



Consumers Energy

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DEK34 RATA Test Report

EU-KARN3-S2

EU-KARN4-S2

EU-AUXBLRA-S2

EU-AUXBLRB-S2

Consumers Energy Company
D.E. Karn Generating Complex
2680 N. Weadock Highway
Essexville, Michigan 48732
SRN: B2840
ORIS: 1702
FRS: 110000593171

September 30, 2022

Test Date: August 24, 2022

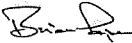
Test Conducted by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No. 39478055
Initial Revision No.: 1.0

CERTIFICATION FOR 40 CFR PART 75 TEST REPORT

(To be completed by authorized AETB firm representative and included in source test report)

Facility ID:	<u>ORIS 1702; SRN B2840</u>	Date(s) Tested	<u>August 24, 2022</u>
Facility Name:	<u>Consumers Energy D.E. Karn Generating Station</u>		
Facility Address:	<u>2742 N. Weadock Hwy., Essexville, MI 48732</u>		
Equipment Tested:	<u>FG-KARN34 Common Stack NOx-Diluent CEMS (NOx & CO2)</u>		
AETB Firm:	<u>Consumers Energy; RCTS AETB</u>		
Business Address:	<u>2742 N. Weadock Hwy, ESD Trailer #4, Essexville, MI 48732</u>		
Phone:	<u>(989) 891-3492</u>	Email:	<u>brian.pape@cmsenergy.com</u>

As the legally authorized representative of the RCTS AETB, I certify that I have reviewed this test report in conjunction with the relevant Quality Manual Appendix D checklist. Having checked each item, I believe the information provided in this test report is true, accurate, and complete.

Signature:  Digitally signed by Brian Pape
DN: cn=Brian Pape, o=Regulatory Compliance Testing Services,
ou=Laboratory Services, email=brian.pape@cmsenergy.com, c=US
Date: 2022.09.30 15:23:27 -0400 Date: September 30, 2022

Name: Brian C Pape Title: AETB Technical Director

Phone: (989) 891-3492 Email: brian.pape@cmsenergy.com

RELATIVE ACCURACY TEST REPORT CHECKLIST

	Description (Typical location(s) in report) [ASTM D 7036-04 Section Reference]
<input checked="" type="checkbox"/>	Title (Title Page) [15.3.1]
<input checked="" type="checkbox"/>	AETB name & address (QM App. D pg. D-2) [15.3.2]
<input checked="" type="checkbox"/>	Unique identification number on each page and a clear identification of the end of the report (Headers & Footers; "End of Report" page) [15.3.3]
<input checked="" type="checkbox"/>	Name and address of the customer (Title Page; QM App. D pg. D-2) [15.3.4]
<input checked="" type="checkbox"/>	Date(s) the testing was performed (Title page; Introduction; QM App. D pg. D-2) [15.3.10]
<input checked="" type="checkbox"/>	Identification of the units tested (Title page; Introduction) [15.3.9]
<input type="checkbox"/>	Identification of regulatory personnel that observed testing (Introduction; Appendix D1) [Note 13]
<input checked="" type="checkbox"/>	Clear identification of the pollutants/parameters tested (Summary & Discussion) [15.3.5]
<input checked="" type="checkbox"/>	Identification of the test methods used (Sampling and Analytical Procedures) [15.3.8]
<input checked="" type="checkbox"/>	Identification of the sampling location, including diagrams, sketches or photographs (Figures) [15.3.6]
<input checked="" type="checkbox"/>	Detailed process description and process operations for each test run (Source and Monitor Description; Appendix B CEMS data sheets) [15.3.7]
<input checked="" type="checkbox"/>	Reference to the test protocol and procedures used by the AETB (Introduction) [15.3.11]
<input checked="" type="checkbox"/>	Test results and units of measure (Summary and Discussion) [15.3.12]
<input checked="" type="checkbox"/>	Information on specific test conditions, including text description of process operations for each test run and description of any operational issues with the unit or the control device (Discussion of Test Results) [15.3.14]
<input checked="" type="checkbox"/>	Discussion of the test results including the uncertainty associated with the test and discussion of possible errors or limiting conditions (Quality Assurance Procedures) [15.3.15]
<input checked="" type="checkbox"/>	Reference Method analyzer calibrations for each RM gas RATA run. (Appendix B) [15.3.16]
<input checked="" type="checkbox"/>	Raw plant CEMS data for each RATA run and each CEMS component (i.e. all gas analyzers, flow monitors). (Appendix B) [15.3.17]
<input checked="" type="checkbox"/>	Raw Reference Method DAS data for each RM gas RATA run. (Appendix B) [15.3.17]
<input type="checkbox"/>	CEMS "Operating Load Analysis" report. (Appendix C) [15.3.11]
<input type="checkbox"/>	Meter box post-test calibration results (Appendix C) [15.3.16]
<input checked="" type="checkbox"/>	NO _x converter check results (Appendix C) [15.3.16]
<input type="checkbox"/>	Pitot calibrations and inspections (Appendix C) [15.3.16]
<input type="checkbox"/>	FRRS/manometer/Magnehelic gage calibration results (Appendix C) [15.3.16]
<input checked="" type="checkbox"/>	Reference Method calibration gas certificates of analysis (Appendix C) [15.3.16]
<input checked="" type="checkbox"/>	RATA field data sheets verified against spreadsheet data (Field data sheets in project file) [15.3.17]
<input checked="" type="checkbox"/>	RCTS AETB Letter of Certification (Appendix D1) [15.3.19]
<input checked="" type="checkbox"/>	Completed QM Appendix F – "AETB Field Test Signature Form" (Appendix D1) [3.1.3; 3.1.9; 3.1.14; 8.3; Note 14; 12.2; 12.3; 12.4; 14.1.1]
<input type="checkbox"/>	Deviations from, additions to, or exclusions from the test protocol, test methods, or AETB Quality Manual entered on QM App. F pg. F-2 (Appendix D2) [15.3.13]
<input checked="" type="checkbox"/>	Names, titles and signatures of persons authorizing the test report – "QM App. D pg. D-2" (After Title Page) [15.3.18]
<input checked="" type="checkbox"/>	QSTI certificates for Qualified Individuals overseeing/performing the test (Appendix D2) [3.1.12]
<input checked="" type="checkbox"/>	Table of Contents is correct (Report Body) [Neatness & professionalism]
<input checked="" type="checkbox"/>	Report Headers & Footers are correct (Report Body) [Neatness & professionalism]
<input checked="" type="checkbox"/>	RM and CEMS run data in correct order (Appendix B) [Neatness & professionalism]

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1.0 INTRODUCTION

Consumers Energy Company (CECo), Regulatory Compliance Testing Section (RCTS) performed Relative Accuracy Test Audits (RATAs) on continuous emission monitoring systems (CEMS) at the exhaust of emission units EU-KARN3-2 (Unit 3), EU-KARN4-2 (Unit 4), EU-AUXBLRA-2 (Unit A), and EU-AUXBLRB-2 (Unit B), collectively identified as FG-KARN34-2 in operation at the Consumers Energy - Karn Facility located in Essexville, Michigan.

The RATA was performed to satisfy requirements in Appendix 3-2 of the Michigan Department of Environment, Great Lakes and Energy (EGLE) Renewable Operating Permit (ROP) No. MI-ROP-B2840-2022, and the United States Environmental Protection Agency (USEPA) Title 40, Code of Federal Regulations (CFR) Part 75, Appendices A and B. A test notification/sampling protocol describing the sampling, calibration, and quality assurance procedures in USEPA Reference Methods (RM) 1, 2, 2H, 3, 3A, 4 (ALT-008), 6C, 7E, and 19, in conjunction with Part 75 Appendices A and B was submitted July 20, 2022 to the USEPA Region V and EGLE offices. The test protocol stated SO₂ RATA testing may be conducted if fuel oil was being fired at the time of the RATA. As only natural gas was fired during the RATA, no SO₂ RATA was conducted. EGLE representative Ms. Lindsey Wells approved the protocol in a letter dated August 18, 2022.

RCTS representatives Thomas Schmelter, Dillon King, and Brian Miska conducted the RATA on August 24, 2022. Mr. Schmelter was the RCTS Lead Qualified Individual (QI) for the gas RATA. Mr. George Eurich, CECo Senior Laboratory Technical Analyst, coordinated the test with applicable plant personnel and Mr. Dale Myers, Senior Technician with D.E. Karn, collected and provided CEMS data. The field test was not witnessed by EGLE representatives.

While the test notification/sampling protocol and schedule included performing a flow RATA, an equipment failure of the stack platform access infrastructure (stack elevator) occurred on the day of field testing. Because of this equipment failure, access to the sampling location was deemed unsafe and RCTS was unable to safely complete the flow RATA.

Although attempts have been made by an elevator service company to repair the stack elevator since August 24, the attempts have been unsuccessful, and the stack elevator remains out of service. RCTS test equipment remains stranded on the stack sampling platform. This equipment includes the RM2 equipment and computer that contained data from the trial flow RATA runs. For that reason, no trial flow data is available to present in this report. The Flow RATA will be completed once the stack elevator is repaired and certified as safe and operational. The trial flow data from August 24, 2022 will be included in the final Flow RATA report.

Table 1-1 presents the test program organization, major lines of communication, and names of responsible individuals.

Table 1-1 Test Program Contact List

Program Role	Contact	Address
EPA Regional Contact	Michael Compher 312-886-5745 compher.michael@epa.gov	U.S. EPA Region 5 77 W. Jackson Blvd. (AR-18J) Chicago, IL 60604
EGLE AQD Emissions Measurement Representative	Mr. Jeremy Brown Acting Technical Programs Unit Supervisor 517-599-7825 brownj9@michigan.gov	EGLE – Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
State Technical Programs Field Inspector	Ms. Lindsey Wells Technical Programs Unit 517-282-2345 wellsL8@Michigan.gov	EGLE – Technical Programs Unit Constitution Hall, 2nd Floor S 525 W. Allegan Lansing, Michigan 48933
State Regional Agency Inspector	Mr. Benjamin Witkopp Environmental Quality Analyst 989-894-6219 witkoppb@michigan.gov	EGLE – Bay City District Office 401 Ketchum Street, Suite B Bay City, Michigan 48708
Responsible Official	Mr. Norman J. Kapala Vice President Generation Operations 616-738-3200 norman.kapala@cmsenergy.com	Consumers Energy Company J.H. Campbell Power Plant 17000 Croswell Street West Olive, Michigan 49460
Test Facility	Mr. George Eurich Sr. Laboratory Technical Analyst 989-891-3317 george.eurich@cmsenergy.com	Consumers Energy Company D.E. Karn Generating Complex 2742 N. Weadock Highway Essexville, Michigan 48732
CEMS Technician	Mr. Dale Myers Senior Technician 989-891-3358 dale.myers@cmsenergy.com	
Corporate Environmental Coordinator	Mr. Jason Prentice Sr. Engineer III 517-788-1467 jason.prentice@cmsenergy.com	Consumers Energy Company Parnall Office (P22-334) 1945 W. Parnall Road Jackson, Michigan 49201
Test Team Representative Gas RATA QI	Mr. Thomas Schmelter, QSTI Sr. Engineering Technical Analyst 517-788-1251 thomas.schmelter@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460

RCTS operates as a self-accredited Air Emission Testing Body (AETB) as described in the AETB Letter of Certification contained in Appendix D of this report and is therefore qualified to conduct test programs required in 40 CFR Part 75. RCTS' AETB program has been developed in accordance with the American Society for Testing and Materials (ASTM) D 7036-04, *Standard Practice for Competence of Air Emissions Testing Bodies*.

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2.0 SUMMARY AND DISCUSSION

The RATA results presented in Appendix B of this report indicate the Units 3, 4, A and B common stack carbon dioxide (CO₂), and oxides of nitrogen (NO_x)-diluent CEMS installed and operating at the D.E. Karn Generating Complex meet the semi-annual relative accuracy (RA) frequency standards in 40 CFR 75 Appendix A. The NO_x and CO₂ RA results also meet the annual reduced RA test frequency incentives in 40 CFR 75, Appendix B. In addition, the CEMS RA results comply with requirements in Appendix 3-2 of EGLE ROP No. MI-ROP-B2840-2022.

The RATA results are summarized in Tables 2-1 and 2-2. RA equations and other applicable sample calculations are presented in Appendix A. Comprehensive test results are presented in Appendix B.

2.1 NO_x GAS RATA

The NO_x-diluent CEMS met the ≤10.0% RA specification and the low NO_x emitting unit ±0.015 lb/mmBtu RM-CEMS mean difference reduced RATA test frequency incentive criterion in Appendix B §2.3.1.2(f). Table 2-1 summarizes the NO_x RATA results.

Table 2-1 Summary of NO_x RATA Results

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required RATA Performance	Actual RATA Performance
Thermo NO _x Model 42i	Units 3&4 SN 0709421280	lb/mmBtu	≤10.0% of mean RM - or - ±0.020 lb/mmBtu RM-CEMS difference	1.16% -0.001 lb/mmBtu
		Bias	d ≤ CC =Pass	Pass

|d| average absolute difference between the RM and CEMS
 |CC| confidence coefficient

2.2 CO₂ GAS RATA

The CO₂ results met the ≤10.0% RA and the mean difference of no greater than ±1.0% CO₂ specifications in 40 CFR 75, Appendix A §3.3.3 and the reduced RATA test frequency incentive standard in 40 CFR 75, Appendix B §2.3.1.2(a) and (h) where the RA is ≤7.5% or the mean difference does not exceed ±0.7% CO₂, respectively. Table 2-2 summarizes the CO₂ RATA results.

Table 2-2 Summary of CO₂ RATA Results

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required Performance Criteria	Actual RATA Performance
Thermo CO ₂ 410i	Unit 3 & 4 SN 0709421281	%	≤10% of mean RM or	2.07%
		%	±1.0% CO ₂ RM-CEMS difference	0.067%

3.0 SOURCE AND MONITOR DESCRIPTION

The D.E. Karn 3 & 4 Plant operates natural gas and/or fuel oil (dual fuel) fired boilers EU-KARN3-2 and EU-KARN4-2, each rated at 638 megawatts (MW) net output and a steam flow of 4,650 klbs/hour. The plant also operates the natural gas-fired auxiliary boilers EU-AUXBLRA-2 and EU-AUXBLRB-2, with each boiler rated at a heat input of 302 mmBtu/hr and a steam output of 225 klbs/hr. Flue gas from the individual boiler exhausts are combined into a common duct or stack designated as SVKARN34 or CS0009. SO₂ and NO_x emissions from Units 3 and 4 are controlled by fuel blending and low NO_x burner technology, respectively. The auxiliary boilers are also equipped with low NO_x burner technology.

Being that all units that share the common stack are peaking units, the entire operating load range is considered normal, as stated in 40 CFR 75, Appendix A, section 6.5.2.1(d).

During the gas RATA, the utility boilers generated approximately 318 MW gross electricity and 2,316 klbs/hr of steam flow. Units 3 and B were both operating during the RATA, with Unit 3 operating at approximately 318 MW gross and a steam flow of 2,313 klbs/hr; the Auxiliary Boiler Unit B operated at minimal loads equating to approximately 2 klbs/hr. Units A and 4 were not operating during testing.

Unit 3 was fired exclusively with natural gas during the RATA (Units A and B can only fire natural gas), and a CO₂ based fuel factor (Fc) of 1,040 scf CO₂/mmBtu was employed when calculating reference method lb/mmBtu emission rates.

Consistent with 40 CFR §75.21(a)(7), the common stack operating hours did not reach or exceed the 480-hr/yr exemption for high sulfur fuel firing, thus an SO₂ RATA was not required. Specifically, for the period 01/01/2021 through 12/31/2021, the cumulative number of common stack operating hours associated with fuel oil firing was 62 hours. For the period 01/01/2022 through 09/27/2022, the cumulative number of common stack operating hours associated with fuel oil firing was 57 hours.

The Thermo Scientific (Thermo) dilution-extractive CO₂, SO₂ and NO_x-diluent CEMS and dual ultrasonic flow CEMS (Flow 1 and Flow 2) installed in the common stack continuously measure gas concentrations and exhaust gas velocity on a wet basis. The flow CEMS are configured in an X pattern, allowing the individual monitors to act in tandem as components of the primary flow system or as redundant backup flow systems, if necessary. Each of the CEMS are linked electronically to a StackVision© data acquisition handling system (DAHS) which records various process, concentration, exhaust gas flow rate and emission rate data. The DAHS is manufactured by ESC Spectrum (ESC).

The common stack sampling test ports are installed at 3.09 stack diameters downstream from the nearest flow disturbance (where the Unit A and B exhaust ductwork enters the Common Stack breeching from the east side), and 3.84 stack diameters upstream from the stack exit. A schematic depicting the common stack test port locations and individual exhaust duct breeching elevations is shown in Figure 1.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

During this test event, only Units 3 and B were operating (with Unit B at minimal load). Because the RATA had previously been performed either with both units 3 and 4 in operation, or only unit 4 in operation, a stratification test was performed prior to beginning the gas RATA. The results of the stratification test showed that the concentration at each individual traverse point differed by no more than ±5.0 percent from the arithmetic average concentration for all traverse points. Therefore, a single RM measurement point located

122.5 inches from the stack wall in the west test port was selected to perform the gas RATA. A minimum of nine 21-minute runs were conducted at the common stack to calculate the gas CEMS RA. The stratification test results are presented in Appendix B2.

Specific test procedures as detailed in 40 CFR Part 60, Appendix B, RM 1, 3A, ALT-008 (in lieu of RM 4), 7E, and 19 were followed. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, was used as a reference. The following Sections describe the sampling and analytical procedures used.

4.1 TRAVERSE POINTS (USEPA METHOD 1)

A single measurement point was used to measure flue gas CO₂ and NO_x concentrations because the sample location is at least 2 duct diameters downstream and 0.5 duct diameters upstream from flow disturbances, the duct is greater than 7.8 feet in equivalent diameter, and a stratification test demonstrated no stratification. Refer to Figures 1 and 2 for sampling in-stack test port location and traverse point detail.

4.2 DILUENT (USEPA METHOD 3A)

During the gaseous RATAs, CO₂ diluent concentrations were measured using a non-dispersive infrared (NDIR) analyzer following guidelines in USEPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from a Stationary Source (Instrumental Analyzer Procedure). Section 4.4 describes the sample apparatus configuration.

4.3 MOISTURE CONTENT (USEPA METHOD ALT-008)

Gas RATA moisture content was determined using USEPA ALT-008, *Alternative Moisture Measurement Method Midget Impingers*. The sample apparatus follows the general guidelines contained in Figure 4-2 and § 8.2 of USEPA Method 4, *Determination of Moisture Content in Stack Gases*, and ALT-008 Figure 1 or 2. Exhaust gas was drawn at a constant rate through a series of midget impingers immersed in an ice bath to remove moisture, which was subsequently measured gravimetrically to calculate moisture content. Figure 3 depicts the Alternative Method 008 Moisture Sample Apparatus.

4.4 CO₂ AND NO_x CONCENTRATIONS (USEPA METHODS 3A AND 7E)

Carbon dioxide and nitrogen oxide concentrations were measured using the following sampling and analytical procedures:

- USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*, and
- USEPA Method 7E, *Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)*

The sampling procedures of the methods are similar with the exception of the analyzers and analytical technique used to quantify the parameters of interest. Components of the extractive gaseous RM system in contact with flue gas are constructed of Type 316 stainless steel and Teflon. Exhaust gas was extracted from the stack through a steel tube probe, heated Teflon® tubing, and a gas conditioning system to remove water and dry the sample before entering a pump, manifold, and the gas analyzers. The output signal from each analyzer was connected to a data acquisition system (DAS). The RM analyzers were calibrated with USEPA Protocol calibration gases and operated to ensure that zero drift, calibration gas drift, bias and calibration error met the specified method requirements. Refer to Figure 4 for a drawing of the reference method gaseous RATA sample apparatus.

Data collected from the RM analyzers were averaged for each run with NO_x concentrations measured in ppmvd. CO₂ concentrations were measured as percent by volume on a dry basis. Equation 19-6 from 40 CFR Part 60, Appendix A, Method 19 was used to calculate NO_x lb/mmBtu emission rates.

4.5 EMISSION RATES (USEPA METHOD 19)

USEPA Method 19, *Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates*, was used to calculate lb/mmBtu emission rates. Measured CO₂ and pollutant concentrations and F factors (ratios of combustion gas volume to heat input) were used to calculate emission rates using equation 19-6 from the method.

USEPA Method 19 Equation 19-6:

$$E = C_d F_c \frac{100}{\%CO_{2d}}$$

Where:

- E = Pollutant emission rate (lb/mmBtu)
- C_d = Pollutant concentration, dry basis (lb/dscf)
- F_c = Volumes of combustion components per unit of heat content, 1,040 scf CO₂/mmBtu for natural gas from 40 CFR 75, Appendix F, Table 1
- %CO_{2d} = Concentration of carbon dioxide on a dry basis (% , dry)

Refer to Appendix A for a RATA calculation summary presenting the calculations used in this report.

5.0 QUALITY ASSURANCE PROCEDURES

The objective of a Quality Assurance (QA) program is to produce data that are complete, representative, and of known precision and accuracy. Within the RATA test program, completeness can be defined as the percentage of the required field measurements and associated documentation achieved. Representativeness, defined as the "when," "how," and "how many" measurements taken, is typically specified within the regulations governing the source to be tested as well as the Test Protocol submitted to the regulatory agency prior to the test event. Precision and accuracy are measures of data quality and exist by design within each of the USEPA reference test methods and procedures incorporated during the RATA.

RCTS addresses these QA goals by operating within a Quality System in compliance with ASTM D 7036-04, Standard Practice for Competence of Air Emissions Testing Bodies; a practice specifying the general competence requirements applicable to all AETB staff engaged in air emission testing at stationary sources, regardless of testing scope. By employing these requirements in conjunction with the precision and accuracy standards in each reference method, RCTS is better able to ensure consistently accurate data quality from an individual and AETB perspective. RCTS' AETB Letter of Accreditation and individual QSTI Certificates are contained in Appendix D.

5.1 DRY GAS METERING CONSOLE

Due to safe access restrictions to the stack CEMS platform, the ALT-008 dry gas meter (DGM) used for the flue gas moisture measurements during the gas RATA remains on the stack CEMS platform. Therefore, the ALT-008 moisture DGM post-test calibration check has not been completed and is not included as supporting documentation in this report.

Historically, this equipment has been very reliable and the individual run moisture measurement results obtained on August 24, 2022 were consistent with expectations for this source and fuel type. When the ALT-008 DGM can be safely recovered, the ALT-008 dry gas metering (DGM) console and pump for measuring exhaust gas moisture content will be calibrated against a DGM calibration standard as described in Method 5, §16.1, using the procedures in Method 5, §10.3.2 and RCTS AETB Standard Operating Procedure 3-4. Should the QA calibration checks be material to the conclusions in this report, RCTS will provide the data and issue a report addendum.

5.2 USEPA PROTOCOL GAS STANDARDS

USEPA Protocol gas standards used by RCTS were purchased from an outside vendor participating in the USEPA Protocol Gas Verification Program (PGVP) calibration gas audit program described 40 CFR Part 75 § 75.21(g) following RCTS AETB Standard Operating Procedure 2-10. The standards are certified to have a total relative uncertainty of no greater than ± 2.0 percent according to the *USEPA Traceability Protocol for Assay & Certification of Gaseous Calibration Standards; EPA - 600/R-97/121; September 1997* or the current version of the traceability protocol (*EPA - 600/R-12/531; May 2012*). Appendix C contains a summary of the PGVP calibration gas standards used during this test program.

5.3 ANALYZER CALIBRATIONS

The gaseous RM instruments were calibrated on-site and operated following manufacturer's specifications, RCTS AETB Standard Operating Procedures 2-1 and 2-3, and the applicable reference method based in part on the quality assurance and quality control requirements contained in USEPA Methods 3A and 7E.

Before beginning the gas RATA, a three-point analyzer calibration error (ACE) check was conducted on each RM analyzer by injecting zero-, mid-, and high-level calibration gases directly into the instruments and measuring the responses. The instrument response must be within $\pm 2.0\%$ of the respective analyzer span or within ± 0.5 ppmv or $\pm 0.5\%$ for CO₂ 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 ± 0.5 ppmv or $\pm 0.5\%$ for CO₂ absolute difference.

A NO_x analyzer nitrogen dioxide (NO₂) to nitric oxide (NO) conversion efficiency (CE) test was conducted to verify the analyzer's ability to convert NO₂ to NO and accurately measure NO_x by chemiluminescence. Refer to Appendix C for this CE documentation.

After each gaseous run, post-test zero and upscale system bias checks were performed to quantify and compensate for RM analyzer drift and bias. The RM system bias is acceptable if those values remain within $\pm 5.0\%$ of the calibration span or ± 0.5 ppmv or $\pm 0.5\%$ for CO₂ absolute difference. The RM drift is acceptable if the zero and upscale values are within $\pm 3.0\%$ of the calibration span. System response times were documented during the initial system bias tests. Calibration gas flow rates were maintained at the target sample rate,

with each subsequent run started after twice the system response time elapsed. Analyzer bias and drift data is presented in Appendix B2.

6.0 DISCUSSION OF TEST RESULTS

The gaseous RATA results indicate the CEMS meet the semi-annual RA frequency standards in 40 CFR 75, Appendix A. The gaseous RATA results also meet the annual reduced RA test frequency incentives in 40 CFR 75, Appendix B. In addition, the CEMS RA results comply with Section 1, Appendix 3-A-S1 Monitoring Requirements in EGLE ROP MI-ROP-B2840-2022.

Prior to the stack elevator failure, two RCTS personnel on the stack sampling platform performed three trial flow RATA runs. CEMS data for the three trial runs was obtained by an RCTS analyst in the office and communicated via walkie-talkie to the analysts on the stack, where it was entered into the spreadsheet. For each of the three trial runs, the average RM reading and the average primary Flow CEMS (average of the two redundant X-pattern ultrasonic flow monitors) differed by no more than $\pm 10\%$ of the average RM value; however, each of the redundant back-up flow monitors were outside this limit and optimization of these systems was necessary. The trial flow RATA runs commenced in Hour 08:00 on August 24, 2022, and Consumers Energy will consider the two redundant backup flow CEMS out-of-control starting at that date/time until such time as passing redundant backup flow CEMS RATAs are completed.

When the RCTS analyst rode the elevator down from the stack sampling platform with the intention of optimizing the individual flow monitors, the elevator failed to stop at the ground-level landing and activated safety limit switches that disabled further operation. Because we would be unable to complete the flow RATA with the one analyst remaining on the stack platform, the flow monitors were not adjusted and flow RATA testing ceased. It should be noted that the last flow RATA was completed in the 3rd quarter of 2021, with a 4 QA operating quarter (i.e., a calendar quarter with at least 168 stack operating hours) retest frequency. Since the last successful flow RATA, only 2 QA operating quarters have elapsed (the 2nd and 3rd quarters of 2022). Thus, at the earliest, the flow RATA is not due until March 31, 2023 assuming that the 4th quarter of 2022 and 1st quarter of 2023 are QA operating quarters. As discussed in Section 1.0, the trial flow RATA information will be included in the final flow RATA report once flow RATA testing has been completed.

During the test event, no deviations were observed by the QI's in attendance. The criteria specified in the applicable Reference Methods and the agency-approved Test Protocol were followed. Hard copy and/or electronic field data were completed in the field and upon return to the home office, verified for data precision and accuracy, further ensuring the appropriate AETB and Reference Method quality measures were met.

The Quality Assurance data include the protocol gas certificates of analysis, analyzer calibration error and system response time, NO₂ to NO converter efficiency check, and instrument interference checks, which are contained in Appendix C. Due to safe access restrictions to the stack CEMS platform, the ALT-008 moisture DGM calibration has not been completed. When available, the equipment will be calibrated. Should the QA calibration checks be material to the conclusions in this report, RCTS will provide the data and issue a report addendum. Gas RATA instrument system bias/drift data are contained in Appendix B2. AETB certification and field test signature forms are provided in Appendix D1.

6.1 CLOCK TIME SYNCHRONIZATION

The electronic timestamps recorded for RM gas RATA runs, and associated moisture runs are on military time basis and synchronized to the CEMS DAHS, which is in Eastern Standard

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Time (EST). RM and CEMS response times were synchronized by adjusting the RM DAHS clock time.

Figures

Figure 1 – D.E. Karn Units 3 & 4 Sampling In-Stack Test Port Location

D E KARN PLANT UNITS 3 & 4
IN-STACK TEST PORT LOCATION
ELEVATION LOOKING WEST

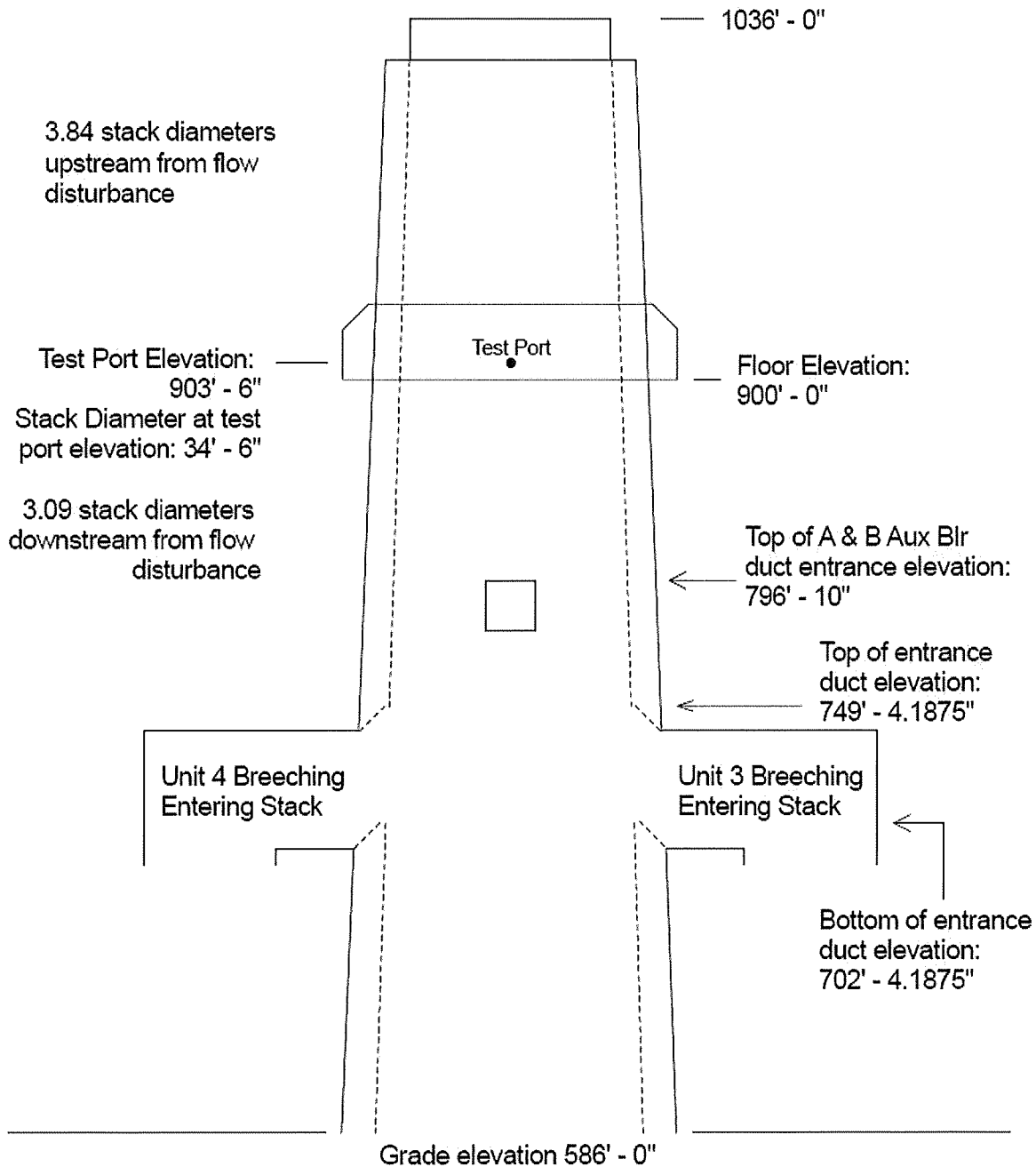
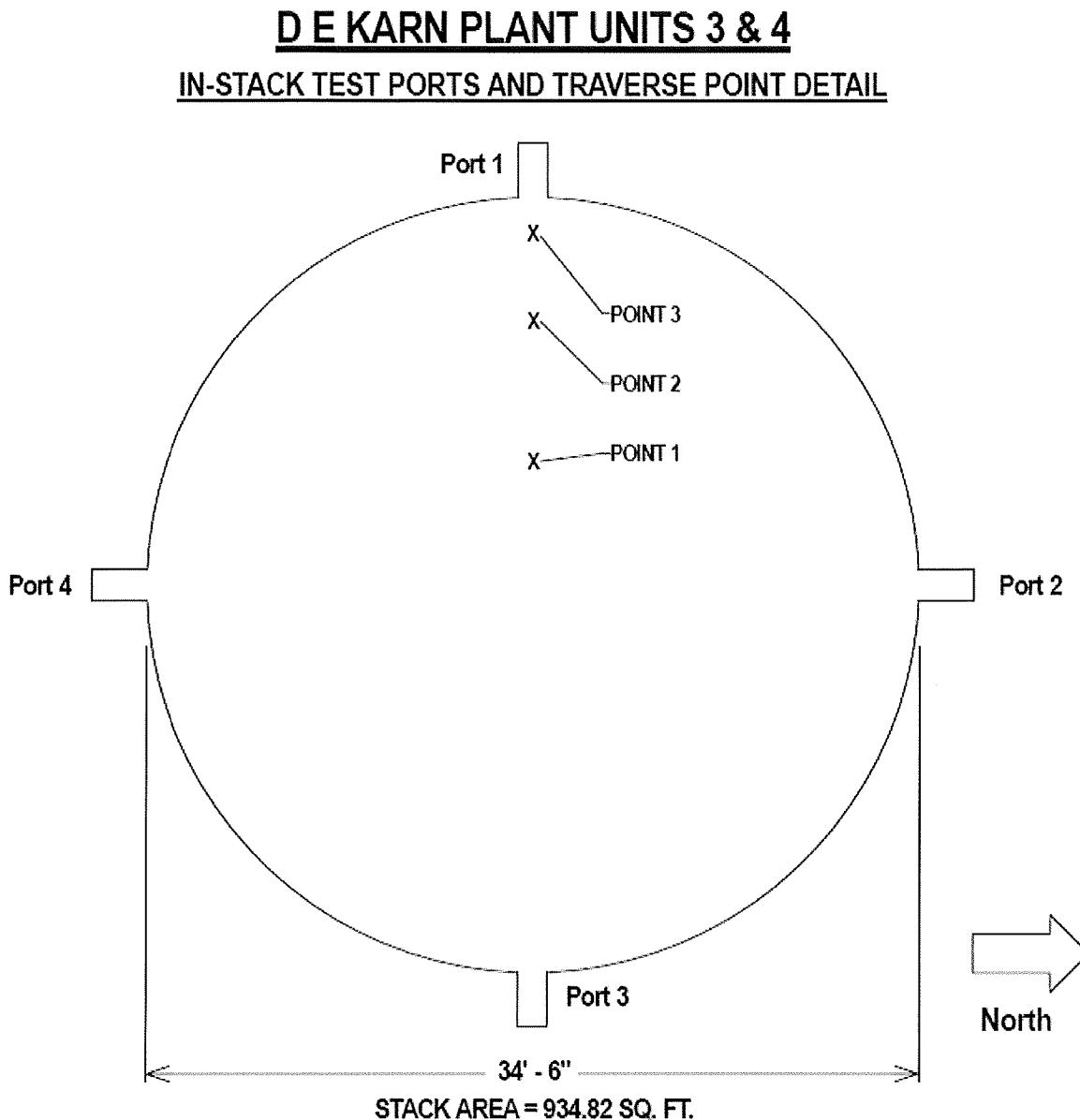
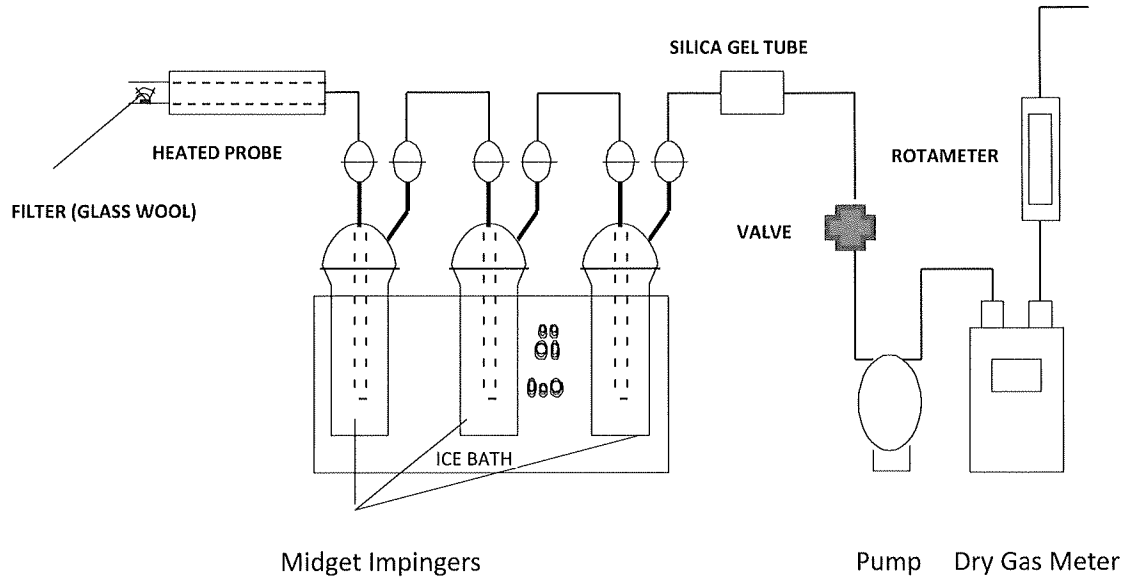


Figure 2 – D.E. Karn Units 3 & 4 In-Stack Test Ports and Traverse Point Detail



Gas RATA Stratification Test Probe Depths
From Inside Stack Wall
(All ports sampled at same points during Stratification Test)
Gas Port Length = 15"
POINT 1 = 122.5"
POINT 2 = 60.4"
POINT 3 = 18.2"
(Port 1, Point 1 was selected to perform the Gas RATA)

Figure 3 – Alternative Method 008 Moisture Sample Apparatus



The silica gel tube depicted in this figure was replaced with a midget impinger (bubbler) with a straight tube insert, as allowed in ALT-008, §1

Figure 4 – Reference Method Gaseous RATA Sample Apparatus

