturbance (B): >8 Limit: 2.0

End of Section

4. METHODOLOGY

PROCEDURES AND REGULATIONS

The test program sampling measurements followed procedures and regulations outlined by the USEPA and EGLE. These methods appear in detail in Title 40 of the CFR and at https://www.epa.gov/emc.

Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery, and analytical procedures. Any modifications to standard test methods are explicitly indicated in this appendix. In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

TITLE 40 CFR PART 60, APPENDIX A

Method 30B "Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps"

TITLE 40 CFR PART 60, APPENDIX B PERFORMANCE SPECIFICATIONS

PS2 "Specifications and Test Procedures for SO_2 and NOx Continuous Emission Monitoring Systems in Stationary Sources"

PS12A "Specifications and Test Procedures for Total Vapor Phase Mercury Continuous Monitoring Systems in Stationary Sources"

PS12B "Specifications and Test Procedures for Monitoring Total Vapor Phase Mercury Continuous Monitoring Systems in Stationary Sources Using a Sorbent Trap Monitoring System"

TITLE 40 CFR PART 63, APPENDIX A

Section 4 "Certification and Recertification Requirements"

METHODOLOGY DISCUSSION

INTRODUCTION

Mercury measurements were made using sorbent trap technology and EPA 30B procedures. The following sections highlight the procedures used. Complete procedures and requirements of EPA 30B are found at *http://www.epa.gov/ttn/emc/promgate/Meth30B.pdf*.

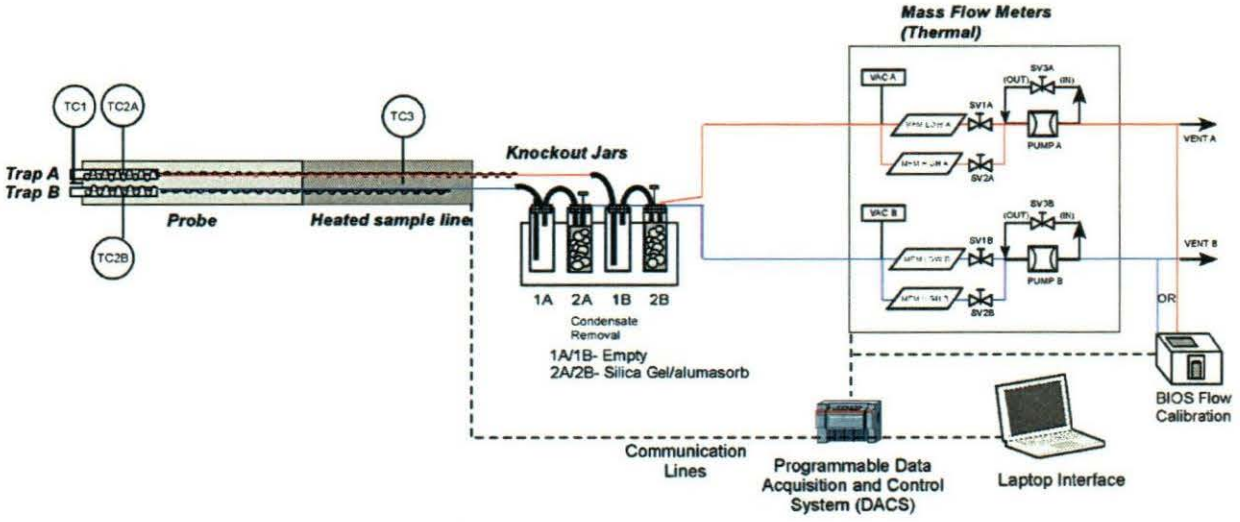
EPA Method 30B sampling procedures use two (or three) section sorbent traps containing an iodated activated charcoal sorbent. Sorbent traps were manufactured and supplied by Ohio Lumex Company located in Solon, Ohio. Known volumes of flue gas were extracted and passed through the sorbent traps for capture of total vapor phase mercury (oxidized and elemental). Sampling was performed using simultaneous, collocated, paired automated sampling systems as per EPA 30B specifications.

The following sections provide additional details for the sampling equipment, sampling procedures and QA/QC tests performed.

Reference Method Sampling System

Figure 4-1 contains a diagram of the sampling system used for EPA RM 30B sampling.

Figure 4-1:
EPA Method 30B Sampling System



System Overview

The sorbent trap sampling system conforms to EPA Method 30B specifications. The system included two independent sample paths (identified as A and B). Sample gas enters a single stainless steel or Hastelloy sample probe containing the two sorbent traps collocated in-situ to the flue gas. After passing through the traps, sample gas passes through a heated umbilical line, moisture removal components including an ice- bath condenser train and drierite scrubber, and an air-tight sample pump and a mass flow meter.

All system sensors, control and function are managed by an automated data acquisition and control system that uses a programmable automated controller. One-minute data averages were recorded for each sample run to a text file located on flash memory on the controller.

The sampling is a batch process. Using the dry gas sample volume measured by the sampling system and the results of the sorbent trap laboratory analyses, the average Hg concentration in the stack gas was determined on a dry basis.

Sorbent Traps

EPA 30B, Section 6.1.1, includes the specification for mercury sampling using sorbent traps that contain at least two sections and can capture gaseous total vapor phase mercury. The sorbent traps used to collect total vapor phase mercury typically contain activated charcoal that has been impregnated with a halogen such as iodine. Each sorbent trap section including applicable sorbent material is identified in Table 4-1. Each section is separated by quartz wool.

Table 4-1:
EPA Method 30B Sorbent Trap Construction

Section	Material	Description
1	Iodinated Activated Carbon (1)	Primary capture of total vapor phase mercury ($Hg^0 + Hg^{+2}$). Contains mercury spike for applicable QA/QC sample runs.
2	Iodinated Activated Carbon (2)	Secondary capture of elemental mercury (Hg^0). Results used to determine Section 1 breakthrough.

Sample Probe and Flexible Sample Line

EPA 30B, Section 6.1.2, includes the specification for the sampling probe assembly. The sorbent trap probe consists of a 316 stainless steel or Hastelloy sheath covering a pair of thermally controlled trap retaining devices and a separately controlled heated sample line containing dual PTFE tubes. The design accommodates the 30B requirement for collocated sorbent traps. This system is also designed for easy and rapid exchange of the traps between sampling periods.

Moisture Removal – Gas Conditioning Module

Moisture collection was performed using a condenser train system. The system employs a set of four knockout jars chilled in an ice bath.

Gas Sampling Module – Mass Flow Meters

After conditioning, the gas sample volume was measured in the gas sampling module. The module contains two independent gas paths, with each path containing a sampling pump (PTFE-coated diaphragm), two thermal mass flow meters and flow control solenoid valves.

Each flow meter has an independent solenoid valve for control of sample flow rate during sampling. Sampling is performed at a constant sampling rate during the test period (+/- 10%). A third solenoid control valve is used to adjust the system vacuum during leak checks.

Programmable Automated Control System/User Interface

System operation is managed by a programmable automated controller (PAC). The flow control system keeps sampling at the set target flow rate (+/-10%). The set-point is based on collecting an appropriate amount of mercury on the sorbent traps. The controller continuously adjusts the control valves in the gas sampling system to maintain the sample flow rate at the set-point.

The controller also records data in one-minute averages to an electronic data file that is saved to the PAC memory.

SAMPLING PROCEDURES

RM 30B operational details are shown in Table 4-2.

Table 4-2:
Summary of EPA 30B Operational Parameters

Method	40 CFR Part 60, Appendix A, Method 30B
Analyte Measured by Reference Method	Total vapor-phase mercury (Hg^0 + Hg^{+2})
Number of Valid RM Runs	10 (9 used for RA)
Length of RM Runs	45 minutes
Reference Method Traverse Points	Three points located at 0.4, 1.2, and 2.0 meters from the stack wall
Reference Method Time per Point	15 minutes
Reference Method Sampling Rate	1150 cc/min
Number of RM Samples per Run	Two (paired, co-located samples), identified as samples C and D
Sorbent Trap Manufacturer	Ohio Lumex
Number of Sections in Sorbent Trap	2
Sorbent Material	Iodinated, activated charcoal, petroleum based
Sorbent Quantity	400 mg per section (approximate)
Sorbent Trap Tube Material	Glass
Spiked Section in Sorbent Trap	First section of traps
Spike Level	10 ng
Probe and Sample Line Material	PTFE
Probe Temperature Control	PID
Sample Line Temperature Control	PID
Gas Dryer Device	Condenser train knockout jars in ice bath
Temperature of Gas Dryer Device	~80°F
Analytical Method	Thermal Desorption / Zeeman atomic absorption spectrometry using high frequency modulation of light polarization
Analytical Instrument	Ohio Lumex RA-915+ with RP-M324 detector
Minimum Analytical Detection Limit	0.58 ng (nominal)
Calibration Range	5 – 200 ng
Method Validation Range (Based on Bias Tests)	5 – 4000 ng

CALIBRATION AND QA/QC REQUIREMENTS

QA/QC specifications for EPA Method 30B are summarized in Table 9-1 of the method. Results of system calibration and QA/QC performance are included in Appendix D.

End of Section