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# 40 CFR Part 60 and 75 CEMS Relative Accuracy Test Audit Report

# EUBOILER

Grayling Generating Station Limited Partnership
4400 West Four Mile Road
Grayling, Michigan 49738
SRN: N2388
FRS: 110028027917
ORIS: 10822

May 16, 2024

**Test Dates: April 17 - 18, 2024**

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
PCS Project No. 2400332

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## CERTIFICATION FOR 40 CFR PART 75 TEST REPORT

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

Facility ID: ORIS: 10822, SRN: N2388 Date(s) Tested: April 15 and 16, 2024

Facility Name: Grayling Generating Station Limited Partnership

Facility Address: 4400 West Four Mile Road, Grayling, MI 49738

Equipment Tested: EUBOILER SO2, NOX, CO2, CO and Volumetric Flow CEMS

AETB Firm: CECo/RCTS AETB

Business Address: 135 W. Trail St., Jackson MI 49201

Phone: (616) 738-3234 Email: thomas.schmelter@cmsenergy.com

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, the information provided in this test report is true, accurate, and complete.

Signature: Date: May 23, 2024

Name: Thomas R. Schmelter Title: AETB Technical Director

Phone: (616) 738-3234 Email: thomas.schmelter@cmsenergy.com

# RELATIVE ACCURACY TEST REPORT CHECKLIST

| | Description (Typical location(s) in report) [ASTM D 7036-04 Section Reference] |
|---|---|
| ■ | Title (Title Page) [15.3.1] |
| ■ | AETB name & address (QM App. D pg. D-2) [15.3.2] |
| ■ | 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] |
| ■ | Name and address of the customer (Title Page; QM App. D pg. D-2) [15.3.4] |
| ■ | Date(s) the testing was performed (Title page; Introduction; QM App. D pg. D-2) [15.3.10] |
| ■ | Identification of the units tested (Title page; Introduction) [15.3.9] |
| ■ | Identification of regulatory personnel that observed testing (Introduction; Appendix D1) [Note 13] |
| ■ | Clear identification of the pollutants/parameters tested (Summary & Discussion) [15.3.5] |
| ■ | Identification of the test methods used (Sampling and Analytical Procedures) [15.3.8] |
| ■ | Identification of the sampling location, including diagrams, sketches, or photographs (Figures) [15.3.6] |
| ■ | Detailed process description and process operations for each test run (Source and Monitor Description; Appendix B CEMS data sheets) [15.3.7] |
| ■ | Reference to the test protocol and procedures used by the AETB (Introduction) [15.3.11] |
| ■ | Test results and units of measure (Summary and Discussion) [15.3.12] |
| ■ | 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] |
| ■ | 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] |
| ■ | Reference Method analyzer calibrations for each RM gas RATA run. (Appendix B) [15.3.16] |
| ■ | Raw plant CEMS data for each RATA run and each CEMS component (i.e., all gas analyzers, flow monitors). (Appendix B) [15.3.17] |
| ■ | Raw Reference Method DAS data for each RM gas RATA run. (Appendix B) [15.3.17] |
| ■ | CEMS "Operating Load Analysis" report. (Appendix C) [15.3.11] |
| ■ | Meter box post-test calibration results (Appendix C) [15.3.16] |
| ■ | $NO_x$ converter check results (Appendix C) [15.3.16] |
| ■ | Pitot calibrations and inspections (Appendix C) [15.3.16] |
| ■ | FRRS/manometer/Magnehelic gage calibration results (Appendix C) [15.3.16] |
| ■ | Reference Method calibration gas certificates of analysis (Appendix C) [15.3.16] |
| ■ | RATA field data sheets verified against spreadsheet data (Field data sheets in project file) [15.3.17] |
| ■ | RCTS AETB Letter of Certification (Appendix D1) [15.3.19] |
| ■ | 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] |
| ■ | 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] |
| ■ | Names, titles, and signatures of persons authorizing the test report – "QM App. D pg. D-2" (After Title Page) [15.3.18] |
| ■ | QSTI certificates for Qualified Individuals overseeing/performing the test (Appendix D2) |
| ■ | Table of Contents is correct (Report Body) [Neatness & professionalism] |
| ■ | Report Headers & Footers are correct (Report Body) [Neatness & professionalism] |
| ■ | 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) conducted continuous emission monitoring systems (CEMS) quality assurance (QA) audits associated with emission unit EUBOILER operating at the Grayling Generating Station (GGS)located in Grayling, Michigan.

The relative accuracy test audits (RATA) were conducted on April 17 and 18, 2024. The purpose of the CEMS audits was to comply with (1) the periodic QA required in 40 CFR Part 75, Appendices A and B, and 40 CFR Part 60, Appendix F, as incorporated in the ROP, and (2) the periodic QA required in the consent order entered into by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD) and GGS on July 28, 2022 (EGLE AQD ACO No. 2022-14).

A test protocol describing the sampling, calibration, and QA procedures in United States Environmental Protection Agency (USEPA) Reference Methods (RM) 1, 2, 2H, 3, 3A, 4, 6C, 7E, 10, and 19, in conjunction with Performance Specifications (PS) 2 (for the $SO_2$ and $NO_x$ lb/MMBtu RATA), 4A (for the CO ppmv RATA), and 40 CFR 75, Appendices A and B was submitted to the USEPA Region 5 and EGLE offices on March 6, 2024. The protocol was subsequently approved in a letter dated April 4, 2024 by EGLE representative Daniel Droste.

The CEMS audits were performed by RCTS representatives Thomas Schmelter, David Kawasaki, and Thomas Duchane. Brent Leichty, Control Technician at the Grayling Generating Station, coordinated the tests with applicable plant personnel and provided CEMS data. EGLE representatives Daniel Droste and Becky Radulski witnessed portions of the testing on April 17 and 18, 2024.

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 accordingly qualified to conduct 40 CFR Part 75 test programs. RCTS' AETB program is developed in accordance with the American Society for Testing and Materials (ASTM) D 7036-04, *Standard Practice for Competence of Air Emissions Testing Bodies*, in which the AETB is required during test projects to provide at least one qualified individual (QI), qualified in the specific methods for that project, to be on-site at all times. RCTS representatives Thomas Schmelter and David Kawasaki met these requirements and assumed the on-site lead QI roles for the duration of the flow and gas CEMS audits, respectively.

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

**Table 1-1**
**Contact Information**

| Program Role | Contact | Address |
|---|---|---|
| EPA Regional Contact | Michael Compher<br>312-886-5745<br>compher.michael@epa.gov<br>r5ardreporting@epa.gov | USEPA Region 5<br>77 W. Jackson Blvd. (AR-18J)<br>Chicago, IL 60604 |
| Regulatory Agency Representative | Jeremy Howe<br>Technical Programs Unit Supervisor<br>231-878-6687<br>howej1@michigan.gov | EGLE<br>Technical Programs Unit<br>525 W. Allegan, Constitution Hall, 2nd Floor S<br>Lansing, Michigan 48933 |
| Regulatory Agency Representative | Becky Radulski<br>Environmental Engineer<br>989-217-0051<br>radulskir@michigan.gov | EGLE<br>Gaylord District Office<br>2100 West M-32<br>Gaylord, Michigan 49735 |
| Regulatory Agency Representative | Daniel Droste<br>Environmental Quality Analyst<br>989-225-6052<br>drosted3@michigan.gov | EGLE<br>Bay City District Office<br>401 Ketchum Street, Suite B<br>Bay City, Michigan 48708 |
| Primary Designated Representative | Edward Going<br>Senior Manager Plant<br>989-348-4575<br>edward.going@nsce.com | Northstar Clean Energy<br>Grayling Generating Station Limited Partnership<br>4400 West 4 Mile Road<br>Grayling, Michigan 49738 |
| Site EHS Manager | Kyle Creason<br>Environmental Safety and Compliance Manager<br>989-348-4575 x112<br>kyle.creasonjr@nsce.com | NorthStar Clean Energy<br>Grayling Generating Station Limited Partnership<br>4400 West 4 Mile Road<br>Grayling, Michigan 49738 |
| Site EHS Manager | Brent Leichty<br>Control Technician<br>989-348-4575<br>brent.leichty@nsce.com | NorthStar Clean Energy<br>Grayling Generating Station Limited Partnership<br>4400 West 4 Mile Road<br>Grayling, Michigan 49738 |
| Field Operations Environmental Compliance | Kathryn Cunningham<br>Principal Environmental Engineer<br>517-768-3462<br>kathryn.cunningham@cmsenergy.com | Consumers Energy Company<br>Howell Service Center (HGO-107A-NOA)<br>1000 Grand Oaks Dr.<br>Howell, Michigan 48843 |
| Test Team Representative | Thomas Schmelter, QSTI<br>Principal Lab Technical Analyst<br>616-738-3234<br>thomas.schmelter@cmsenergy.com | Consumers Energy Company<br>L&D Training Center<br>17010 Croswell Street<br>West Olive, Michigan 49460 |
| Test Team Representative | David Kawasaki, QSTI<br>Sr. Engineering Technical Analyst<br>925-550-1632<br>david.kawasaki@cmsenergy.com | Consumers Energy Company<br>Royal Oak Service Center<br>4600 Coolidge Hwy<br>Royal Oak, Michigan 48073 |

# 2.0 SUMMARY AND DISCUSSION

The Grayling Generating Station carbon dioxide ($CO_2$), oxides of nitrogen ($NO_x$), sulfur dioxide ($SO_2$), carbon monoxide (CO), and volumetric airflow CEMS relative accuracy (RA) results indicate the CEMS meet the annual RA frequency standards in 40 CFR 75, Appendix A. Further, where applicable, the CEMS meet the applicable RATA requirements of 40 CFR Part 60, Appendices B and F, and EGLE AQD ACO No. 2022-14.

Results are presented in Tables 2-1 through 2-5 and Appendix B of this report. RA equations and other applicable sample calculations are presented in Appendix A.

## 2.1 Wall Adjustment Factor

The applicable default wall adjustment factor (WAF) of 0.9950 (dimensionless) was used to adjust the flue gas velocity and calculate volumetric flow rate. Accordingly, when reviewing the volumetric flow RATA results, note the volumetric flowrate corrected for WAF is used in relative accuracy calculations.

## 2.2 Volumetric Flowrate

The flow monitoring system consists of a Sick Model FLSE100-PR ultrasonic air flow probe installed in the EUBOILER exhaust stack. Two high frequency ultrasonic sender/receiver transducer units are installed opposite one another on a probe situated at a 45° angle within the exhaust stack. Pulses of sound are emitted between the sender/receiver units and the transit time is used to calculate the gas flow rate. The signal transducer produces an electronic signal to the control unit and output is captured in a VIM Technologies CEMLink6 data acquisition system. The flow monitor is used in conjuction with diluent measurements to calculate heat input rate, as well as to calculate pollutant mass emission rates.

As part of the RATA test program, trial flow RATA runs were performed on April 17, 2024, at low and high operating loads for the purpose of evaluating and optimizing the flow CEMS, if necessary, as allowed in 40 CFR 75, Appendix B §2.3.2(b)(2). The trial flow data was included in the 12-run flow RATA results at high load, as the individual trial run results from the EUBOILER flow monitor were within the ±10% difference specification in 40 CFR 75.20(b)(3)(vii)(E).

The low load trial flows failed to meet the 40 CFR 75.20(b)(3)(vii)(E)(2) trial run criteria since the average reference method reading and the average CEMS reading for one or more runs differed by more than ±10% of the average reference method value. Subsequent reference method quality assurance checks (i.e. Pitot tube inspection, leak check, thermocouple check, oil-filled manometer leveling and zeroing) were completed and three additional test runs were performed to evaluate CEMS performance, for a total of six low-flow test runs. Based on the results of these test runs, a complete 9-run flow RATA test would likely have resulted in an RA that exceeded the ≤10.0% RA criterion; therefore, the low-flow RATA was aborted.

Consequently, the flow CEMS probe was removed, inspected, cleaned, and reinstalled. Subsequently, a probationary calibration error test was performed in accordance with 40 CFR 75.20(b)(3)(vii)(A). Cleaning of the flow CEMS probe resulted in an approximate 7% increase in measured flow rate. The flow CEMS measured an average of 4,606 kscfh for Runs 1-6 from 08:05 thru 09:59 at 168 klbhr steam load and 4,948 kscfh during runs 1-12 from 12:37 through 14:36 at 169 klbhr steam load, while the RM measured 5,200 kscfh and 5,273 kscfh, respectively. No re-linearization of the flow monitor was required.

After the CEMS probe cleaning and probationary calibration a 12-run flow RATA was conducted at low load that resulted in an RA of 7.61% which met the less than ±10% RA criteria. However, because the low flow RATA exceeded the reduced (annual) relative accuracty test frequency criterion of ≤7.5% RA, an additional RATA was conducted on April 18, 2024 at a marginally reduced load condition (161 klbhr steam load versus 169 klbhr).

The 12-run flow RATA results at low and high load levels met the annual reduced test frequency incentive standard of ≤7.5% in 40 CFR 75, Appendix B §2.3.1.2(c), and the semi-annual test frequency requirement of ≤7.5% in EGLE AQD ACO No. 2022-14, Stipulations 9.A and 9.B. Table 2-1 summarizes the volumetric airflow RATA results.

**Table 2-1**
**Summary of Volumetric Airflow RATA Results**

| CEMS Make/ Model | CEMS Duct Location & Serial Number | RATA Criteria | Required RATA Performance | Actual RATA Performance |
|---|---|---|---|---|
| Sick Model FLSE100 -PR | EUBOILER SN: 22248469 | Low Load (April 17, 2024) | ≤10% of mean RM | 7.61% |
| | | Low Load (April 18, 2024) | | 5.97% |
| | | High Load (April 17, 2024) | | 6.89% |
| | | Bias† | \|d\| ≤ \|CC\| = Pass | 1.065 |

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient
† highest bias measured at normal (low) or second most frequently used load level (high) is presented

## 2.3 $SO_2$ Gas RATA

The facility operates $SO_2$ dilution out-of-stack pulsed fluorescence CEMS at the exhaust stack to report continuous emissions. The $SO_2$ concentrations (ppm) are used in conjunction with flow data to support 40 CFR Part 75 mass emissions reporting and assess compliance with a 24-hour rolling $SO_2$ mass emission limit. The lb/MMBtu emission rates are used to evaluate compliance with a related rolling $SO_2$ emission limit. Since the $SO_2$ emission standard is less than 0.20 lb/MMBtu, and the measured emissions were less than 50% of the 0.07 lb $SO_2$/MMBtu 24-hour rolling average emission limit, the emission limit was used as the denominator in calculation of CEMS relative accuracy.

The $SO_2$ ppm RATA results met the ±15 ppm specification in 40 CFR 75, Appendix A §3.3.1(b) as well as the reduced RATA test frequency incentive standard of ±12 ppm in 40 CFR 75, Appendix B §2.3.1.2(e). The $SO_2$ lb/MMBtu RATA results met the ≤20% RA criterion when the emission limit was used as the denominator in the RA calculation as required by 40 CFR 60, Appendices B and F. Table 2-2 summarizes the $SO_2$ RATA results.

**Table 2-2**
**Summary of $SO_2$ RATA Results**

| CEMS Make and Model | CEMS Location & Serial Number | RATA Performance Criteria | Required RATA Performance | Actual RATA Performance |
|---|---|---|---|---|
| Thermo Model 43iQ | EUBOILER SN: 1192744555 | ppm | ≤10% of mean RM or ±15.0 ppm RM-CEMS difference | 882.31% |
| | | | | -0.3 ppm |
| | | Bias (ppm) | \|d\|≤\|CC\|=Pass | Pass |
| | | lb/MMBtu† | ≤20% of emission limit | 1.61% |

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient
† As the $SO_2$ lb/MMBtu emission limit is less than 0.20 lb/MMBtu and the measured emissions were less than 50% of the emission limit, the $SO_2$ emission limit of 0.07 lb/MMBtu was used in the denominator of the percent RA calculation in lieu of the average RM value per §13.2 of 40 CFR Part 60, Appendix B, Performance Specification 2.

## 2.4 $NO_x$ Gas RATA

The facility operates $NO_x$ dilution out-of-stack chemiluminescence CEMS at the exhaust stack to report continuous emissions. The $NO_x$ emission rates (lb/MMBtu) are used in 40 CFR Part 75 Acid Rain Program reporting and to evaluate compliance with rolling $NO_x$ emission limits.

The $NO_x$ lb/MMBtu RATA results met the ≤10% RA specification in 40 CFR 75, Appendix A §3.3.1(a), as well as the reduced RATA test frequency incentive standard of ≤7.5% RA in 40 CFR 75, Appendix B §2.3.1.2(a). Table 2-3 summarizes the $NO_x$ RATA results.

**Table 2-3**
**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 42iQ-D | EUBOILER SN: 1192744557 | lb/MMBtu | ≤10% of mean RM | 1.19% |
| | | Bias | \|d\|≤\|CC\|=Pass | Pass |

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

## 2.5 $CO_2$ Gas RATA

The facility operates a $CO_2$ dilution out-of-stack non-dispersive infrared CEMS at the exhaust stack that was evaluated during this test program. The $CO_2$ concentrations are used to calculate heat input and pollutant lb/MMBtu emission rates. The $CO_2$ RATA results met the ≤10% RA requirement, the mean difference of no greater than ±1.0% $CO_2$ specification 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% $CO_2$, respectively. Table 2-4 summarizes the $CO_2$ RATA results.

**Table 2-4**
**Summary of $CO_2$ RATA Results**

| CEMS Make and Model | CEMS Location & Serial Number | RATA Performance Criteria | Required Performance Criteria | Actual RATA Performance |
|---|---|---|---|---|
| Thermo Model 410iQ | EUBOILER SN: 1192674378 | % | ≤10% of mean RM or ±1.0% $CO_2$ RM-CEMS difference | 6.52% RA |
| | | % | | -0.5% |

## 2.6 CO GAS RATA

A CO dilution out-of-stack non-dispersive infrared gas filter correlation CEMS is installed at the boiler exhaust to report continuous emissions and evaluate compliance with CO emission limits. The CO ppm RATA results met the ≤10% RA specification in 40 CFR 60, Appendix B, Performance Specification 4A, §13.2.

For purposes of RM CO lb/MMBtu and lb/hr calculations, the RM CO concentrations, $CO_2$ concentrations, and CEMS flowrate data were utilized. Since the CO mass emission rates were less than 50% of the 0.40 lb/MMBtu and 209.2 lb/hr 24-hour rolling average emission limits, the emission limits were used in calculation of relative accuracy. The CO lb/MMBtu RATA results met the ≤10% RA specification in 40 CFR 60, Appendix B, Performance Specification 2, §13.2. The CO lb/hr RATA results met the ≤20% RA specification in 40 CFR 60, Appendix B, Performance Specification 6, §13.2. Table 2-5 summarizes the CO RATA results.

**Table 2-5**
**Summary of CO RATA Results**

| CEMS Make and Model | CEMS Location & Serial Number | RATA Performance Criteria | Required RATA Performance | Actual RATA Performance |
|---|---|---|---|---|
| Thermo Model 48iQ | EUBOILER SN: 1192744556 | ppm | 10% of mean RM or ±5.0 ppm RM-CEMS difference + CC | 8.49% |
| | | | | 10.2 ppm |
| | | lb/MMBtu | ≤10% of emission standard[1] | 5.96% |
| | | lb/hr | ≤20% of emission standard[1] | 2.16% |

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient
[1] As the average RM CO lb/MMBtu and CO lb/hr emission rates was less than 50% of the CO emission limits, the emission limits were used in the denominator of the percent RA calculation in lieu of the average RM value per §13.2 of 40 CFR Part 60, Appendix B, Performance Specifications 2 (lb/MMBtu) and 6 (lb/hr).

# 3.0 SOURCE AND MONITOR DESCRIPTION

The Grayling Generation Station Limited Partnership is an electric utility facility located southeast of Grayling, Michigan. The facility commenced operation on May 9, 1992 and includes one 635 MMBtu/hr wood fired boiler equipped with natural gas auxiliary burners. The boiler is of a spreader-stoker design with a source classification code (SCC) of 10100911. The facility receives chipped wood by truck and uses this fuel in the boiler to produce steam. The steam is used to turn a turbine and generator to produce approximately 38 MW of electricity at full capacity. The electricity is sold to Consumers Energy (the utility subsidiary of CMS Energy) and routed through transmission and distribution systems to consumers. Emissions from the boiler are controlled by multiple air pollution control systems and monitored by the CEMS systems.

Sick ultrasonic air flow CEMS and Thermo Scientific dilution-extractive $SO_2$, $NO_x$ $CO_2$, and CO CEMS are installed in the EUBOILER exhaust stack. The CEMS interface with a data acquisition and handling system (DAHS) manufactured by VIM Technologies, responsible for recording data that includes exhaust gas flow rate, pollutant and diluent concentrations, emission rates, and operating parameters. Figure 1 illustrates the EUBOILER Data Flow Diagram and Sampling Location.

The CEMS systems quality assured during this test program are summarized in Table 3-1.

**Table 3-1**
**CEMS Information**

| Make and Model | System ID | Component ID | Span | Serial Number |
|---|---|---|---|---|
| Flow Sick Model FLSE100-PR | FL1 | 106 | 200,000 SCFM | 22248469 |
| $SO_2$ Thermo Model 43iQ | SO1 | 109 | 50 ppm | 1192744555 |
| $NO_x$ Thermo Model 42iQ-D | NO1 | 108 | 200 ppm | 1192744557 |
| $CO_2$ Thermo Model 410iQ | CO1 | 107 | 20% | 1192674378 |
| CO Thermo Model 48iQ | NA | NA | 1,000 ppm | 1192744556 |

In preparation for the testing, an Operating Load Analysis was obtained for EUBOILER encompassing a period of February 8, 2023 through February 7, 2024. Based on these four or more quarters of representative historical operating data, the first (i.e., normal) and second most frequently used load levels were determined to ensure the appropriate load levels were selected during the RATAs. Based upon planned revisions to the Part 75 Monitoring Plan and the Operating Load Analysis reviewed, Low and High are the most frequently used load levels, with High designated as the normal operating level and Low designated as an additional normal operating level. Therefore, the gas RATAs were conducted at Low load, while the flow RATAs were performed at Low and High loads. Refer to Appendix C for the Operating Load Analysis / Load Range Utility Report.

# 4.0 SAMPLING AND ANALYTICAL PROCEDURES

Specific test procedures detailed in 40 CFR Part 60, Appendix A, Reference Methods 1, 2, 2H, 3, 3A, 4, 6C, 7E, 10, and 19 were followed in conjunction with Part 75 Appendices A and B to conduct the RATA and calculate CEMS RA. $CO_2$, $NO_x$, CO, and $SO_2$ concentrations were measured for 21 minutes during each gas RATA run. Flue gas velocity and temperature were measured for a minimum of 5 minutes during each flow RATA test run. The following sections provide the sampling and analytical procedures employed.

## 4.1 Traverse Points (USEPA Method 1)

The number and location of traverse points used for determining exhaust gas velocity and flow RA was determined in accordance with USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*. The exhaust stack area was calculated and the cross-section divided into traverse points of equal area based on the location of existing airflow disturbances. Sixteen traverse points, 8 traverse points in each of 2 test ports, were used to measure flue gas volumetric flowrate. Refer to Figure 2 for the EUBOILER flow traverse points dimensions and detail.

Because the sampling location at the exhaust stack is at least 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance, gas concentrations were measured while traversing the duct approximately every 7-minutes at 16.7, 50.0, and 83.3 percent of the duct dimension parallel to the port (15.4, 46, and 76.6 inches from the stack wall). Refer to Figure 3 for the EUBOILER Gas Traverse Points Dimensions and Detail.

## 4.2 Velocity and Volumetric Flow (USEPA Method 2 and 2H)

The exhaust gas velocity and temperature measurements were conducted in accordance with USEPA Method 2*, Determination of Stack Gas Velocity and Volumetric Flow Rate*. The pressure differential across the positive and negative openings of an S-type Pitot tube connected to a pressure transducer were used to calculate exhaust gas velocity and volumetric flowrate. Refer to Figure 4 for an illustration of the volumetric flow RM apparatus.

As described in Section 2.1, the RM flow data incorporates the applicable default WAF of 0.9950 as referenced in USEPA Method 2H*, Determination of Stack Gas Velocity Taking into Account Velocity Decay near the Stack Wall.*

It should be noted that the most recent calibration for Pitot tube 2331 employed during sampling, resulted in an A-side $C_p$ of 0.820 and a B side $C_p$ of 0.826. Rather than use the average of the A and B-side $C_p$ values, the A-side $C_p$ of 0.820 was used in accordance with Section 10.1.5.1.1 of Method 2, as the A-side of the pitot consistently faced the flow direction throughout testing. The Pitot tube calibration certification is presented in Appendix C.

## 4.3 Diluent and Molecular Weight (USEPA Method 3 and 3A)

During the gas RATAs, $CO_2$ 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 4.5 describes the sample apparatus configuration.

Oxygen ($O_2$) and $CO_2$ concentrations were also measured to calculate flue gas composition during the flow RATAs using USEPA Method 3, *Gas Analysis for the Determination of Dry Molecular Weight* using calibrated Fyrite gas analyzers. Triplicate grab samples were captured in absorbing fluid resulting in a proportional fluid rise to the gas concentration absorbed. Each sample concentration was read on the instrument scale, and the calculated dry molecular weight was verified to not differ from the triplicate sample mean by more than 0.3 g/g-mole (0.3 lb/lb-mole), with the average result reported to the nearest 0.1 g/g-mole (0.1 lb/lb-mole).

## 4.4 Moisture Content (USEPA Method 4)

Flow and gas RATA moisture content was determined using USEPA Method 4, *Determination of Moisture in Stack Gases*. Exhaust gas was drawn at a constant rate through a series of impingers immersed in an ice bath to remove moisture, which was subsequently measured gravimetrically to calculate moisture content. The Method 4 Moisture Sample Apparatus is shown in Figure 5.

## 4.5 $CO_2$, $SO_2$, $NO_x$, and CO Concentrations (USEPA Methods 3A, 6C, 7E and 10)

Carbon dioxide, sulfur dioxide, nitrogen oxide, and carbon monoxide 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),*
- USEPA Method 6C, *Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure),*
- USEPA Method 7E*, Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure),* and
- USEPA Method 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)*

The sampling procedures of the methods are similar except for 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 heated stainless-steel 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 6 for a drawing of the reference method gaseous RATA sample apparatus.

Data collected from the RM analyzers were averaged for each run with CO, $NO_x$, and $SO_2$ concentrations measured in ppmvd. $CO_2$ 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 CO, $NO_x$ and $SO_2$ lb/MMBtu emission rates. Data from the flow CEMS was used to calculate CO lb/hr mass emission rates.

## 4.6 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 $CO_2$ 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, (scf $CO_2$/MMBtu) |
| $\%CO_{2d}$ | = | Concentration of carbon dioxide on a dry basis (%, dry) |

The $F_c$ factor reported by the facility was used to calculate RM lb/MMBtu emissions and calculate CEMS relative accuracy. Refer to Appendix A for 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 Pitot Tube, Thermocouple, and Pressure Equipment

The Pitot tube-thermocouple assembly for measuring exhaust gas volumetric flow was inspected and/or calibrated according to procedures in RCTS' AETB Standard Operating Procedure 3-5 and Appendix O, USEPA RM 2, and Approved Alternative Method 011 (ALT-011).

A Pitot tube inspection occurred before the field test to confirm there is no gross damage or excess misalignment of the Pitot openings. A post-test Pitot tube inspection and certification was performed to evaluate if the Pitot face openings are still aligned within acceptable tolerances.

ALT-011 describes the inherent accuracy and precision of a thermocouple within ±1.3°F in the range of -32°F and 2,500°F and states that a system performing accurately at one temperature is expected to behave similarly at other temperatures. Therefore, a single point thermocouple calibration procedure to verify accuracy within ±1.0% of absolute temperature, taking into account the presence of disconnected wire junctions or a potential miscalibrated temperature display, was performed. After the test event, the accuracy of the thermocouple system was checked at ambient temperature, or other temperature, within the range specified by the manufacturer, using a reference thermometer. The temperatures of the thermocouple and reference thermometer(s) shall agree within ±2°F.

The differential pressure transmitters used with Method 2 were calibrated in accordance with §6.2.1 of the method and RCTS AETB Standard Operating Procedure Appendix J-4. Refer to Appendix C for Pitot tube, thermocouple, differential pressure and barometer calibration or inspection records.

## 5.2 Dry Gas Metering Console

The dry gas metering (DGM) console and pump for measuring exhaust gas moisture content was calibrated using critical orifices as described in Method 5, §16.0. A Post-Test Metering System Calibration check was performed pursuant to Method 5, §16.3 procedures. Refer to Appendix C for DGM console calibration data.

## 5.3 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% according to the *USEPA Traceability Protocol for Assay & Certification of Gaseous Calibration Standards* (*EPA – 600/R-12/531; May 2012*). Appendix C contains a summary of the PGVP calibration gas standards used during this test program.

## 5.4 Analyzer Calibrations

The gaseous RM instruments were calibrated on-site and operated following manufacturer's specifications and the applicable reference method based in part on the quality assurance and quality control requirements contained in USEPA Methods 3A, 6C, 7E, and 10.

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 ±2.0% of the respective analyzer span or within ±0.5 ppmv or ±0.5% for $CO_2$ 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 ±5.0% of the calibration span or ±0.5 ppmv or ±0.5% for $CO_2$ absolute difference.

A $NO_x$ analyzer nitrogen dioxide ($NO_2$) to nitric oxide (NO) conversion efficiency (CE) test was conducted to verify the analyzer's ability to convert $NO_2$ to NO and accurately measure $NO_x$ by chemiluminescence.

After each gas RATA 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 ±5.0% of the calibration span or ±0.5 ppmv or ±0.5% for $CO_2$ absolute difference. The RM drift is acceptable if the zero and upscale values are within ±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 B, while calibration data is in Appendix C.

# 6.0 DISCUSSION OF TEST RESULTS

The CEMS RATA results presented in Tables 2-1 through 2-5 and Appendix B indicate the CEMS operating at the Grayling Generating Station EUBOILER exhaust meet the performance specifications in 40 CFR 75, Appendix A, and the annual reduced RATA test frequency incentive standards in 40 CFR 75, Appendix B. Further, where applicable, the CEMS meet the applicable RATA requirements of 40 CFR Part 60, Appendices B and F, and the semi-annual test frequency requirements in EGLE AQD ACO No. 2022-14, Stipulations 9.A and 9.B. These data indicate compliance with the CEMS monitoring and recordkeeping requirements of the facility's air permit MI-ROP-N2388-2014a.

During the test event, no deviations were observed by the QIs 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.

Quality Assurance data, such as protocol gas certificates of analysis, analyzer calibration error and system response time, $NO_2$ to NO CE check and instrument interference information are presented in Appendix C. Gas RATA instrument system bias/drift data is presented in Appendix B5. AETB certifications and signature forms are provided in Appendices D1 and D2.

## 6.1 Clock Time Synchronization

The electronic timestamps recorded for RM RATA runs are on military time basis and synchronized to the CEMS DAHS, which is in Eastern Standard Time (EST).

# Figures

Figure 1 – EUBOILER Data Flow Diagram and Sampling Location

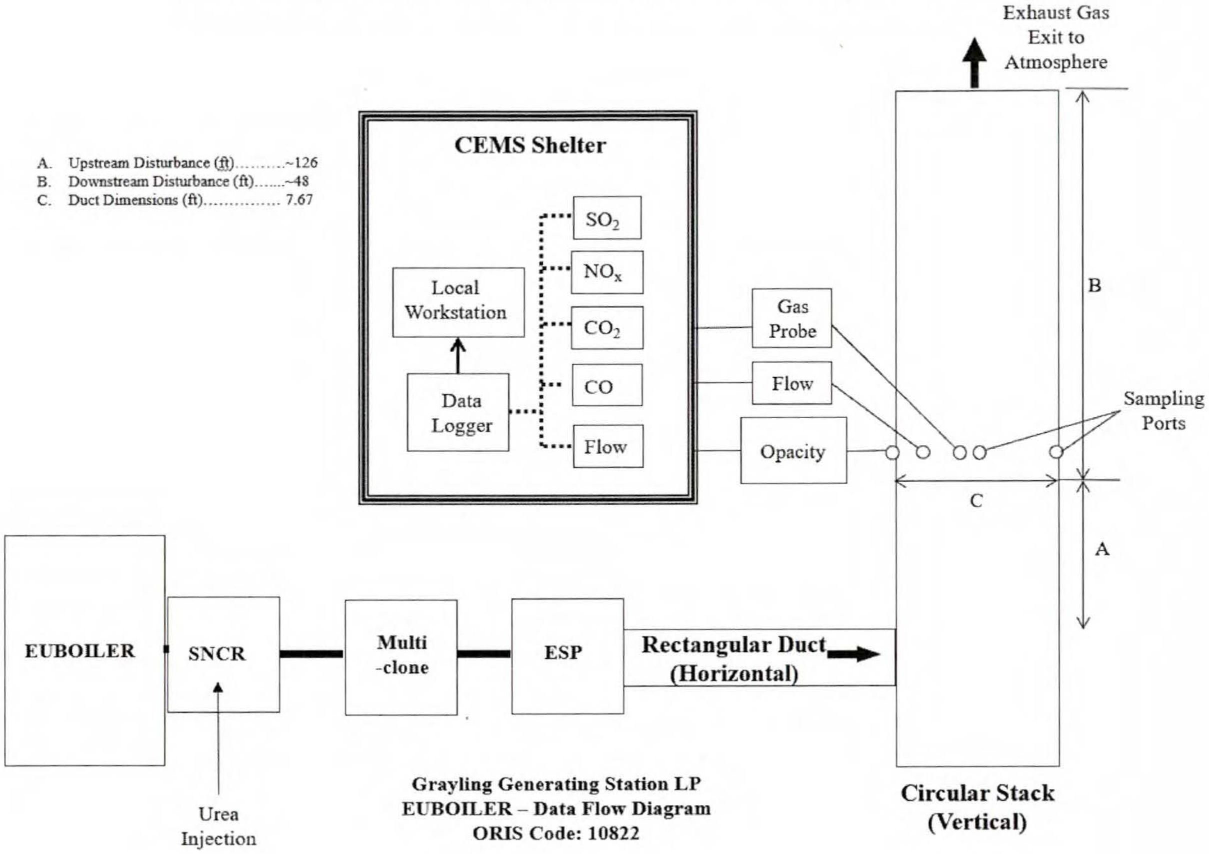
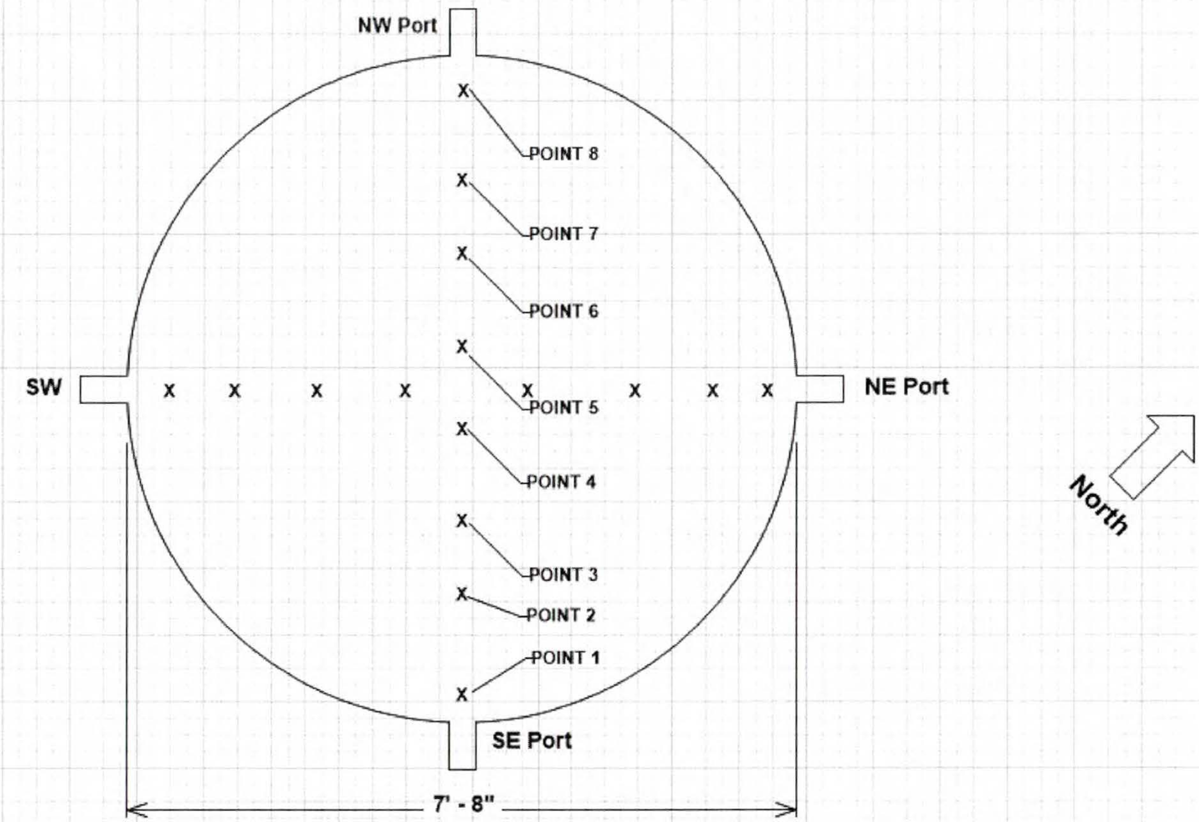


Figure 2 – EUBOILER Flow Traverse Points Dimensions and Detail




STACK AREA = 46.2 SQ. FT.

**FLOW RATA TRAVERSE POINT LOCATIONS**

**Note: SW Test Port Length = 14.5" from inside stack wall to outside flange.**
**SE Test Port Length = 13" from inside stack wall to outside flange.**

**DISTANCES FROM INSIDE STACK WALL**

| | |
|---|---|
| Point 1 | 89.1" |
| Point 2 | 82.3" |
| Point 3 | 74.2" |
| Point 4 | 62.3" |
| Point 5 | 29.7" |
| Point 6 | 17.8" |
| Point 7 | 9.7" |
| Point 8 | 2.9" |

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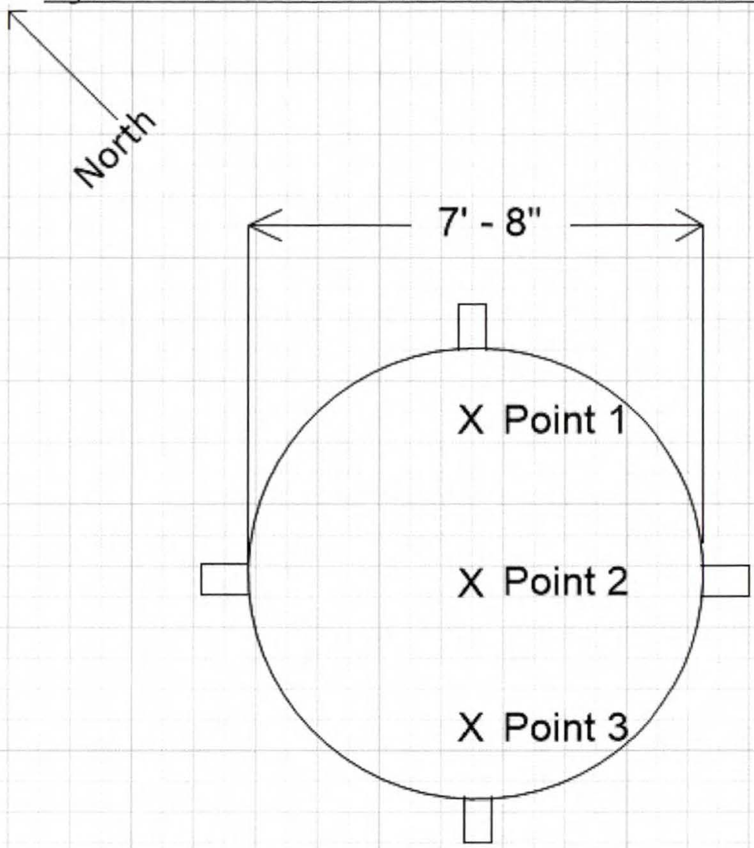
Figure 3 – EUBOILER Gas Traverse Points Dimensions and Detail




In-Stack Sample Point Locations

Distances from inside stack wall:

Point 1 = 76.6"
Point 2 = 46"
Point 3 = 15.4"

Figure 4 – Volumetric Airflow RATA Sample Apparatus

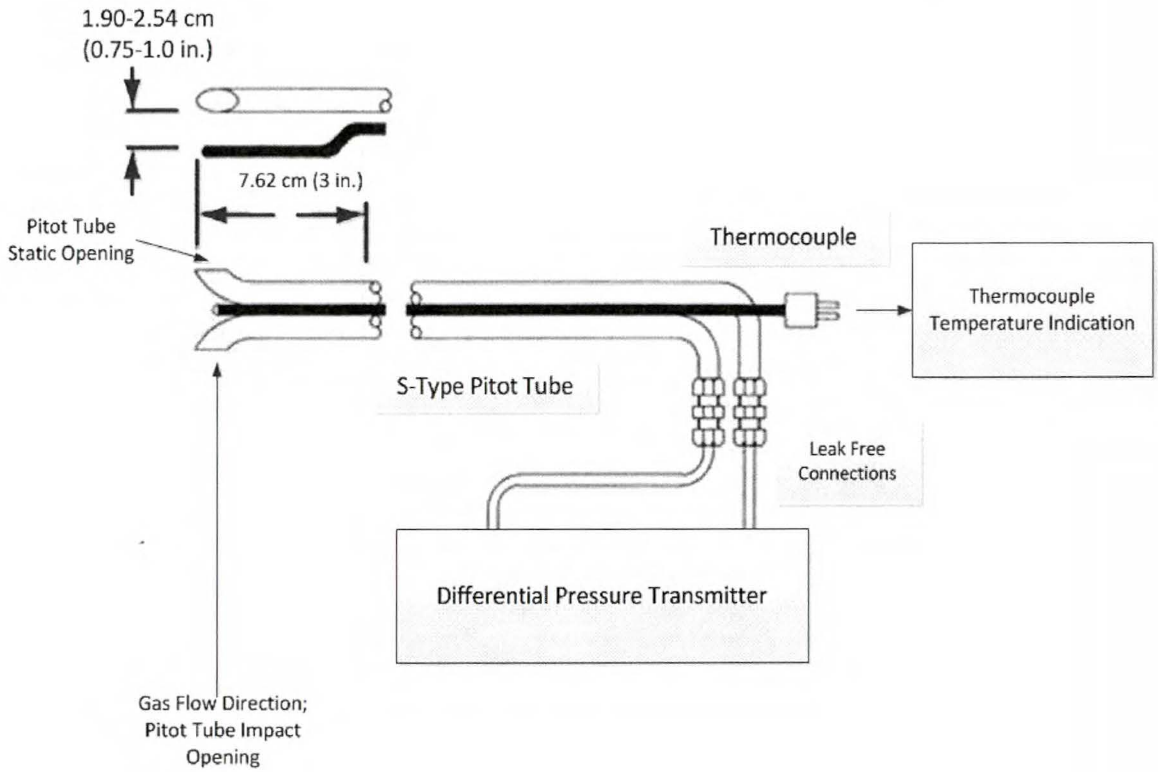


Figure 5 – Method 4 Moisture Sample Apparatus

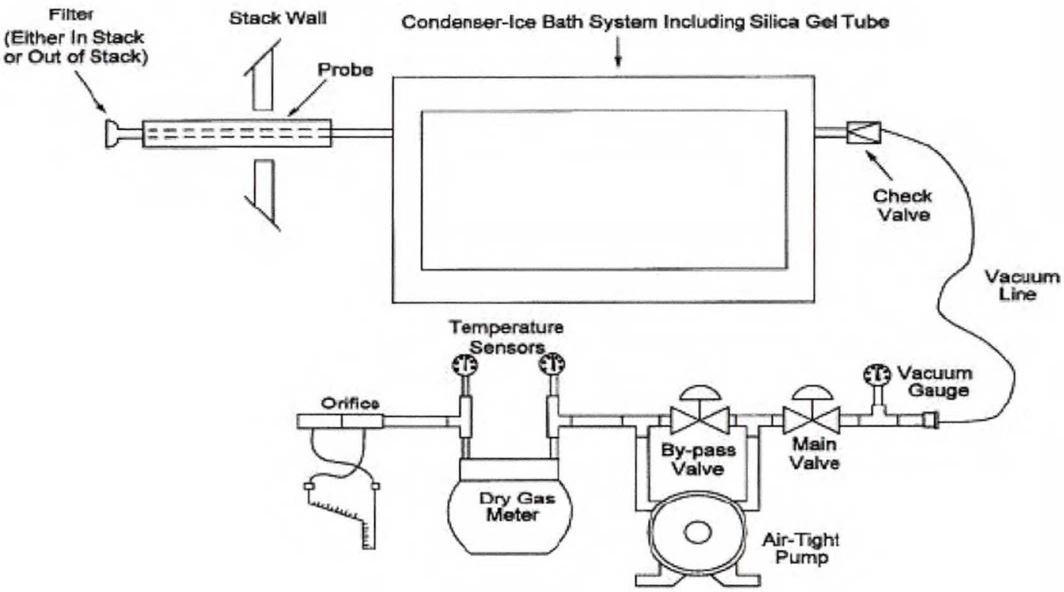


Figure 6 – Reference Method Gaseous RATA Sample Apparatus