

# PM<sub>10/2.5</sub>, VOC, NH<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, and HCHO ROP Test Report FG-TURB/DB1,3

Consumers Energy Company Covert Generating Station 26000 77<sup>th</sup> Street Covert, Michigan 49043 SRN: N6767

July 18, 2024

# Test Dates: May 21 and 22, 2024

Test Performed by the Consumers Energy Company Regulatory Compliance Testing Section Air Emissions Testing Body Laboratory Services Section Work Order No. 42664880

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Regulatory Compliance Testing Section Environmental & Laboratory Services Department

# **EXECUTIVE SUMMARY**

Consumers Energy Company (CE) Regulatory Compliance Testing Section (RCTS) conducted particulate matter less than 10 microns in diameter (PM<sub>10</sub>), particulate matter less than 2.5 microns in diameter (PM<sub>2.5</sub>), volatile organic compounds (VOC), ammonia (NH<sub>3</sub>), sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) mist, and formaldehyde (HCHO) testing at two electric generating units (EGUs) operated at the Covert Generating Station (CGS) in Covert, Michigan. Each EGU is comprised of a combustion turbine (CT) and duct burner (DB), which vent to a common exhaust stack. The individual CTs and DBs are identified as emission units EU-TURBINE1 and EU-TURBINE3, and EU-DB1 and EU-DB3, respectively, in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) No. MI-ROP-N6767-2020a. An additional CT/DB set, identified as EU-TURBINE2 and EU-DB2, was not in operation and therefore was not tested during this mobilization. Note that the turbine and duct burner emission units are also collectively identified as FG-TURB/DB1-3 in the ROP. Each EGU is equipped with a heat recovery steam generator (HRSG), classifying all three EGUs as combined-cycle units. For ease of reference, each combined-cycle unit comprised of EU-TURBINE1/EU-DB1, EU-TURBINE2/EU-DB2 and EU-TURBINE3/EU-DB3 will henceforth be referenced as Units 1, 2, and 3, respectively.

The test program, performed May 21 and 22, 2024, was conducted to satisfy the 5-year testing requirements found in MI-ROP-N6767-2020a, FG-TURB/DB1-3 Section I. Emission Limits special condition (SC) 9, 11, 12, 14, and 15, and Section V. Testing/Sampling SC 2 and 3.

Triplicate 120-minute PM<sub>10/2.5</sub> and H<sub>2</sub>SO<sub>4</sub> test runs and triplicate 60-minute VOC, NH<sub>3</sub>, and HCHO test runs were conducted following the procedures in United States Environmental Protection Agency (USEPA) Reference Methods (RM) 1, 2, 3A, 4, 5, 8, 25A, 202, and 320. There were no deviations from the approved stack test protocol or the USEPA Reference Methods, except for rescheduling due to the testing postponement for Unit 2. Mr. Clayton DeRonne, Ms. Mariah Scott, and Mr. Trevor Drost with EGLE witnessed portions of the testing. The Units 1 and 3 results are summarized in the following table.

Parameter Units		Average	Emission Limit	
Unit 1				
PM10/2.5	lb/hr	19.9 <sup>‡</sup>	10.7	
VOC	ppmvd @ 15% O2	0.2	1.0	
NH₃	ppmvd @ 15% O2	7.8	10	
H <sub>2</sub> SO <sub>4</sub>	lb/hr	1.4 <sup>‡</sup>	1.0	
ненот	ppbvd	33	_†	
нсноч	lb/hr	0.16	_†	
Unit 3				
PM10/2.5	lb/hr	16.7 <sup>‡</sup>	10.7	
VOC	ppmvd @ 15% O2	0.3	1.0	
NH <sub>3</sub>	ppmvd @ 15% O2	5.9	10	
H <sub>2</sub> SO <sub>4</sub>	lb/hr	2.4 <sup>‡</sup>	1.0	
HCHOT	ppbvd	33		
поноч	lb/hr	0.15	_†	

#### Table E-1 Executive Summary of Test Results

<sup>†</sup> Formaldehyde testing was performed to further evaluate the facility's status as a minor source of hazardous air pollutants (HAPs).
<sup>‡</sup> Due to data quality concerns these data are not considered reliable and should not be used to evaluate compliance.

The Units 1 and 3 emission results indicate compliance with the VOC and NH<sub>3</sub> emission limits in the permit. Due to data quality concerns, one cannot confidently make a compliance determination for  $PM_{10/2.5}$  and H<sub>2</sub>SO<sub>4</sub>; therefore, a retest for these pollutants is underway, with field sampling completed July 16, 2024 and preliminary results expected the week of July 22, 2024. Refer to Section 5.0 for further discussion.

Detailed test results are presented in Appendix Tables 1 through 6. Sample calculations, field data sheets, and laboratory data are presented in Appendices A, B, and C. Operating data and supporting documentation are provided in Appendices D and E.

# **1.0 INTRODUCTION**

This report summarizes the results of the particulate matter less than 10 microns in diameter ( $PM_{10}$ ), particulate matter less than 2.5 microns in diameter ( $PM_{2.5}$ ), volatile organic compounds (VOC), ammonia ( $NH_3$ ), sulfuric acid ( $H_2SO_4$ ) mist, and formaldehyde (HCHO) testing at two electric generating units (EGUs) operated at the Covert Generating Station (CGS) in Covert, Michigan.

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## 1.1 IDENTIFICATION, LOCATION, AND DATES OF TESTS

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted the tests at the dedicated exhausts of EGUs Units 1 and 3 operating at the Covert Generating Station in Covert, Michigan on May 21 and 22, 2024.

A test protocol was submitted to EGLE on April 18, 2024, and subsequently approved by Jeremy Howe, Air Quality Division Unit Supervisor, in a letter dated May 13, 2024.

## 1.2 PURPOSE OF TESTING

The purpose of the test was to satisfy the 5-year testing requirements found in EGLE Renewable Operating Permit (ROP) No. MI-ROP-N6767-2020a, FG-TURB/DB1-3 Section I. Emission Limits special condition (SC) 9, 11, 12, 14, and 15, and Section V. Testing/Sampling SC 2 and 3. The applicable emission limits are presented in Table 1-1.

#### Table 1-1 Emission Limits

Parameter	Emission Limit	Units	Applicable Requirement
PM10/2.5	10.7	lb/hr	
VOC	1.0	ppmvd @ 15% O <sub>2</sub>	MI-ROP-N6767-2020a FG-TURB/DB1-3
NH <sub>3</sub>	10	ppmvd @ 15% O <sub>2</sub>	I. Emission Limits SC 9, 11, 12, 14, and 15, and V. Testing Sampling SC 2 and 3.
H <sub>2</sub> SO <sub>4</sub>	1.0	lb/hr	
НСНО	-	ppbvd & lb/hr	None. Formaldehyde testing is being performed to further evaluate the facility's status as a minor source of hazardous air pollutants (HAPs).

## 1.3 BRIEF DESCRIPTION OF SOURCE

The Covert Generating Station operates three combined-cycle EGUs, each comprised of a CT and DB. Each Mitsubishi model 501G KIA CT has a heat input of 2,829 MMBtu/hr, is natural gas-fired, and is equipped with a dry low-NO<sub>x</sub> combustor and inlet air evaporative cooling. Further, each CT exhaust is routed to a natural gas-fired duct burner with a heat input capacity of 256 MMBtu/hr and a dry low-NO<sub>x</sub> burner.

## **1.4 CONTACT INFORMATION**

Table 1-2 presents names, addresses, and telephone numbers for contacts involved in this test program.

#### Table 1-2 Test Program Contact List

Program Role	Contact	Address
Regulatory Agency Representative	Jeremy Howe Technical Programs Unit Supervisor 231-878-6687 <u>howej1@michigan.gov</u>	EGLE Technical Programs Unit Constitution Hall, 2nd Floor South 525 West Allegan Street Lansing, Michigan 48933
Regulatory Agency District Representative	Monica Brothers Environmental Manager 269-312-2535 brothersm@michigan.gov	EGLE Kalamazoo District Office 7953 Adobe Road Kalamazoo, Michigan 49009
Regulatory Agency District Representative	Mariah Scott Environmental Quality Analyst 517-899-3519 scottm29@michigan.gov	EGLE Kalamazoo District Office 7953 Adobe Road Kalamazoo, Michigan 49009
Regulatory Agency District Representative	Clayton DeRonne Environmental Quality Analyst 517-855-1357 deronnec@michigan.gov	EGLE Grand Rapids District Office 350 Ottawa Avenue NW, Unit 10 Grand Rapids, Michigan 49503
Regulatory Agency District Representative	Trevor Drost Environmental Quality Analyst 517-245-5781 drostt@michigan.gov	EGLE - Technical Programs Unit Constitution Hall, 2nd Floor South 525 West Allegan Street Lansing, Michigan 48933
Responsible Official	Ken Tomaski Senior Manager Plant Operations 616-286-6302 <u>kenneth.d.tomaski@cmsenergy.com</u>	Consumers Energy Company Covert Generating Station 26000 77 <sup>th</sup> Street Covert, Michigan 49043
Facility Management	Scott Reeves Transition Manager 616-368-1605 scott.reeves@cmsenergy.com	Consumers Energy Company Covert Generating Station 26000 77 <sup>th</sup> Street Covert, Michigan 49043
Facility Operations	Chris Head Manager Plant Operations 616-286-6305 <u>chris.a.head@cmsenergy.com</u>	Consumers Energy Company Covert Generating Station 26000 77 <sup>th</sup> Street Covert, Michigan 49043
Corporate Air Quality Contact	Michael Gruber Senior Environmental Engineer 989-493-3363 michael.gruberii@cmsenergy.com	Consumers Energy Company DE Karn Generating Complex 2742 N. Weadock Hwy Essexville, Michigan 48732
Test Team Representative	Thomas Schmelter, QSTI Principal Lab Technical Analyst 616-738-3234 thomas.schmelter@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460

# 2.0 SUMMARY OF RESULTS

## 2.1 OPERATING DATA

The EGUs fired natural gas during the test event. The units were run at the maximum achievable load condition and corresponded to approximately 393 gross megawatts (MW) for Unit 1 and 384 MW for Unit 3. Refer to Appendix D for detailed operating data.

## 2.2 APPLICABLE PERMIT INFORMATION

The Covert Generating Station is assigned State of Michigan Registration Number (SRN) N6767 and operates in accordance with air permit MI-ROP-N6767-2020a. The air permit incorporates federal regulations, and the facility is associated with Facility Registry Service (FRS) identification number

110015846076. EU-TURBINE-1 with EU-DB1, and EU-TURBINE-3 with EU-DB3, are the emission units affected by this test program. These units are included in the FG-TURB/DB1-3 flexible group.

## 2.3 RESULTS

The Units 1 and 3 results are summarized in Table 2-1.

### Table 2-1

#### Summary of Test Results

Parameter	Units	Average	Emission Limit
Unit 1			
PM10/2.5	lb/hr	19.9 <sup>‡</sup>	10.7
VOC	ppmvd @ 15% O2	0.2	1.0
NH <sub>3</sub>	ppmvd @ 15% O2	7.8	10
H <sub>2</sub> SO <sub>4</sub>	lb/hr	1.4 <sup>‡</sup>	1.0
licuot	ppbvd	33	_†
HCHO	lb/hr	0.16	_†
Unit 3			
PM10/2.5	lb/hr	16.7 <sup>‡</sup>	10.7
VOC	ppmvd @ 15% O2	0.3	1.0
NH <sub>3</sub>	ppmvd @ 15% O2	5.9	10
H <sub>2</sub> SO <sub>4</sub>	lb/hr	2.4 <sup>‡</sup>	1.0
henet	ppbvd	33	_†
HCHO!	lb/hr	0.15	_†

<sup>†</sup> Formaldehyde testing was performed to further evaluate the facility's status as a minor source of hazardous air pollutants (HAPs).
<sup>‡</sup> Due to data quality concerns these data are not considered reliable and should not be used to evaluate compliance

The PM<sub>10/2.5</sub> results are biased high and likely not representative of actual emissions due to excessive amounts of inorganic and organic condensable particulate matter measured in the field train recovery blank. In addition, the H<sub>2</sub>SO<sub>4</sub> emissions are high in comparison to mass balance calculations using representative natural gas sulfur content analysis and fuel flow rates of the combustion turbine and duct burners and are of suspect reliability. Due to these issues, compliance with permit limits cannot be evaluated for PM<sub>10/2.5</sub> and H<sub>2</sub>SO<sub>4</sub> and a retest of these pollutants is underway, with field sampling completed July 16, 2024 and preliminary results expected the week of July 22, 2024. Refer to Section 5.0 for further discussion.

Detailed test results are presented in Appendix Tables 1 through 6. Sample calculations, field data sheets, and laboratory data are presented in Appendices A, B, and C. Operating data and supporting documentation are provided in Appendices D and E.

## 3.0 SOURCE DESCRIPTION

The Covert Generating Station operates three combined-cycle EGUs, each comprised of a CT and DB. Each Mitsubishi model 501G KIA CT has a heat input of 2,829 MMBtu/hr, is natural gas-fired, and is equipped with a dry low-NO<sub>x</sub> combustor and inlet air evaporative cooling. Further, each CT exhaust is routed to a natural gas-fired duct burner with a heat input capacity of 256 MMBtu/hr and a dry low-NO<sub>x</sub> burner. The combined emissions from each CT and DB set are further reduced via oxidation catalyst and selective catalytic reduction.

## 3.1 PROCESS

Each EGU can be operated by firing natural gas in only the CT (without the DB operating), or simultaneously in each CT and DB. The CT produces electricity primarily via the hot combustion gases expanding inside the CT. The expanding gas causes the CT blades to spin, which rotate a drive shaft that turns an electrical generator. Furthermore, the HRSG recovers heat from the CT exhaust to generate steam, which is used to drive a second turbine attached to an additional drive shaft and electrical generator. During periods of high electrical demand and/or during periods where ambient conditions limit

Page 3 of 22 QSTI: T. Schmelter steam generation in the HRSG, the amount of heat available to the HRSG can be supplemented by operating the duct burner located at each EGU. The duct burners only produce electricity via the HRSG.

Typically, the combined cycle turbines are operated in a continuous (i.e., baseload) manner to meet the electrical demands of CE customers. The fuel composition, heat input rate, amount of gross electricity produced, and load stability are factors that may influence emissions with respect to time.

## 3.2 PROCESS FLOW

Emissions from all three units are controlled by dry low-NO<sub>x</sub> combustor burners, selective catalytic reduction (SCR) with ammonia injection, and oxidation catalyst. The dry low NO<sub>x</sub> burners and the SCR system were operated in a normal manner during the tests (the oxidation catalysts are passive devices).

## 3.3 MATERIALS PROCESSED

The turbines and duct burners fire pipeline quality natural gas defined within the ROP as having not more than 0.8 grains total sulfur per 100 standard cubic feet (gr S/100 scf). A fuel sample taken at Covert Generating Station on July 10, 2024 contained 0.016 gr S/100 scf, and representative data from the natural gas supplier (TC Energy) indicated total sulfur contents of 0.1215 and 0.1551 gr S/100 scf on May 21 and 22, 2024, respectively. Fuel sample analyses are included in Appendix C.

## 3.4 RATED CAPACITY

The 40 CFR Part 75 Monitoring Plan maximum hourly load for each EGU is 430 gross Megawatts,<sup>1</sup> for a combined generating capacity of approximately 1,290 gross megawatts at the Covert Generating Station. Based upon equipment ratings, the maximum sustainable gross load is not expected to exceed 411.6 MW per unit (CT = 264.6 MW and Steam Turbine = 147 MW), but this level of generation is not attainable year-round due to ambient conditions which can limit output from the CT.

## 3.5 PROCESS INSTRUMENTATION

Operators, environmental technicians, and/or data acquisition systems continuously monitored the process during testing. Due to the various instrumentation systems, the sampling times were correlated to instrumentation times. One-minute data for the following parameters were collected during the test runs:

- Unit load (%)
- Total heat input (MMBtu/hr)
- Gross electricity output (MW)
- Natural gas fuel flow (HSCFH)

Refer to Appendix D for operating data.

# 4.0 SAMPLING AND ANALYTICAL PROCEDURES

RCTS personnel tested for PM<sub>10/2.5</sub>, VOC, NH<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, and HCHO 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.

<sup>&</sup>lt;sup>1</sup> 430 gross Megawatt value is the design capacity of the combined electrical generators (gas turbine and heat recovery steam generation) at each EGU and as such are included in the Part 75 monitoring plan. The Covert EGUs are heat input limited and thus can only generate a maximum of approximately 411 gross megawatts under ISO Conditions. Further, EGU gross Megawatt output design capacity is impacted by seasonal conditions (e.g., the summer maximum hourly load is approximately 390 MW gross instead of 411 gross megawatts).

#### Table 4-1 Test Methods

Parameter	Method	USEPA Title
Sampling location	1	Sample and Velocity Traverses for Stationary Sources
Traverse points	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular Weight	ЗA	Determination of Oxygen and Carbon Dioxide Concentrations from Stationary Sources (Instrumental Analyzer Procedure)
Moisture	4	Determination of Moisture Content in Stack Gases
Filterable Particulate Matter	5†	Determination of Particulate Matter Emissions from Stationary Sources
Sulfuric acid mist	8/ALT-133	Determination of Sulfuric Acid and Sulfur Dioxide Emissions from Stationary Sources
Volatile organic compounds, methane	25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Condensable Particulate Matter	202†	Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources
Ammonia, ethane, formaldehyde, moisture	320	Vapor Phase Organic and Inorganic Emissions by Extractive FTIR

<sup>†</sup> Methods 5 and 202 were conducted in conjunction to measure PM<sub>10/2.5</sub>. All particulate matter collected by Methods 5 and 202 were assumed to be less than 10 microns in diameter.

## 4.1 DESCRIPTION OF SAMPLING TRAIN AND FIELD PROCEDURES

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

#### Table 4-2 Test Matrix

Source / Date	Run	Sample Type	Start Time (EST)	Stop Time (EST)	Test Duration (min)	Comment
	1	PM <sub>10/2.5</sub> , H <sub>2</sub> SO <sub>4</sub>	06:50	09:10	120	Sample volume collected via isokinetic testing: 2.132 dscm (PM) and 1.977 dscm (H <sub>2</sub> SO <sub>4</sub> )
	1	VOC, NH <sub>3,</sub> HCHO	08:04	09:03	60	Single point sample.
Unit 3	2	PM <sub>10/2.5</sub> , H <sub>2</sub> SO <sub>4</sub>	09:50	12:17	120	Sample volume collected via isokinetic testing: 2.068 dscm (PM) and 1.925 dscm (H <sub>2</sub> SO <sub>4</sub> )
May 21, 2024	2	VOC, NH <sub>3,</sub> HCHO	09:50	10:49	60	Single point sample.
	3	PM <sub>10/2.5</sub> , H <sub>2</sub> SO <sub>4</sub>	12:45	15:07	120	Sample volume collected via isokinetic testing: 2.089 dscm (PM) and 1.937 dscm ( $H_2SO_4$ )
	3	VOC, NH <sub>3,</sub> HCHO	12:45	13:44	60	Single point sample.
	1	PM <sub>10/2.5</sub> , H <sub>2</sub> SO <sub>4</sub>	06:55	09:24	120	Sample volume collected via isokinetic testing: 2.183 dscm (PM) and 1.969 dscm (H <sub>2</sub> SO <sub>4</sub> )
Unit 1	1	VOC, NH <sub>3,</sub> HCHO	07:00	07:59	60	Single point sample.
May 22, 2024	2	PM <sub>10/2.5</sub> , H <sub>2</sub> SO <sub>4</sub>	10:19	12:40	120	Sample volume collected via isokinetic testing: 2.231 dscm (PM) and 2.032 dscm (H <sub>2</sub> SO <sub>4</sub> )
	2	VOC, NH <sub>3,</sub> HCHO	10:19	11:18	60	Single point sample.

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Table 4-2 Test Matrix

Source / Date	Run	Sample Type	Start Time (EST)	Stop Time (EST)	Test Duration (min)	Comment
	3	PM <sub>10/2.5</sub> , H <sub>2</sub> SO <sub>4</sub>	13:15	15:41	120	Sample volume collected via isokinetic testing: 2.308 dscm (PM) and 2.019 dscm (H <sub>2</sub> SO <sub>4</sub> )
	3	VOC, NH <sub>3,</sub> HCHO	14:32	15:31	60	Single point sample.

## 4.2 SAMPLE LOCATION AND TRAVERSE POINTS (USEPA METHOD 1)

The number and location of traverse points for determining exhaust gas velocity and volumetric airflow were determined in accordance with USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*. Four test ports are in the horizontal plane of the 265-inch (22.1-foot) diameter duct. The ports are situated:

- Approximately 70 feet or 3.5 duct diameters downstream of a flow disturbance, and
- Approximately 20 feet or 0.9 duct diameters upstream of the stack exit.

The sample ports are 6 inches in diameter and extend 12 inches beyond the stack wall. The area of the exhaust duct was calculated, and the cross-section divided into a number of equal areas based on distances to air flow disturbances. Flue gas was sampled at six traverse points from each of four sample ports for a total of 24 sample points. A stack schematic of the sample port locations is presented in Figure 4-1 with traverse points listed in Table 4-3.

## Figure 4-1. Representative Sampling Location



Regulatory Compliance Testing Section Environmental & Laboratory Services Department Table 4-3 Traverse Points

Traverse Point / Port	Inches from Stack Wall (including 12" port)	
1	17.6	
2	29.8	
3	43.3	
4	58.9	
5	78.3	
6	106.3	

## 4.3 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 ( $\Delta$ P) across the positive and negative openings of the Pitot tube at each traverse point were measured using an "S Type" (Stauscheibe or reverse type) Pitot tube connected to an appropriately sized oil filled manometer. Exhaust gas temperatures were measured using a chromel/alumel "Type K" thermocouple and a temperature indicator. Refer to Figure 4-2 for the Method 2 Pitot tube and thermocouple configuration.

Flue gas velocity and velocity vector measurements (cyclonic flow evaluation) have previously been measured following the procedures in USEPA Method 2 at the sampling locations. Cyclonic flow is defined as a flow condition with an average null angle greater than 20 degrees. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head reading—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. 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 previous average null yaw angle measured at the exhausts were less than 20° requirement. Since no significant ductwork and/or stack configuration changes have occurred, the null angle information is considered reliable and additional cyclonic flow verifications were not performed.



## Figure 4-2. Method 2 Sample Apparatus

## 4.4 MOLECULAR WEIGHT (USEPA METHOD 3A)

Oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) concentrations were measured using the sampling and analytical procedures of USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure).* The Method 3A sample line was attached to the Method 8 sample probe to collect O<sub>2</sub> and CO<sub>2</sub> concentrations at each of the traverse points simultaneously with H<sub>2</sub>SO<sub>4</sub> measurements. This diluent data was also used for the PM<sub>10/2.5</sub> and VOC sampling, with all testing having been conducted concurrently. For the VOC runs which were shorter in duration than the H<sub>2</sub>SO<sub>4</sub> and PM<sub>10/2.5</sub> runs, only that subset of diluent 1-minute data collected during the VOC runs was used to determine the average diluent concentrations for each run.

Flue gas was sampled from the stack through a stainless-steel probe, Teflon® sample line, and through a gas conditioning system to remove water and dry the sample before entering a sample pump, gas flow control manifold, and paramagnetic and infrared gas filter correlation gas analyzers. Figure 4-3 depicts the Method 3A sampling system.





Prior to sampling exhaust gas, the analyzers were calibrated by performing a calibration error test where zero-, mid-, and high-level calibration gases were introduced directly to the back of the analyzers. The calibration error check was performed to evaluate if the analyzers' response was within  $\pm 2.0\%$  of the calibration gas span or high calibration gas concentration or  $\pm 0.5\%$  absolute difference to be acceptable.

An initial system bias check was then performed by measuring the instrument response while introducing zero- and mid- or high-level (upscale) calibration gases at the probe, upstream of all sample conditioning components, and drawing it through the various sample components in the same manner as flue gas. The initial system bias check is acceptable if the instrument response at the zero and upscale calibration is within  $\pm 5.0\%$  of the calibration span or  $\pm 0.5\%$  absolute difference.

Upon successful completion of the calibration error and initial system bias tests, sample flow rates and component temperatures were verified, and the probe was inserted into the duct at the appropriate traverse point. After confirming the unit was operating at established conditions, the test run was initiated. O<sub>2</sub> and CO<sub>2</sub> concentrations were recorded at 1-minute intervals throughout the test runs, however data collected during port changes were excluded from the test run averages.

At the conclusion of the test run, a post-test system bias check was performed to evaluate analyzer bias and drift from the pre- and post-test system bias checks. The system-bias checks evaluate if the analyzers bias was within  $\pm 5.0\%$  of span or  $\pm 0.5\%$  absolute difference and that drift was within  $\pm 3.0\%$ . The analyzers' responses were used to correct the measured oxygen and carbon dioxide concentrations for analyzer drift. The corrected concentrations were used to calculate molecular weight and emission rates. Refer to Appendix E for analyzer calibration supporting documentation.

## 4.5 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 5/202 and 8 sample apparatus. Flue gas was drawn through a series of impingers immersed in an ice bath to condense and remove water from the sample. The amount of water condensed and collected in the impingers was measured gravimetrically and used to calculate the exhaust gas moisture content. EPA Method 320 was also used to measure moisture content concurrent with the NH<sub>3</sub> and HCHO test runs that were conducted at the same time as the VOC test runs. The Method 320 moisture results from the FTIR analyzer measuring HCHO were used to correct VOC concentrations from a wet to dry basis, as those moisture results were slightly higher than those from the FTIR analyzer used for the NH<sub>3</sub> testing, thereby resulting in slightly higher corrected dry VOC concentrations. The FTIR analytical reports provided both dry and wet concentrations for NH<sub>3</sub> and HCHO, and those values were used directly in all subsequent calculations.

## 4.6 FILTERABLE PARTICULATE MATTER (USEPA METHOD 5)

Filterable particulate matter samples were collected isokinetically by withdrawing a sample of the flue gas through a filter following the procedures of USEPA Method 5, *Determination of Particulate Matter Emissions from Stationary Sources.* In the Method 5 sampling apparatus, the flue gas passes through a nozzle, heated glass-lined probe, glass-fiber filter, and into a series of impingers with the configuration presented in Table 4-4. The filter collects filterable particulate matter while the impingers collect water vapor and/or condensable particulate matter. Figure 4-4 depicts the USEPA Method 5 sampling train.



#### Figure 4-4. USEPA Method 5 Sampling Train

Before testing, a preliminary velocity traverse was performed and/or representative flow data from previous measurements were reviewed to calculate an ideal nozzle size that allows isokinetic sampling. A pre-cleaned nozzle with 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 leak 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 was placed around the impingers, while the probe and filter temperatures were allowed to stabilize to a temperature of 248±25°F before sampling commenced. 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 an isokinetic sampling rate that was within 100±10% for the duration of the test.

At the conclusion of a test run and the post-test leak check, the sampling train was disassembled and the impingers and FPM 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, probe liner, and 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, was measured using a scale; these weights were used to calculate the moisture content of the sampled flue gas. Refer to Figure 4-5 for the USEPA Method 5 sample recovery scheme.



#### Figure 4-5. 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 4-6.

#### Figure 4-6. USEPA Method 5 Analytical Scheme



## 4.7 CONDENSABLE PARTICULATE MATTER (USEPA METHOD 202)

Condensable particulate matter (CPM) was collected in conjunction with USEPA Method 5 using 40 CFR Part 51, EPA Method 202, *Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources.* Condensable particulates were collected in clean, baked glassware consisting of a glass coil condenser, a dropout impinger, a modified Greenburg-Smith (GS) impinger with an open tube tip, a CPM filter holder containing a Teflon filter, one impinger containing approximately 100 mL of water and one impinger containing silica gel for moisture collection. Figure 4-7 presents the USEPA Method 202 sampling train and Table 4-4 presents the Method 5/202 impinger configuration. The CPM filter temperature was targeted between 65 and 85°F throughout each test run using a water recirculation pump attached to the condenser.

#### Figure 4-7. USEPA Method 202 Sampling Train



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## Table 4-4 Method 202 Impinger Configuration

Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Amount (gram)			
1	Dropout	Empty	0			
2	Greenburg-Smith	Empty	0			
	CPM Filter					
3	Modified	Water	100			
4	Modified	Silica gel desiccant	~200-300			

Upon test completion, each impinger was weighed to evaluate exhaust gas moisture content, after which the condenser, dropout impinger, GS impinger, and CPM filter housing were re-assembled. An ultra-high purity nitrogen source was connected to the condenser inlet and the apparatus was purged at a rate of at least 14 liters per minute for a minimum of one hour to remove any dissolved sulfur dioxide gases from the condensed impinger water. During the purge, the condenser recirculation pump remained in service and the CPM filter exit temperature was monitored.

After the nitrogen purge, the dropout impinger and GS impinger condensate were transferred to a clean sample bottle labeled as "CPM Container #1." The back half of the Method 5 filter bell, condenser, impingers and connecting glassware were rinsed twice with deionized, ultra-filtered water into the same container. The water rinses were followed by an acetone rinse and duplicate hexane rinses into a separate sample bottle identified as "CPM Container #2." The CPM filter was removed prior to the water and organic rinses and placed in a clean Petri dish identified as "CPM Container #3." Liquid levels on the sample bottles were marked and the samples were sealed and prepared for transport to the laboratory for analysis. Refer to Figures 4-8 and 4-9 for the Method 202 sample recovery and analytical schemes.

#### Figure 4-8. USEPA Method 202 Sample Recovery Scheme





#### Figure 4-9. USEPA Method 202 Analytical Scheme

## 4.8 SULFURIC ACID MIST (USEPA METHOD 8)

Sulfuric acid mist was measured following the sampling and analytical procedures of USEPA Method 8, *Determination of Sulfuric Acid and Sulfur Dioxide Emissions from Stationary Sources*. Flue gas passed through a heated glass lined probe, a series of impingers, and a glass filter holder. Figure 4-10 presents the Method 8 sampling train and Table 4-5 presents the modified Method 8 impinger configuration. The second and third impingers containing 3% hydrogen peroxide were replaced by an empty impinger because SO<sub>2</sub> analysis was not required in this test program.



#### Figure 4-10. USEPA Method 8 Sampling Train

#### Table 4-5 Method 8 Impinger Configuration

Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Amount (gram)		
1	Greenburg-Smith	80% isopropyl alcohol	100		
Glass fiber filter					
2	Modified	Empty	0		
3	Modified	Silica gel desiccant	200		

Before testing, a preliminary velocity traverse was performed and/or representative flow data from previous measurements were reviewed to calculate an ideal nozzle size that allows isokinetic sampling. A pre-cleaned nozzle with 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 leak 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 was placed around the impingers, while the probe and filter temperatures were allowed to stabilize to a temperature of 248±25°F or the minimum temperature required to prevent visible condensation. 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 an isokinetic sampling rate that was within 100±10% for the duration of the test.

At the conclusion of a test run and the post-test leak check, the sampling train was disassembled and the impingers were purged with ambient air for 15 minutes at the average flow rate used for sampling. The impingers and filter housing were then transported to the recovery area.

The weight of liquid collected in each impinger, including the silica gel impinger, was measured using a scale; these weights were used to calculate the moisture content of the sampled flue gas. The contents of the first impinger were transferred to a pre-cleaned container labeled as "Container No. 1." The probe, first impinger, and front half of the filter holder were rinsed with 80% isopropyl alcohol and collected in "Container No. 1."

The sample containers, including blanks, were transported to the laboratory for analysis. The samples were analyzed by ion chromatography following Method 8 / ALT-133 procedures.

## 4.9 VOLATILE ORGANIC COMPOUNDS (USEPA METHOD 25A)

Non-methane organic compound (NMOC) concentrations were measured using a Thermo Model 55i Direct Methane and Non-methane Analyzer following the guidelines of USEPA Method 25A, *Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer (FIA)*. The instrument uses a flame ionization detector (FID) to measure the exhaust gas total hydrocarbon concentration in conjunction with a gas chromatography column that separates methane from other organic compounds. Sample gas is injected into the column and methane's low molecular weight and high volatility cause the compound to move through the column more quickly than other organic compounds and is quantified by the FID. The column is then flushed with inert carrier gas and the remaining nonmethane organic compounds are analyzed in the FID. This analytical technique allows separate methane and non-methane organic compound measurements via the use of a single FID.

The field VOC instrument/measurement system, depicted in Figure 4-11, was calibrated with zero air and three propane and methane gas blends following USEPA Method 25A specifications at the zero level, low (25 to 35 percent of calibration span), mid (45 to 55 percent of calibration span) and high (80 to 90 percent of calibration span).



#### Figure 4-11. USEPA Method 25A Sample Apparatus

Please note that any ethane concentration measured by the Thermo 55i is combined with the NMOC measurements; however, the VOC definition in 40 CFR, Part 51 VOC does not include methane or ethane. Specifically, §51.100(s)(1) defines VOC as "any compound of carbon…other than the following, which have been determined to have negligible photochemical reactivity: methane, ethane…"

Therefore, if the natural gas fired contains elevated ethane concentrations, the measured NMOC concentrations may reflect a positive NMOC bias.

## 4.10 AMMONIA, ETHANE, AND FORMALDEHYDE (USEPA METHOD 320)

Ammonia, ethane, and formaldehyde concentrations were measured following the sampling and analytical procedures of USEPA Method 320, *Vapor Phase Organic and Inorganic Emissions by Extractive FTIR*. Note that as non-methane VOC concentrations without any deduction for ethane were well below the limit of 1.0 ppmvd at 15% O<sub>2</sub>, the Fourier transform infrared (FTIR) contractor (Prism Analytical Technologies) did not ultimately analyze the spectra to quantify ethane concentrations. Exhaust gas was extracted through a heated stainless-steel probe and heated Teflon® sample line prior to being introduced to a heated-head sampling pump and the FTIR analyzer. The stainless-steel probe and Teflon® sample line was maintained at approximately 300°F. Refer to Figure 4-12 for a drawing of the USEPA Method 320 Sampling/Spiking System.

#### Figure 4-12. USEPA Method 320 Sampling/Spiking System



FTIR data was collected using two MKS MultiGas 2030 FTIR spectrometers, with one configured with a StarBoost system for the HCHO testing. The StarBoost technology consists of a 5-micron infrared detector, optical filtration, and signal amplification. It is designed to optimize signal response and limit instrument noise for low detection limit applications. The FTIR are equipped with a temperature-controlled, 5.11-meter multipass gas cell maintained at 191°C. Data was collected in differential mode with 2 cm<sup>-1</sup> resolution sample data and 8 cm<sup>-1</sup> resolution background for the StarBoost system and 0.5 cm-1 resolution for the standard system. Each FTIR spectrum was derived from the coaddition of ~200 scans for formaldehyde and 64 scans for ammonia, with a new data point generated every 60 seconds. A minimum of 60 minutes of reference spectra data were collected for each run.

Prior to testing, a nitrogen (zero) calibration gas was introduced directly to the FTIR to verify it is free of contaminants. A methane or ethylene calibration transfer standard (CTS) was introduced to ensure suitable agreement between the sample and reference spectra. Following the CTS, a calibration gas containing formaldehyde or ammonia (spike gas) and N<sub>2</sub>O or sulfur hexafluoride (tracer gas) was introduced to the FTIR to verify calibration. The zero and CTS checks were performed through the

sampling system and an analyte spike was performed by introducing the formaldehyde and  $N_2O$  or ammonia and sulfur hexafluoride calibration gas at an approximate 1:10 ratio with the sampled flue gas.

The detection limit was calculated as three times the standard deviation of the concentrations from ten representative background spectra taken during the analysis. The detection limit for the test project was 0.030 ppmv formaldehyde, 0.30 ppmv for ammonia and 0.1% for moisture.

Following each run, another CTS and zero check were recorded and compared to the pre-test CTS. The pre- and post-test CTS are required to be within ±5% of the mean value.

# 5.0 TEST RESULTS AND DISCUSSION

The Units 1 and 3 emission results indicate compliance with the VOC and NH<sub>3</sub> limits in the permit. Due to data quality concerns, a compliance determination for  $PM_{10/2.5}$  and  $H_2SO_4$  cannot be made; therefore, a retest for these pollutants is underway, with field sampling completed July 16, 2024, and preliminary results expected the week of July 22, 2024. Refer to Section 2.3 for a summary of the test results.

## 5.1 TABULATION OF RESULTS

Table 2-1 in Section 2 of this report summarizes the results and Appendix Tables 1 through 6 contain detailed tabulation of results, process operating conditions, and exhaust gas conditions.

Appendix D contains the CEMS related information that was collected. Tables with 1-minute averages for the parameters are presented for each test run, along with the test run averages. When arriving at the test run averages, 1-minute data associated with port changes have been excluded.

When comparing the start and stop times between the RM test runs and the CEMS data, note that the last minute of the CEMS run average data is one minute ahead of the RM run end time for the  $PM_{10/2.5}$  and  $H_2SO_4$  testing. This is due to a difference in reporting convention, where the end minute recorded for each  $PM_{10/2.5}/H_2SO_4$  RM run reflects when the last reading was taken, but not the last minute during which sampling occurred. For example, the times for Unit 3 RM Run 1 are listed as 06:50-09:10. While the last RM Run 1 value was recorded at 09:10, the last full minute of sampling was 09:09.

## 5.2 SIGNIFICANCE OF RESULTS

The Units 1 and 3 VOC and NH<sub>3</sub> results were used to demonstrate ongoing compliance with the limits present in EGLE ROP MI-ROP-N6767-2020a. The HCHO results will be used to further evaluate the facility's status as a minor source of HAPs.

Final laboratory results for  $PM_{10/2.5}$  and  $H_2SO_4$  were received on July 8, 2024, and reveal quality issues and are anomalous compared to manufacturer's, historical, and/or mass balance data. Using these flawed data, the  $PM_{10/2.5}$  and  $H_2SO_4$  emissions are elevated in comparison to permit limits. Out of an abundance of caution, FG-TURB/DB1-3 was taken offline on July 9, 2024. The shutdowns were primarily driven by elevated  $H_2SO_4$  results, as there was no initial indication of a possible sample representativeness issue as was the case for the  $PM_{10/2.5}$  results. CE then worked to schedule retesting for  $PM_{10/2.5}$  and  $H_2SO_4$  as quickly as possible, ultimately securing Alliance Technical Group to perform testing on July 15 and 16, 2024. As discussed in Section 5.3, the  $PM_{10/2.5}$  and  $H_2SO_4$  stack test results from Unit 1 (5/22/2024) and Unit 3 (5/21/2024) are not believed to be representative of actual emissions.

## 5.3 PM10/2.5 AND H2SO4

Investigations to date have not identified any operational issues with the combustion turbines or duct burners. Low CO and VOC levels observed during the May 2024 testing support efficient combustion and there is no indication of elevated sulfur levels in the natural gas fuel. The elevated test results are believed to be solely attributed to testing and/or laboratory analytical issues with Method 202 and Method 8.

Although no significant changes to the process or operations have occurred, the PM<sub>10/2.5</sub> data from May 21 and 22, 2024 differs significantly from historical stack tests conducted on May 10, 2019 (Unit 3) and June 4, 2020 (Unit 1). This comparison suggests issues with PM<sub>10/2.5</sub> sample collection and/or analysis as

supported by elevated Method 202 blanks and contamination. Table 5-1 provides a comparison of the 2019/2020 and anomalous 2024 PM<sub>10/2.5</sub> data sets.

Unit/Run	2019/2020 Result (lb/hr)	2024 Result (lb/hr)	Difference (lb/hr)	% Difference
U3 Run 1	8.668	15.0	6.3	53.5
U3 Run 2	6.914	20.3	13.4	98.4
U3 Run 3	10.39	14.6	4.2	33.7
U3 Average	8.657	16.7	8.0	63.4
U1 Run 1	6.662	25.8	19.1	117.9
U1 Run 2	6.244	22.3	16.1	112.5
U1 Run 3	4.358	11.8	7.4	92.1
U1 Average	5.755	20.0	14.2	110.6

#### Table 5-1 Comparison of PM<sub>10/2.5</sub> Historical Test Results

Variability of the H<sub>2</sub>SO<sub>4</sub> measurements suggests method imprecision and the potential for interference, as the combustion turbine operations were consistent over both days of testing and natural gas total sulfur content ranged between 0.1215 and 0.1551 gr S/100 scf based upon information provided by the natural gas supplier (TC Energy). A comparison of the 2019/2020 and 2024 H<sub>2</sub>SO<sub>4</sub> emissions data is presented in Table 5-2.

#### Table 5-2 Comparison of H<sub>2</sub>SO<sub>4</sub> Historical Test Results

Unit/Run	2019/2020 Result (lb/hr)	2024 Result (lb/hr)	Difference (lb/hr)	% Difference
U3 Run 1	0.05	4.0	4.0	195.1
U3 Run 2	0.04	0.8	0.8	181.0
U3 Run 3	0.05	2.3	2.3	191.5
U3 Average	0.05	2.4	2.4	191.8
U1 Run 1	0.55	1.4	0.9	87.2
U1 Run 2	0.54	1.5	1.0	94.1
U1 Run 3	0.55	1.2	0.7	74.3
U1 Average	0.55	1.4	0.9	87.2

The comparison may also suggest a bias present with EPA Method 8 performed in May 2024 relative to Conditional Test Method (CTM) 013 performed in 2019/2020. Although the analysis of the EPA Method 8 samples was performed by ion chromatography following ALT-133 procedures (consistent with the analytical approach for CTM-013), application of CTM-013 can reduce potential interferences (i.e., ammonia) that may be present in the sampled flue gas.

Furthermore, emissions of sulfur compounds, mainly SO<sub>2</sub>, are directly related to the sulfur content of the fuel, but the May 2024  $H_2SO_4$  results erroneously suggest the sulfur in the emissions exceeds the total sulfur available from the natural gas being combusted in the turbine. An example mass balance using the highest sulfur content in natural gas based upon the May 21-22, 2024 data from TC Energy (0.1551 gr S/100 scf) and the highest run average natural gas flow rate (Unit 1, Run 2, at 25,787.4 HSCFH) is presented below. Consistent with the permit application for Permit No. 186-17, the calculation is based upon 10% of the available sulfur being emitted as  $H_2SO_4$ .

$$\frac{0.1551 \text{ grains } S}{100 \text{ scf natural gas}} \times \frac{2,578,740 \text{ scf natural gas}}{1 \text{ hour}} \times \frac{1 \text{ pound}}{7,000 \text{ grains}} \times \frac{98.079 \frac{g}{mol} H_2 SO_4}{32.065 \frac{g}{mol} S} \times 10\%$$
$$= \frac{0.17 \text{ pound } H_2 SO_4}{\text{hour}}$$

Regulatory Compliance Testing Section Environmental & Laboratory Services Department Page 18 of 22 QSTI: T. Schmelter It should be noted that 10% conversion of the available sulfur to  $H_2SO_4$  may be conservative (i.e., higher than actual). Data from a turbine vendor<sup>2</sup> suggests that between 5-10% of the available SO<sub>2</sub> will be converted to SO<sub>3</sub> during the combustion process and subsequently react to form  $H_2SO_4$ . The Covert Generating Station oxidation and SCR catalyst vendor further indicates no more than 1.5% by volume of the remaining SO<sub>2</sub> will be converted to SO<sub>3</sub> across the catalysts. Information from the Electric Power Research Institute<sup>3</sup> (EPRI) suggests that for combined-cycle units, much of the  $H_2SO_4$  which is produced (at least 50%) will be removed by the combination of interactions between ammonia slip, moisture, and the low temperatures experienced within the HRSG.

Since the May 2024  $H_2SO_4$  results are an order of magnitude higher than the theoretical  $H_2SO_4$  emissions, they should be approached with skepticism. Further, the Unit 3  $H_2SO_4$  results for Runs 1 and 3 were higher than the potential  $H_2SO_4$  even if all the available sulfur were assumed to have been emitted in that form (versus the assumed 10% conversion). Likely, a sampling or laboratory error, and/or method interference has occurred, and a retest using CTM-013 was conducted July 15 and 16, 2024.

## 5.4 VARIATIONS FROM SAMPLING OR OPERATING CONDITIONS

To present test data on a consistent basis,  $O_2$  and  $CO_2$  (diluent) concentrations, EGU operating parameters, and CEMS concentrations were averaged according to  $PM_{10/2.5}/H_2SO_4$  and VOC/NH<sub>3</sub>/HCHO sampling start and stop times, omitting sample port changes. No variations from sampling or operating conditions were encountered.

## 5.5 PROCESS OR CONTROL EQUIPMENT UPSET CONDITIONS

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

## 5.6 AIR POLLUTION CONTROL DEVICE MAINTENANCE

A boiler tube leak was repaired during an outage in late March 2024 at the HRSG associated with Unit 1. During the March 2024 outage, cleaning occurred at the SCR associated with Unit 1. No other 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.

## 5.7 RE-TEST DISCUSSION

Based on the results of this test program, a re-test for  $PM_{10/2.5}$  and  $H_2SO_4$  was conducted July 15 and 16, 2024 at Units 1 and 3. CE expects to have preliminary results the week of July 22, 2024 and will provide a final test report within 60 days of completing the retests. Preliminary and final test results will be communicated to EGLE verbally and/or via email as quickly as possible prior to submittal of the final test report.

#### 5.8 RESULTS OF AUDIT SAMPLES

Audit samples are not required for the reference methods utilized during this test program and are not available from USEPA Stationary Source Audit Sample Program providers. A list of QA/QC Procedures is listed in Table 5-3.

<sup>&</sup>lt;sup>2</sup> GE Energy – Air Emissions Terms, Definition and General Information, GER-4249 (08/05); accessed at https://www.gevernova.com/content/dam/gepower-new/global/en\_US/downloads/gas-new-site/resources/reference/ger-4249-air-emissions-terms-definitions-general-information.pdf.

<sup>&</sup>lt;sup>3</sup> EPRI – Estimating Total Sulfuric Acid Emissions from Stationary Power Plants, 1023790 (March 2012); accessed at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjDm6S9rq6H AxXK5skDHTLnA9gQFnoECEUQAQ&url=https%3A%2F%2Fdownloads.regulations.gov%2FEPA-R06-OAR-2014-0754-0008%2Fattachment 35.pdf&usg=AOvVaw2xBru8StpTfh9EQnY0Sxjm&opi=89978449.

### Table 5-3 QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	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	Verify area of stack is accurately measured	Review as-built drawings and field measurement	Pre-test	Field measurement agreement with as-built drawings			
M1: Cyclonic flow evaluation	Evaluate the sampling location for cyclonic flow	Measure null angles	Pre-test	≤20°			
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			
M2: Pitot tube leak check	Verify leak free sampling system	Apply minimum pressure of 3.0 inches of H <sub>2</sub> O to Pitot tube	Pre-test and post- test	$\pm 0.01$ in H <sub>2</sub> O for 15 seconds at minimum 3.0 in H <sub>2</sub> O velocity head			
M3A and 25A: Calibration gas standards	Ensure accurate calibration standards	Traceability protocol of calibration gases	Pre-test	Calibration gas uncertainty ≤2.0%			
M3A: Calibration Error	Evaluates operation of analyzers	Calibration gases introduces directly into analyzers	Pre-test	±2.0% of span or ≤0.5% abs. difference			
M3A and 25A: System bias and analyzer drift	Evaluates ability of sampling system to delivery stack gas to analyzers	ability of Calibration gases Pre-test and post system to introduced through ack gas to sampling system		Bias: ±5.0% of span or cylinder value (M25A) Drift: ±3.0% of span or 0.5% abs. difference (M3A opti)			
M4 Field Balance Calibration Check	Evaluates field balance accuracy	Use Class 6 weight to check balance accuracy	Use Class 6 weight to check balance accuracy				
M5 and 8: Nozzle diameter measurements	Verify nozzle diameter used to calculate sample rate	Measure inner diameter Pre-test across three cross- sectional chords		3 measurements agree within ±0.004 inch			
M5 and 8: Apparatus Temperature	Prevents condensation within sample apparatus	Set probe & filter heat controllers to 248±25°F	Verify prior to and during each run	Apparatus temperature must be 248±25°F			
M5 and 8: Sample rate	Ensure representative sample collection	Calculate isokinetic sample rate	During and post- test	100±10% isokinetic rate			
M5, 8, 202: 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 and 8: Post-test meter audits	Evaluates accurate measurement equipment for sample volume	DGM pre- and post-test; compare calibration factors (Y and $Y_{qa}$ )	Pre-test and post- test	±5%			
M202: impinger temperature	Ensure collection of condensates	Maintain CPM filter temperature below 85°F Throughout test		CPM filter temperature ≥65°F and ≤85°F			
M320: Zero	Verify contaminant free system and detection	Calibration gas introduced directly into analyzer		<detection limit<="" td=""></detection>			
M320: CTS Direct	Verify analytical stability	Calibration gas directly Pre-test into analyzer		±5% of calibration value			
M320: Analyte Direct	Verify FTIR calibration	Calibration gas directly Pre-test into analyzer		Verify calibration value			
M320: CTS Response	Verify sample recovery	Calibration gas through sample system	libration gas through Pre-test and post- mple system test				
M320: Zero Response Spike	Verify leak free analytical system	Calibration gas through Pre-test and post- sample system test		Bias correct data			
M320: Analyte Spike	Evaluates operation of analyzer	Calibration gas into sampling system at ≤10.0% of sampling rate	Pre-test	Evaluates operation of analyzer			

## 5.9 CALIBRATION SHEETS

Calibration sheets, including dry gas meter, gas protocol sheets, and analyzer quality control and assurance checks are presented in Appendix E.

#### 5.10 SAMPLE CALCULATIONS

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

#### 5.11 FIELD DATA SHEETS

Field data sheets are presented in Appendix B.

#### 5.12 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.

## 5.13 QA/QC BLANKS

Reagent and media blanks were analyzed for the parameters of interest. The results of the blanks analyses are presented in Table 5-4. Laboratory QA/QC and blank results data are contained in Appendix C.

#### Table 5-4 QA/QC Blanks

Sample Identification	Result	Comment
Method 5 Acetone Blank	-1.0 mg	Sample volume was 200 ml. Acetone blank corrections were not applied.
Method 5 Filter Blank	-0.3 mg	Reporting limit is 0.1 mg.
Method 202 DI H <sub>2</sub> O Blank	0.32 mg	Sample volume was 150 ml. Result is for inorganic condensable.
Method 202 Acetone Blank	0.37 mg	Sample volume was 160 ml. Result is for organic condensable.
Method 202 Hexane Blank	2.84 mg	Sample volume was 146 ml. Result is for organic condensable. Elevated; exceeds manufactures certificate of analysis (0.03 mg/160 ml) for evaporation residue suggesting contamination from wash bottle.
Method 202 Field Train Recovery Blank	3.00 mg inorganic 6.55 mg organic	Total CPM of 9.54 mg. Maximum blank correction of 2.0 mg applied. Results indicate contamination.
Method 8 IPA Blank	<113 µg (Non-Detect)	Ensures acceptable level of peroxide impurities in isopropanol.

High Method 202 hexane reagent and field train recovery blank (FTRB) results were measured. The origin of the high blank values is unknown and bias the CPM and total PM<sub>10/2.5</sub> results high for the testing performed.

Despite following EPA Method 202 Best Practices procedures and those incorporated into internal quality systems, the Method 202 hexane reagent and field train recovery blank values indicate contamination, which caused a high bias to the test results. A comparison of the M202 organic and inorganic fractions to the FTRB value is presented in Table 5-5.

M202 CPM Fraction	U3 Run 1	U3 Run 2	U3 Run 3	U1 Run 1	U1 Run 2	U1 Run 3	FTRB
Organic	3.91	6.83	5.59	10.43	7.69	3.88	6.55
Inorganic	6.30	6.42	3.94	4.99	5.11	4.89	3.00
Total CPM	10.21	13.25	9.53	15.42	12.81	8.77	9.54

Table 5-5 Comparison of Method 202 Sample to FTRB Catch Weights

The residual mass collected in the FTRB is assumed to be attributed only to the materials and procedures used in sample collection, recovery, and analysis. A maximum blank correction of 2.0 milligrams is allowed and was used to calculate  $PM_{10/2.5}$  lb/hr emissions. A minimal FTRB is critical when evaluating sources with low CPM concentrations, where a value of 2.0 mg can be significant compared to the sample results. In this instance, if the total mass of the FTRB (9.54 mg) versus the maximum allowed blank correction (2.0 mg) was subtracted from the emission rate calculations, the results would be materially different. Refer to Figure 5-1 for a chart showing the difference in  $PM_{10/2.5}$  (filterable and CPM) mass emissions using different FTRB corrections. For this reason, a compliance determination cannot be made with this data set and a retest is warranted to properly assess compliance with the emission limit.



Figure 5-1. Comparison of FTRB corrections to Mass Emission Rate