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**40 CFR Part 63, Subpart UUUUU
Mercury CEMS
Certification Test Report**

**Consumers Energy Company
Dan E. Karn Unit 1**

Prepared by:

**George E. Eurich
Consumers Energy
2742 N. Weadock Highway
Essexville, MI 47832**

November 2, 2015



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

**RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION**

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Consumers Energy DE Karn 1&2 Plant County Bay

Source Address 2742 N. Weadock Highway City Essexville

AQD Source ID (SRN) B2840 ROP No. MI-ROP-B2840-2014 ROP Section No. 1

Please check the appropriate box(es):

Annual Compliance Certification (Pursuant to Rule 213(4)(c))

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, this source was in compliance with ALL terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, EXCEPT for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))

Reporting period (provide inclusive dates): From _____ To _____

1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, EXCEPT for the deviations identified on the enclosed deviation report(s).

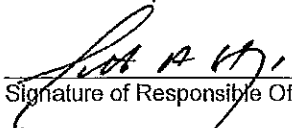
Other Report Certification

Reporting period (provide inclusive dates): From 2/17/2015 To 9/30/2015

Additional monitoring reports or other applicable documents required by the ROP are attached as described:
DE Karn Unit 1 Mercury CEMS Certification Test Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Scott Hugo Site Production Manager (989) 891-3268
Name of Responsible Official (print or type) Title Phone Number


Signature of Responsible Official

11/2/15
Date

* Photocopy this form as needed.

1 INTRODUCTION

Dan E. Karn Unit 1 is subject to 40 CFR Part 63, Subpart UUUUU—*National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units*. The preceding rule is also known as the Mercury and Air Toxics Standard, or MATS. In order to comply with the mercury monitoring obligations of MATS, Consumers Energy has elected to install a mercury continuous emissions monitoring system (CEMS).

The purpose of this test program is to satisfy the mercury CEMS certification requirements specified in Appendix A of 40 CFR Part 63, Subpart UUUUU. Consistent with Section 4.0 of Appendix A, the required certification tests consist of a 7-day calibration error test, linearity check, three-level system integrity check, cycle time test, and relative accuracy test audit (RATA). Each of required certification checks or tests has been conducted on the mercury CEMS on Unit 1; all but the RATA were conducted by Consumers Energy employees with assistance from the mercury CEMS vendor's technical staff within the past 60 days. The mercury CEMS RATA was conducted by C.E.M. Solutions, Inc. of Hernando, Florida on February 17-18, 2015.

The applicable MATS mercury emission rate limit for existing non-low rank coal-fired generating units are 1.2 pounds per trillion British Thermal Units (lb/TBtu), or 0.013 pounds per gigawatt-hour (lb/GWh). Each generating unit owner / operator may decide which limit shall be applied to their affected unit. At this time, Consumers Energy has decided to demonstrate compliance with the 1.2 lb/TBtu limit. The mercury CEMS records mercury concentrations in the exhaust gas in micrograms per standard cubic meter ($\mu\text{g}/\text{scm}$). Auxiliary CEMS measurements such as the diluent concentration of the exhaust gas needed to calculate the lb/TBtu emission rate are obtained from CO₂ and/or flow CEMS which were previously certified pursuant to 40 CFR Part 75. The CO₂ and flow CEMS continue to follow the quality assurance and quality control procedures found within 40 CFR Part 75, Appendices A and B. Therefore, certification of auxiliary CEMS is not required for purposes of conducting mercury monitoring pursuant to 40 CFR Part 63, Subpart UUUUU.

The mercury CEMS RATA was conducted on February 17 and 18, 2015. Consumers Energy conducted the other certification tests in September 2015. A detailed RATA test report was provided to the Michigan Department of Environmental Quality – Air Quality Division (MDEQ-AQD) in April 2015 and will not be further discussed in the body of this report. If another copy of the certification RATA test report is desired, Consumer's Energy can provide one on request. The non-RATA certification test results are provided in Attachments 1 through 3 describing the outcome of the 7-day calibration error test, linearity test check, and 3-level system integrity check respectively. Included in the discussion of the test results below is Consumers Energy's assertion that this mercury CEMS is exempted from the cycle time test requirement as described in Appendix A of 40 CFR Part 63, Subpart UUUUU, with supporting information provided in Attachment 4.

2 SOURCE DESCRIPTION

The Dan E. Karn Plant is operated to comply with the requirements described in Renewable Operating Permit (ROP) MI-ROP-B2840-2014, Section 1. The generating unit Karn Unit 1 (or simply, Unit 1) is a 2,500 mmBtu/hr, 265 MW net, dry bottom tangential coal-fired boiler designated as EUKARN1 in the ROP. Unit 1 fires low sulfur pulverized coal and incorporates the following pollution control equipment:

- Selective Catalytic Reduction (SCR) to control NO_x
- Pulse-Jet Fabric Filter bag house to control particulate matter
- Spray Dry Absorber (SDA) to control SO₂ and other acid gases (the SDA and fabric filter are also expected to provide mercury removal co-benefits)
- Activated Carbon Injection system for additional mercury control to the extent that such control is required to comply with MATS.

Thermo Scientific (Thermo) dilution-extractive CO₂, SO₂ and NO_x CEMS, a dilution-extractive Tekran Model 3300 mercury CEMS, a Sick Dusthunter SP100 scattered light particulate monitor, and Teledyne ultrasonic air flow CEMS are installed at the exhaust stack location. The air flow CEMS incorporates dual ultrasonic flow monitors (A and B) configured in an X-pattern in the stack. In this configuration the individual monitors act in tandem as components of the primary flow system or as redundant backup flow systems, if necessary.

The preceding CEMS interface with a data acquisition handling system (DAHS) manufactured by Environmental Systems Corporation (ESC), with the associated software referred to as StackVision™. The DAHS records various data including exhaust gas flow rates, concentrations and emissions, as well as operating unit parameters such as unit load. The DAHS is used to generate certification test reports for the 7-day calibration error test, linearity check, and three-level system integrity check, as well as per run printouts containing 1-minute and average data for the mercury CEMS RATA.

Figure 1 provides a general schematic of the Unit 1 monitoring equipment, boiler control equipment and testing location relative to upstream and downstream disturbances. The mercury CEMS is located with other CEMS equipment, and its stack probe is located at the test location height.

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- A. Stack Height (ft)350.5
- B. Test Location Height (ft).....147.0
- C. Downstream Disturbance (ft).....70.7
- D. Upstream Disturbance (ft).....203.5
- E. Stack Diameter (ft).....22.3

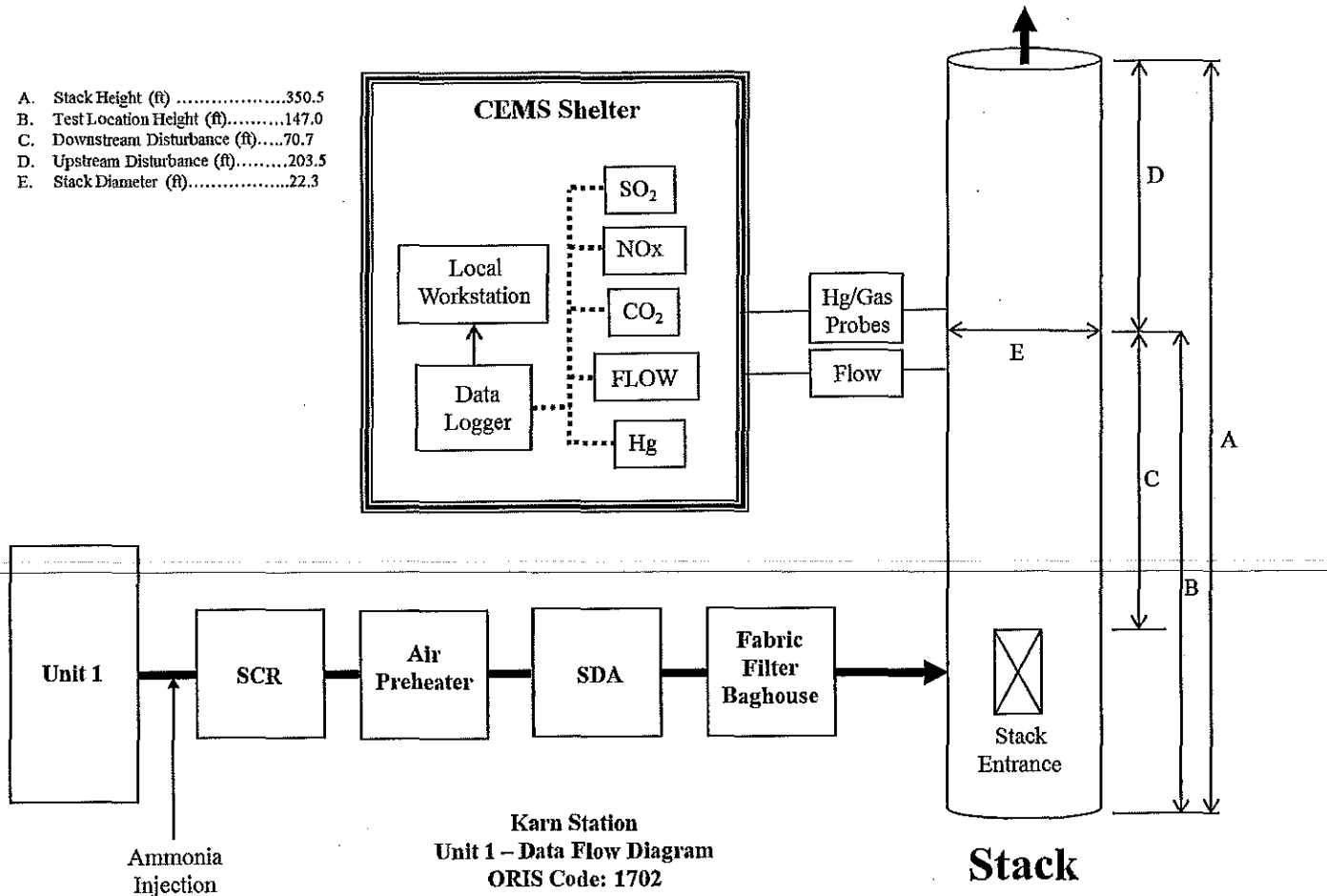


Figure 1: Karn 1 CEMS Configuration

3 CERTIFICATION TEST REPORT

All certification testing for the mercury CEMS was performed in accordance with the requirements in Appendix A of 40 CFR Part 63, Subpart UUUUU, as well as the applicable EPA Reference Methods in Appendix A of 40 CFR Part 60. A description of the certification test procedures is presented in the subsections below.

The RATA was performed by C.E.M. Solutions, Inc., with support provided by the CEMS vendor and Dan E. Karn Plant personnel. The testing contractor followed all procedures and policies specified in their Quality Manual and Standard Operating Procedures, both of which were developed in accordance with ASTM D-7036-04, *Standard Practice for Competence of Air Emission Testing Bodies*. Please note that the ASTM D-7036-04 requirements do not directly apply to the mercury CEMS RATA, but such principles were applied to the RATA test as a matter of quality assurance.

The remaining certification tests were conducted by Dan E. Karn Plant personnel with support from Tekran, the mercury CEMS vendor.

3.1 7-Day Calibration Error Test

A 7-day calibration error test for the mercury CEMS was performed in accordance with the certification procedures specified in Section 4.1.1.1 of Appendix A, 40 CFR Part 63, Subpart UUUUU. This test measures the stability of the instrument by recording the results of the analyzer's daily calibration error check during seven consecutive unit operating days (versus calendar days).

The test commenced on September 5, 2015 and concluded on September 11, 2015. A normal calibration error check was conducted approximately 24-hours apart while the unit was operating. ~~The mercury CEMS was challenged at each of two calibration levels while the monitor was operating in its~~ normal sampling mode: (1) zero-level, below the level detectable by the mercury CEMS; and (2) mid-level, at 50.0 – 60.0% of the instrument span. The mid-level calibration gas was generated by a NIST-Traceable Elemental Hg Standard generator (the NIST traceability certification of the Hg Standard generator is provided in Attachment 5). The calibration gas passed through all filters, sample conditioners and other monitor components used to collect the exhaust gas samples, including as much of the sampling probe as was practical. No manual adjustments were made to the instrument during the calibration.

The 7-day calibration error test results are acceptable for the mercury CEMS if none of the test results differ from the reference value of the calibration gas by more than 5.0% of span or an absolute difference of no more than 1.0. µg/scm, whichever is least restrictive. The equation used to determine the calibration error results is:

$$CE = \frac{|R-A|}{S} \times 100 \quad \text{Equation 1}$$

Where:

CE = Percentage calibration error based upon span of the instrument.

R = Reference value of zero- or upscale calibration gas introduced into the monitoring system.

A = Actual monitoring system response to the calibration gas.

S = Span of the instrument.

The mercury CEMS passed the 7-day calibration error test, with results summarized below in Table 1. The results of the 7-day calibration error test, along with calibration error check details from each of the seven days of the test, are provided in Attachment 1.

Table 1. Summary of Hg CEMS 7-Day Calibration Error Test Results

Parameter	Audit Result (%)	Required Performance	Pass/Fail
7-Day Cal. Error, Zero-Level	0.0% Maximum	≤ 5.0%	Pass
7-Day Cal. Error, Mid-Level	2.0% Maximum	≤ 5.0%	Pass

3.2 Linearity Check

A 3-point linearity check was performed for the mercury CEMS in accordance with the requirements specified in Section 4.1.1.2 of Appendix A, 40 CFR Part 63, Subpart UUUUU on September 9, 2015. This check measures the ability of the instrument to accurately measure the elemental mercury content of the exhaust gas across a range of reference values reflective of the measurement span of the instrument. For the linearity check, NIST traceable elemental mercury standards were introduced in the same manner as the daily span calibration gases, consistent with the requirements in Section 3.2.1.1.3.6 of Appendix A. The mercury CEMS was challenged three times at each of three calibration levels; low, mid, and high. The three calibration gas levels are defined in Sections 3.1.9, 3.1.10 and 3.1.11 as follows: (1) a low-level concentration between 20.0 to 30.0% of span, (2) a mid-level concentration between 50.0 to 60.0% of span, and (3) a high-level concentration between 80.0 to 100.0% of span.

Results of the linearity checks are acceptable if the mercury CEMS reading differs from the audit gas concentration by no more than 10.0% of the audit gas concentration or if the absolute value of the average difference between the monitor response and the audit gas concentration does not exceed 0.8 µg/scm, whichever is less restrictive. An analyzer is considered out of control from the time that an unacceptable linearity check is completed until the time that an acceptable linearity check is completed, following corrective maintenance.

The equation used to determine the results of the linearity check is as follows:

$$LE = \frac{|R-A|}{R} \times 100 \quad \text{Equation 2}$$

Where:

LE = Percentage linearity error, based upon the reference value

R = Reference value of calibration gas introduced into the monitoring system

A = Average of the monitoring system responses

The mercury CEMS passed the linearity check, with results summarized below in Table 2. The detailed results of the linearity test are provided in Attachment 2.

Table 2. Summary of Hg CEMS Linearity Check Results

Parameter	Audit Result (%)	Required Performance	Pass/Fail
Linearity Error, Low-Level	4.9%	≤ 10.0%	Pass
Linearity Error, Mid-Level	1.8%	≤ 10.0%	Pass
Linearity Error, High-Level	1.9%	≤ 10.0%	Pass

3.3 3-Level System Integrity Check

A 3-level system integrity check was performed for the mercury CEMS in accordance with the requirements specified in Section 4.1.1.3 of Appendix A, 40 CFR Part 63, Subpart UUUUU on September 10, 2015. Similar to the linearity check, this check measures the ability of the instrument to accurately measure the oxidized mercury content of the exhaust gas across a range of reference values reflective of the measurement span of the instrument. For the 3-level system integrity check, gases from a NIST traceable source of oxidized Hg were introduced in the same manner as the daily span calibration gases, consistent with the requirements in Section 3.2.1.1.3.6 of Appendix A. The calibration gas levels were consistent with those described for the linearity check.

Results of the system integrity checks are acceptable if the mercury CEMS reading differs from the audit gas concentration by no more than 10.0% of the audit gas concentration or if the absolute value of the average difference between the monitor response and the audit gas concentration does not exceed 0.8 µg/scm, whichever is less restrictive. An analyzer is considered out of control from the time that an unacceptable system integrity check is completed until the time that an acceptable system integrity check is completed, following corrective maintenance. The equation used to determine the results of the system integrity check is the same as that for the linearity test.

The mercury CEMS passed the 3-level system integrity check, with results summarized in Table 3. The results of the 3-level system integrity check are provided in Attachment 3. The title of the test report is shown as "Linearity Test" rather than "3-Level System Integrity Test". Contained in the summary of the test at the top of the report is a line that reads, "Hg Integrity Check?". It should be noted that this option is selected indicating that this is, in fact, a 3-level system integrity check report despite the title printed (a software default that cannot be edited).

Table 3. Summary of Hg CEMS Three-Level System Integrity Check Results

Parameter	Audit Result (%)	Required Performance	Pass/Fail
System Integrity Error, Low-Level	6.2%	≤ 10.0%	Pass
System Integrity Error, Mid-Level	3.0%	≤ 10.0%	Pass
System Integrity Error, High-Level	1.9%	≤ 10.0%	Pass

3.4 Cycle Time Test

A cycle time test is required to certify mercury CEMS according to Section 4.1.1 and 4.1.1.4 of Appendix A, 40 CFR Part 63, Subpart UUUUU. However, Section 4.1.1.4 states,

...Integrated batch sampling type Hg CEMS are exempted from this test; however, these must be capable of delivering a measured Hg concentration reading at least once every 15 minutes.

Attachment 4 is an excerpt from the Tekran Model 2537S Mercury Vapor Analyzer User Manual. This excerpt describes the sampling methodology of the mercury CEMS. The highlighted paragraph on page 6-2 states that this CEMS collects batch samples at a user selected interval with a recommended range of 150 seconds (2.5 minutes) to 900 seconds (15 minutes). Therefore, the mercury CEMS qualifies for the cycle time test exemption and no cycle time test has been conducted on it.

3.5 Relative Accuracy Test Audit

A RATA was performed on the mercury CEMS in accordance with the requirements specified in Section 4.1.1.5 of Appendix A, 40 CFR Part 63, Subpart UUUUU on February 17 and 18, 2015. A complete report of that RATA including the passing test results and the testing contractor's methods and quality assurance tests was provided to the MDEQ-AQD in April 2015. Table 4 presents a summary of the RATA results from that report.

Table 4. Summary of Hg CEMS RATA Results

Parameter	Audit Result (%)	Required Performance*	Pass/Fail
Relative Accuracy	25.8% 0.430 µg/m ³	RA ≤ 20.0% or ± 1.0 µg/m ³	Pass

**40CFR63 Subpart UUUUU, Appendix A 4.1.1.5.2: The alternate RATA specification (1.0 µg/m³) is based on the difference between monitor and reference method mean value and only applies when the mean RM value is less than 5.0 µg/m³. The average RM value during the 9 test runs used in the RATA was 1.91 µg/m³.*

4 CERTIFICATION APPLICATION

As required in Section 7.2.4 of Appendix A, 40 CFR Part 63, Subpart UUUUU, the results of all certification tests will be submitted electronically using the EPA's ECMPS Client Tool, either prior to or concurrent with the quarterly report for the 2nd quarter of 2016.

5 MERCURY CEMS CERTIFICATION TEST CONTACT

Karn/Weadock Generating Station

George E. Eurich
2742 N. Weadock Highway
Essexville, Michigan 48732
Office: (989) 891-3317
george.eurich@cmsenergy.com

6 SUMMARY OF ANALYZER SERIAL NUMBER AND SPAN VALUE

Analyzer Manufacturer: Tekran Instruments Corporation
Analyzer Model Number: 2537S
Analyzer Serial Number: 3054
Basis for Gas Measurement: wet (dilution extractive)
Instrument Span Value: 10.0 µg/scm