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REPORT ON HYDROGEN CHLORIDE COMPLIANCE TESTING

Performed for:
CONSUMERS ENERGY
UNIT 1 EXHAUST DUCT
J.H. CAMPBELL GENERATING COMPLEX

Client Reference No: 4400058909
CleanAir Project No: 13046
Revision 0: August 31, 2016

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

Submitted by,

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REVISION HISTORY

REPORT ON HYDROGEN CHLORIDE COMPLIANCE TESTING

DRAFT REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
D0a	08/01/16	All	Draft version of original document.
D0b	08/19/16	All	Second draft version of original document.

FINAL REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
0	08/31/16	All	Final version of original document.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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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 Company, J.H. Campbell Plant — County: Ottawa

Source Address: 17000 Croswell — City: West Olive

AQD Source ID (SRN): B2835 — ROP No.: MI-ROP-B2835-2013a — 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 7/6/2016 To Present

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Submittal of Unit 1 Hydrogen Chloride stack test report for MATS compliance.

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

Norman J. Kapala	Site Business Manager	(616) 738-3200
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official — 9-1-2016 — Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

PROJECT OVERVIEW

INTRODUCTION

Consumers Energy contracted Clean Air Engineering (CleanAir) to perform hydrogen chloride (HCl) testing at the J.H. Campbell Generating Complex, located in West Olive, Michigan, for Mercury and Air Toxics Standards (MATS) compliance purposes.

This report summarizes Consumers Energy's demonstration of compliance with the 40 CFR Part 63 UUUUU MATS emission limit of 0.002 lb/MMBtu for HCl on EUBOILER1 (Unit 1) Exhaust Duct (AQD Source ID B2835), in accordance with procedures outlined in EPA Method 320 of 40 CFR Part 63, Appendix A.

All testing was conducted in accordance with the regulations set-forth by the United States Environmental Protection Agency (EPA) and the Michigan Department of Environmental Quality (DEQ).

Key Project Participants

Individuals responsible for coordinating and conducting the test program were:

K. Cunningham – Consumers Energy
S. Lachance – DEQ
K. Sullivan – CleanAir

Test Program Parameters

The testing was performed at the EUBOILER1 (Unit 1) Exhaust Duct and included the following emissions measurements:

- hydrogen chloride (HCl)
- flue gas composition (e.g., CO_2 and H_2O)

Unit 1 testing was conducted on July 6, 2016. Consumers Energy demonstrated compliance with the applicable limit while Unit 1 burned 100% Powder River Basin (PRB) fuel. The test program was conducted while Unit 1 was being operated at full load (90% to 110% design capacity) conditions during burning of 100% PRB fuel.

PROJECT OVERVIEW

TEST PROGRAM SYNOPSIS

Test Schedule

The on-site schedule followed during the test program is outlined in Table 1-1.

Table 1-1:
Unit 1 Schedule of Activities

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	Unit 1 Outlet	USEPA M320/3A	HCl/CO_2	7/06/16	10:39	11:58
2	Unit 1 Outlet	USEPA M320/3A	HCl/CO_2	7/06/16	12:12	13:15
3	Unit 1 Outlet	USEPA M320/3A	HCl/CO_2	7/06/16	13:28	14:30

Results Summary

Table 1-2 summarizes the results of the test program. A more detailed presentation of the test conditions and results of analysis are shown on page 2-1.

Table 1-2:
Summary of Test Results

Source Constituent	Sampling Method	Average Emission	Applicable Limit[1]
Unit 1 Exhaust Duct			
HCl (lb/MMBtu)	EPA M3A/320	0.00051	0.0020

[1] Compliance limits obtained from 40 CFR 63, Subpart UUUUU Mercury and Air Toxics Standards.

PROJECT OVERVIEW

Discussion of Test Program

CleanAir performed three (3) 60-minute test runs, utilizing EPA Method 320 in conjunction with EPA Method 3A, to determine HCl emission rates in lb/MMBtu. CleanAir conducted testing at Unit 1 while the unit was operated at full load and burning 100% PRB fuel.

All HCl concentrations were measured as parts per million on a wet volumetric basis (ppmwv). HCl concentrations measured in ppmwv were converted to lb/MMBtu by measuring diluent CO_2 concentrations concurrently through the utilization of EPA Method 3A. In accordance with specifications outlined in 40 CFR Part 75, Appendix F, Section 3.3.6 and in Section 63.10007 of the MATS rule, a default Fc factor of 1840 was utilized to convert HCl concentrations to emission rates (as presented in Table 1 in Section 3.3.5 of Part 75, Appendix F).

Sample calculations for concentrations and emission rates are presented in Appendix B of this report. Further description of the sample location and process are presented in Section 3 of this report. Further description of test methodology is presented in Section 4 and in Appendix A of this report.

All sampling data presented in this report is based on Eastern Daylight Savings Time (EDT). Plant generation data presented in this report is based on Eastern Standard Time (EST), approximately 60 minutes behind EDT.

End of Section 1 – Project Overview

RESULTS

Table 2-1:
Unit 1 – HCl Emissions

Run No.		1	2	3	Average
Date (2016)		Jul 6	Jul 6	Jul 6	
Start Time (approx.)		10:39	12:12	13:28	
Stop Time (approx.)		11:58	13:15	14:30	
Process Conditions					
R_P	Gross Load (MW)	277	276	277	**277**
F_c	Carbon dioxide-based F-factor (dscf/MMBtu)	1,840	1,840	1,840	**1,840**
Gas Conditions					
CO_2	Carbon dioxide (dry volume %)	11.9	11.9	11.9	**11.9**
B_w	Actual water vapor in gas (% by volume)	11.6	11.5	11.5	**11.6**
HCl Results					
C_{sw}	Concentration (ppmwv)	0.49	0.30	0.25	**0.35**
C_{sd}	Concentration (lb/scf)	4.6E-08	2.9E-08	2.3E-08	**3.3E-08**
E_{Fc}	Emission Rate - F_c-based (lb/MMBtu)	0.00072	0.00045	0.00036	**0.00051**

End of Section 2 – Results

DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Consumers Energy owns and operates the J.H. Campbell Generating Complex, located in West Olive, Michigan. The complex is comprised of three units with the combined electrical generating capacity of 1,450 megawatts (MW) and capable of consuming 6 million tons of coal per year. Testing described in this report was performed at the exhaust duct of Unit 1.

Units 1 is rated at approximately 260 MW net. Unit 1 is equipped with a dry sorbent injection (DSI), activated carbon injection (ACI) and a pulse jet fabric filter (PJFF) baghouse to control emissions. The exhaust duct for Unit 1 feeds into a common stack shared with Unit 2.

Consumers Energy collected and logged gross load generation (MW) data during the test program and provided this data to CleanAir for presentation in this report. Consumers Energy accessed this data via the J.H. Campbell's CEMS DAHS.

A schematic of the process for Unit 1 is shown in Figure 3-1 on page 3-2.

DESCRIPTION OF INSTALLATION

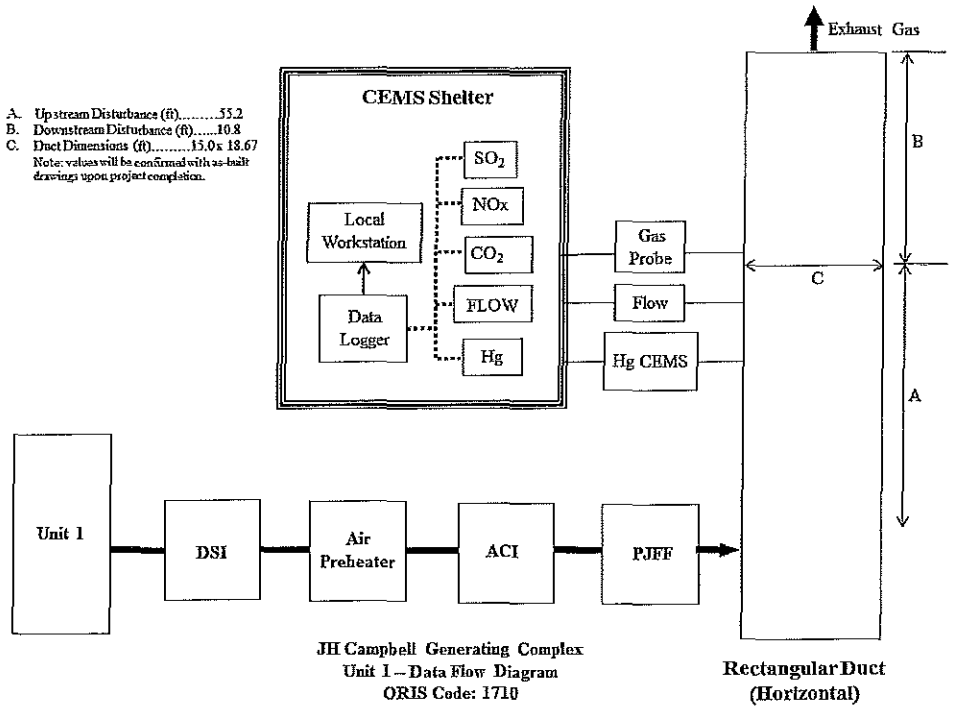


Figure 3-1: Unit 1 Process Schematic

DESCRIPTION OF INSTALLATION

DESCRIPTION OF SAMPLING LOCATIONS

Sampling point locations were determined according to EPA Method 3A, with references to EPA Methods 1 and 7E.

Table 3-1 outlines the sampling point configurations. The figure shown on page 3-4 illustrates the sampling points and orientation of sampling ports for the source tested in the program.

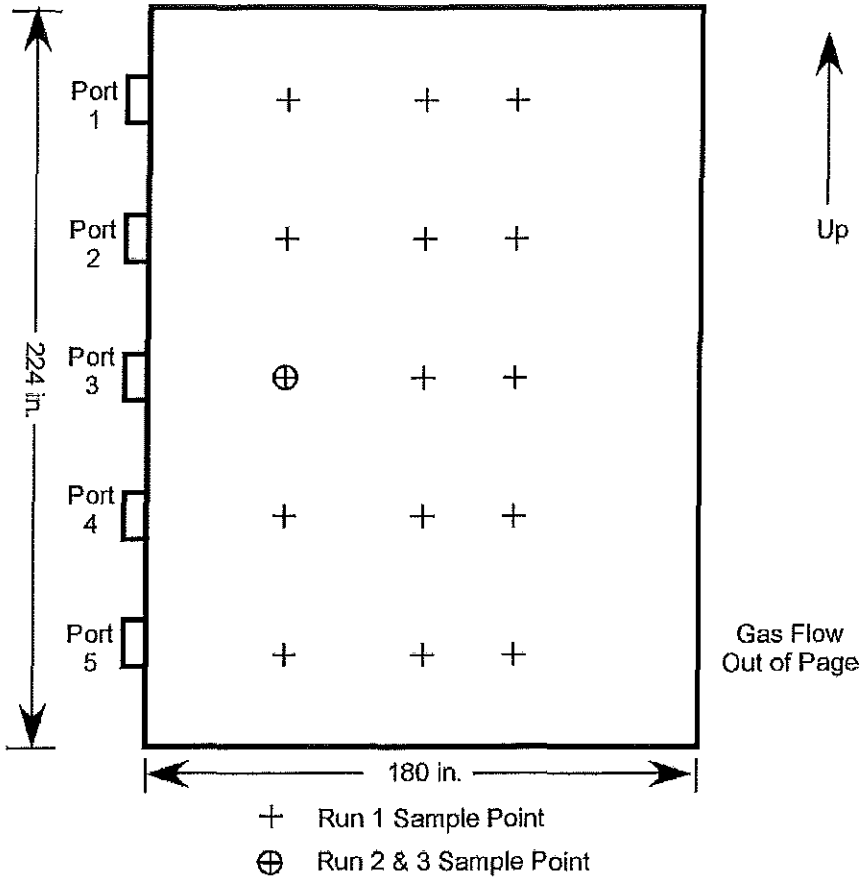
Table 3-1:
Sampling Points

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Unit 1 Exhaust Duct							
HCl/CO_2	EPM M320/3A	1	5	3	4	60	3-2
HCl/CO_2	EPM M320/3A	2-3	1	1	60	60	3-2

Due to feasibility and safety concerns arising from use of a test probe greater than 12 feet, CleanAir conducted a modified stratification check on Unit 1 utilizing a test probe only 12 feet in length. Due to the depth of the exhaust duct, a 12-foot probe was not sufficiently long enough to extend to the first sample point per EPA Method 1 and 7E procedures. Instead, the first sample point of the stratification check was at a point at which the extent of the probe was fully into the duct or the probe was "all the way in." This first sample point was approximately 120 inches into the duct. The subsequent points were then located at sample points per EPA Methods 1 and 7E procedures. Method 1 analysis is presented in Appendix D.

A stratification check for CO_2 was conducted during Run 1, in order to comply with specifications outlined in EPA Method 3A. The stratification check passed criteria required for single port, single point testing. Consequently, subsequent to Run 1 test runs were conducted at a single point most representative of the average CO_2 concentration during the stratification check.

DESCRIPTION OF INSTALLATION



Stratification Point	Port to Point Distance (in.)
1	30.0
2	90.0
3	120.0

Equivalent Duct diameters upstream from flow disturbance (A): 0.6 Limit: 0.5
Equivalent Duct diameters downstream from flow disturbance (B): 3.3 Limit: 2.0

Figure 3-2: Unit 1 Sampling Point Determination (Modified EPA Method 3A)

End of Section 3 -- Description of Installation

METHODOLOGY

Clean Air Engineering followed procedures as detailed in EPA Methods 1, 3A, 301 and 320. The following table summarizes the methods and their respective sources.

Table 4-1:
Summary of Sampling Procedures

Title 40 CFR Part 60 Appendix A	
Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 3A[1]	"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Title 40 CFR Part 63 Appendix A	
Method 301	"Field Validation of Pollutant Measurement Methods from Various Waste Media"
Method 320	"Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy"

[1] Method 3A references various Method 7E provisions which were followed.

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and on the World Wide Web at http://ecfr.gpoaccess.gov.

Diagrams of the sampling apparatus and major specifications of the sampling, recovery and analytical procedures are summarized for each method in Appendix A.

CleanAir followed specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and as prescribed in CleanAir's internal Quality Manual.

Sampling System

The FTIR sampling system was utilized to determine concentrations for both HCl (ppmwv) and CO_2 (%wv). The FTIR sampling system extracted effluent gas at a constant rate and utilized a stainless steel probe and heated filter box maintained at 375°F. The back-end of the probe was connected to a heated Teflon sample line maintained at approximately 375°F, which delivered the sample gas from the stack to the FTIR. The gas entered the FTIR on a hot-wet basis.

The FTIR was calibrated/validated according to each respective analyte reference method (EPA Method 320 and 3A) procedures. All calibration gas certificates are included in Appendix D of this report.

EPA Method 320 Sampling

CleanAir incorporated guidelines as stated in 40 CFR 63, Appendix A, EPA Method 320, "Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy."

METHODOLOGY

Prior to testing, a calibration transfer standard (CTS) was used to demonstrate suitable agreement between sample spectra and reference spectra. The CTS was introduced at a point as close as practical to the probe tip right before the external particulate filter.

Subsequent to the CTS check, a spike/tracer gas (in this case, a mixed HCl/SF_6 cylinder) was introduced into the sampled exhaust gas stream prior to the FTIR at a constant flow rate of no more than 10% of the total sample flow. The system "passed" the QA spikes when the average spike concentration was within 0.7 to 1.3 times the expected concentration. All QA spike checks are included in Appendices D and E of this test report.

Data was validated and corrected per specifications outlined in EPA Method 301. If the QA spike check was not within a range of ±10% of the expected value, then a correction factor (CF) was applied to the average concentration of the applicable run (i.e. the average concentration of HCl for the run was "bias adjusted"). Sample calculations for QA spikes and CF are presented in Appendix B.

A total of 60 reference spectra were collected for each run. Each sample spectrum was documented with the sampling conditions, the sampling time (period when the cell is being filled), the time the spectrum was recorded, the instrumental conditions (path length, temperature, pressure, resolution and signal integration time) and a spectral filename.

Following each sampling run, another CTS spectrum was recorded. The pre- and post-test CTS spectra were then compared. The peak absorbance in pre- and post-test CTS was compared to the required ±5% of the mean value for the run to be valid.

EPA Method 3A Sampling

The FTIR sample system was also utilized to determine the diluent CO_2 concentration of the effluent gas. In addition to all QA/QC procedures outlined in EPA Method 320, all QA/QC procedures outlined in EPA Method 3A were performed.

Calibration error checks were performed by introducing zero nitrogen (N_2), high-range and mid-range calibration gases to the inlet of the FTIR. The FTIR was challenged on-site using certified mixtures of O_2/CO_2 calibration gases. Analyzer bias checks were conducted before and after each run. Bias checks were performed by introducing calibration gas to the inlet of the sampling system's heated external filter. Per Method 3A specifications, the average results for each run were drift-corrected. Method 3A diluent QA/QC checks are presented in Appendix F of this report.

An FTIR CO_2 interference check with moisture is presented in Appendix D. The FTIR calibration curve used to quantify CO_2 concentrations is also presented in Appendix D.

End of Section 4 – Methodology