Consumers Energy

Count on Us

Test Report

EUTURBINE2-5 & EUTURBINE2-6

Ray Compressor Station
69333 Omo Road
Armada, Michigan 48005
SRN: B6636

Test Date:
July 23, 2015

September 16, 2015
Work Order No. 24148567
Revision 0

Test Performed by:
Consumers Energy Company
Regulatory Compliance Testing Section – Air Emissions Testing Body
Engineering Services Department
Compiled by G. A. Koteskey, Technical Analyst

DEQ

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 Ray Compressor Station County Macomb

Source Address 69333 Omo Road City Armada

AQD Source ID (SRN) B6636 ROP No. MI-ROP-B6636-2015 ROP Section No. ______

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 ______ To ______

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

Test Report for Combustion Turbines 2-5 & 2-6

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

Gregory Baustian	Ex. Manager, Gas Compression & Storage	(616) 237-4009
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official 9/16/2015 Date

* Photocopy this form as needed. EQP 5736 (Rev 11-04)

1.0 INTRODUCTION

Identification, location and dates of tests

Consumers Energy Company (CEC), Regulatory Compliance Testing Section (RCTS) performed emissions testing on two (2) identical low-NOx Solar natural gas-fired turbines, identified as EUTURBINE2-5 and EUTURBINE2-6 (collectively identified as FGTURBINES) on July 23, 2015 at CEC Ray Compressor Station in Armada, Michigan. Please note that reproducing portions of this test report may omit critical substantiating documentation or cause information to be taken out of context. If any portion of this report is reproduced, please exercise due care in this regard.

Purpose of testing

The purpose of the testing was to re-establish the range of gas producer speed within which the turbines can operate and continuously comply with the applicable nitrogen oxides (NO_x) and carbon monoxide (CO) emission limits. The NOx and CO emission limits applicable to the turbines are specified in Conditions I.1 and I.2 of Table FGTURBINES in the Renewable Operating Permit (ROP), and are summarized in Table 1 below.

Table 1
Summary of NO_x and CO Emission Limits
Turbines 2-5 and 2-6

Pollutant	Limit	Time Period/ Operating Scenario	Equipment
NO_x	0.8 gram	Per brake horsepower-hour at 100% gas producer speed	Each Turbine
	5.5 pounds	Per hour	
	23.2 tons	Per year	
	150 part per million	at 15% oxygen on a dry gas basis	
CO	1.0 grams	Per brake horsepower-hour at 100% gas producer speed	Each Turbine
	6.7 pounds	Per hour	
	29.0 tons	Per year	

Brief description of source

The Ray Compressor Station is a natural gas compressor station. The purpose of the facility is to maintain pressure of natural gas in order to move it in and out of storage reservoirs and along the pipeline system. Both turbines are Solar Centaur T4500 exclusively fired with pipeline quality natural gas. Each of the Solar combustion turbines are equipped with integral SoLoNOx combustors. These combustors incorporate a dry low-NO_x combustion technology that reduces the formation of nitrogen oxides.

Names, addresses, and telephone numbers of the contacts for information regarding the test and the test report, and names and affiliation of all personnel involved in conducting the testing

A Test Protocol, dated June 12, 2015, was submitted and subsequently approved by the MDEQ in their letter dated July 2, 2015. RCTS Technical Analysts Gregg Koteskey and Brian Glendening performed the tests on July 23, 2015. CEC Senior Engineer Ms. Amy Kapuga was onsite to coordinate the collection of process data. Ray Senior Field Leader, Mr. Dominic Tomasino, coordinated the test and CEC Station Operator, John Johns, collected operating data. MDEQ representatives Mr. Tom Maza and Mr. Erik Gurshaw were on site to witness a portion of this test event.

Table 2
TEST PROGRAM CONTACT LIST

Responsible Party	Address	Contact
Test Facility	Ray Compressor Station 69333 Omo Road Armada, Michigan 48005	Mr. Dominic Tomasino Senior Field Leader 586-307-3238 dominic.tomasino@cmsenergy.com
Corporate Air Quality Contact	Consumers Energy Company Environmental Services Department 1945 West Parnall Road Jackson, Michigan 49201	Ms. Amy Kapuga Senior Engineer 517-788-2201 amy.kapuga@cmsenergy.com
Emission Test Representative	Consumers Energy Company RCTS - AETB 17010 Croswell Street West Olive, Michigan 49460	Mr. Brian Glendening, QSTI Senior Technical Analyst 616-738-3234 brian.glendening@cmsenergy.com
Regulatory Agency Representative	Michigan Department of Environmental Quality Air Quality Division Detroit District Office Cadillac Place, 3058 W. Grand Blvd Detroit, MI 48202	Mr. Thomas Maza Environmental Quality Analyst 313-456-4709 mazat@michigan.gov
	Michigan Department of Environmental Quality Air Quality Division – SE Michigan District 27700 Donald Court Warren, Michigan 48092	Mr. Erik Gurshaw Environmental Quality Analyst 586-753-3743 gurshawe@michigan.gov

2.0 SUMMARY AND DISCUSSION

Operating Data

Operating data collected during each test run included power turbine speed, gas producer speed, fuel gas flow, horsepower, suction pressure, discharge pressure, fuel gas pressure, ambient temperature and barometric pressure.

Applicable Permit Number

The Ray Compressor Station is currently operating pursuant to the terms and conditions of ROP No. MI-ROP- N6636so-2015. Performance tests were conducted, as required, on two (2), identical, low-NO_x Solar natural gas-fired combustion turbines identified as EUTURBINE2-5 and EUTURBINE2-6 (collectively identified as FGTURBINES).

Results

The emission test verified the individual turbines were operating properly through the re-establishment of a turbine GPS operating range which continuously demonstrated compliance with the applicable ROP NO_x and CO emission limits. A summary of the test results are presented below.

TABLE 3
SUMMARY OF TURBINE 2-5 and 2-6
NO_x and CO Emissions and GPS Operating Range

	Turbine 2-5				Turbine 2-6			
Parameter	95.8% GPS		92.6% GPS		95.2% GPS		92.8% GPS	
	NOx	CO	NOx	CO	NOx	CO	NOx	CO
ppm, corrected to 15% O_2	31.6	--	30.1	--	19.6	--	19.0	--
g/bhp-hr[1]	0.62	0.06	0.53	0.05	0.40	0.12	0.36	0.13
lb/hr	4.59	0.41	3.97	0.35	2.82	0.83	2.52	0.93
tons/yr	20.12	1.79	17.40	1.52	12.34	3.65	11.05	4.06

[1] The g/bhp-hr emission limits are only applicable at 100% gas producer speed.
* Based on 8,760 hours per year

NOTE: Emissions data above for Unit 2-5 high GPS is calculated from Runs 1, 3, and 4 whereas Unit 2-6 high GPS is calculated from Runs 1, 2, 3, and 4. Emissions data for each unit at low GPS is calculated from a total of two runs. See Section 5.0 for further information.

Based on the preceding values, the GPS operating range for Turbines 2-5 and 2-6 has been re-established as specified in Condition V.1 of Table FGTURBINES in the ROP. Therefore, when operating within this range of GPS, demonstrate continuous compliance with the applicable NO_x and CO emission limits.

3.0 SOURCE DESCRIPTION

Description of Process

The Ray Compressor Station is a natural gas compressor station employed for the transport or movement of natural gas in and out of storage reservoirs and along the pipeline system. The station utilizes eight (8) natural gas-fired reciprocating engine drive compressor units and two (2) natural gas-fired combustion turbine-driven compressor units (designated as 2-5 and 2-6) for this purpose. The engine or turbine compresses the natural gas, thus increasing pipeline pressure and providing the energy to move the gas. Turbines 2-5 and 2-6 were tested and consist of the two previously mentioned identical simple cycle Solar T4500 natural gas-fired combustion turbines used for driving natural gas compression equipment. Each of the Solar turbines are equipped with integral SoLoNO$_x$ combustors. These combustors incorporate a dry low-NO$_x$ combustion technology that reduces the formation of nitrogen oxides.

Process Flow Sheet or Diagram

NA

Type and Quantity of Raw Material Processed During the Tests

NA

Maximum and Normal Rated Capacity of the Process

EUTURBINE2-5 and EUTURBINE2-6 are limited to a maximum output of approximately 3,100 horsepower each. At this achievable output, the heat input rating of each turbine is approximately 31.6 million Btu/hr.

Description of Process Instrumentation Monitored During the Test

Station operators entered turbine operating data, obtained from control room displays, into a spreadsheet during each run. The following operating parameters were recorded: power turbine speed, gas producer speed, fuel gas flow, horsepower, suction pressure, discharge pressure, fuel gas pressure, ambient temperature and barometric pressure. The process data, contained in Attachment 1, was averaged and provided to RCTS to assist with emission rate calculations.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Description of sampling train(s) and field procedures

All testing, sampling, analytical, and calibration procedures used for this test program were performed in accordance with 40 CFR, Part 60, Appendix A. The NO_x and CO concentrations from the turbines were determined in accordance with EPA Reference Method 7E, using specific applications, as necessary, from Method 20 and Method 10, respectively. The carbon dioxide (CO_2) concentrations from the turbines were determined in accordance with EPA Reference Method 3A.

Triplicate 21-minute test runs were to be performed simultaneously at each turbine exhaust at minimum and maximum achievable gas producer speeds (expressed as a percentage of maximum speed). The minimum producer speed targeted was approximately 90% of load and the maximum producer speed targeted was approximately 100% of load.

The exhaust gases were extracted from the stacks with a non-heated Type 316 stainless steel probe (due to the high exhaust gas temperatures) into a heated Teflon sample line which prevented moisture from condensing until the exhaust gases were run through an electronic chiller unit which removed the moisture prior to injection into the various analyzers (NOx, CO, and CO2). A simplistic diagram of the sampling system is presented as Figure 2.

Traverse Points

A stratification test was performed at each unit in accordance with Method 1 specifications, as directed by Method 7E, Section 8.1.2 to determine the appropriate number of traverse points. The test protocol submitted to the agency on June 12, 2015 stated that a 12 point stratification test would be performed, however due to the complex internal baffle configuration of the ducts, the alternative 3 point stratification test also specified in Method 7E, Section 8.1.2 was used. Stratification was checked concurrently from both turbines during Run 1 of the high gas producer speed test at three points through the centroidal area of the ducts at 16.7, 50.0, and 83.3 percent of the measurement line. The individual point and mean NO_x concentrations were then calculated and the average traverse point concentrations were found to differ less than 5% of the mean concentration, as well as less than +/- 0.5 ppm, demonstrating that the gas stream was unstratified allowing testing to continue by sampling at a single point which closely matched the mean concentration. This stratification data is provided in Attachment 3.

Diluent/Molecular Weight

CO_2 was measured using a non-dispersive infrared (NDIR) Thermo Model 410i analyzer equipped with paramagnetic O_2 analysis capacit, following the guidelines of U.S. EPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from a Stationary Source (Instrumental Analyzer Procedure).*

Nitrogen Oxides

NO_x was measured using a Thermo-Environmental (Thermo) Model 42I-HL chemiluminescent analyzer following the guidelines of U.S. EPA Method 7E, *Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure).*

Carbon Monoxide

CO concentrations were measured using a Thermo Model 58i gas filter correlation analyzer following the guidelines of U.S. EPA Reference Method 10, *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure).*

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. As an internally accredited Air Emission Testing Body, RCTS recognizes and values these data objectives, and employs a Quality System following ASTM D 7036-04, *Standard Practice for Competence of Air Emissions Testing Bodies (AETB).* ASTM D 7036-04 is a practice specifying general competence requirements applicable to all AETB staff performing air emission testing at stationary sources, regardless of test scope. For this test event, completeness is defined as the percentage of required field measurements and associated documentation achieved, while representativeness is defined as the "when," "how," and "how many" measurements were taken, which is specified within the regulations governing the tested source and within the Test Protocol submitted to the regulatory agency prior to the test event. Precision and accuracy measures exist by design within each of the U.S. EPA reference test methods and procedures incorporated during the emission test.

U.S. EPA Protocol gas standards certified according to the U.S. EPA Traceability Protocol for Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997 or May, 2012 version and certified to have a total relative uncertainty of ±1 percent were used to calibrate the analyzers during the test program. Although not required in the context of this Parts 60 and 63 test program, the vendors providing the calibration gases also participate in the Protocol Gas Verification Program (PGVP), an EPA audited program developed for 40 CFR Part 75.

The extractive sample system instruments were calibrated and operated following the appropriate method guidelines, based on specifications contained in Method 7E (as referenced in Methods 3A and 10). Before daily testing began, an Analyzer Calibration Error (ACE) test was conducted by introducing the calibration gases directly into each analyzer. If the measured response didn't meet the ±2 percent of instrument span specification or within 0.5 ppmv absolute difference to pass the ACE check, appropriate action was taken and the ACE was repeated. Prior to beginning the first run, an initial system bias check was conducted by introducing the low and upscale calibration gases into the sampling system at the probe outlet and drawing them through the sample conditioning system in the same manner as the exhaust gas sample, while measuring the instrument response. Each instrument response must meet a specification of ≤ 5.0 percent of instrument span.

Low and upscale bias calibrations were performed after each run thereafter to quantify system calibration drift and bias. During the initial system bias tests, system response time was measured and the sample flow rate throughout the remainder of the test was monitored to maintain the sample flow rate within 10 percent of the average flow rate observed during the response time test. Sampling for each run was started after twice the system response time had elapsed.

Description of recovery and analytical procedures
NA

Dimensioned sketch showing all sampling ports in relation to breeching and to upstream and downstream disturbances or obstructions of gas flow and a sketch of cross-sectional view of stack indicating traverse point locations and exact stack dimensions
Figure 2 shows the combustion turbine exhaust stack arrangement and location of test ports (same for each of Turbines 2-5 and 2-6).

5.0 TEST RESULTS AND DISCUSSION

Detailed tabulation of results, including process operating conditions and exhaust gas conditions

Table 3 contains a summary of the individual turbine NO_x and CO emission rates and associated gas producer speeds from the July 23, 2015 performance tests. Operational data, individual run concentrations and emissions, calculation spreadsheets, field data sheets, calibration information and fuel analyses are contained in Attachments 1 - 5.

Discussion of significance of results relative to operating parameters and emission regulations

The average NO_x and CO emission rates, at all tested gas producer speeds, were below the emission limits. Thus, Units 2-5 and 2-6 are in compliance with the ROP NO_x and CO emission limits and the re-established operating range is between 92.6% and 95.8% gas producer speed.

Discussion of any variations from normal sampling procedures or operating conditions, which could have affected the results

NA

Documentation of any process or control equipment upset condition which occurred during the testing

Testing began on Turbines 2-5 and 2-6 concurrently at high gas producer speed. The facility control room was notified before each run to begin collecting the process data for the run. After Run 1 was successfully completed showing acceptable NO_x and CO emissions limits for both turbines, Run 2 began. During Run 2 an upset occurred with Unit 2-5 causing non-compliant NO_x concentrations. The Unit 2-5 NO_x levels slowly decreased throughout the remainder of the 21-minute run, however the unit was still out of compliance and RCTS contacted the unit operators and inquired if this upset was caused by changes to the established test operation parameters, to which operations reported no changes had been initiated. Post-run 2 calibrations were performed and the logged data was saved. Both turbines were then brought offline to diagnose the cause of the upset.

Site mechanics diagnosed the cause of the Unit 2-5 upset as a faulty fuel control valve. A spare fuel control valve was on site and the mechanics proceeded to replace the faulty component. Discussion was held between MDEQ representative Mr. Thomas Maza, who witnessed the increase in NO_x concentrations during Run 2, and RCTS regarding the use of Run 2 for calculating a three-run result average. Mr. Maza considered Run 2 unrepresentative of the normal Turbine 2-5 operating conditions due to the faulty fuel control valve and allowed Run 2 to be omitted when calculating the result averages, providing two additional successful test runs could be completed at high gas producer speed to provide a representative three run average.

The turbines were restarted after repairs to 2-5 were completed and testing resumed after an appropriate warm-up period. A total of four runs were completed on 2-5 and 2-6 at high gas producer speed. Average test results for Unit 2-5 and 2-6 were calculated from Runs 1, 3 and 4, and average test results for Unit 2-6 were calculated from Runs 1-4.

The units were then set to the low gas producer speed for the required 3 test runs at low gas producer speed. Testing began and two runs were completed with acceptable results for both turbines. At the conclusion of the calibrations for Run 2 at low speed, both units tripped offline. Operations and site mechanics reported that while operating at the established low gas producer speed, slight fluctuations in the units operation caused the turbines to drop below the minimum operating speed parameter which triggered an automatic emergency shut down of the turbine fuel supply valves. Consequently, operations lost communication with the fuel supply valves and informed the test crew that the units could not be restarted until the communications system was troubleshot, diagnosed, and repaired.

Due to the expected duration of repairs required to restart the turbines, Mr. Maza reviewed the test results of the first two low GPS runs on both units and accepted them as a complete test, despite the absence of a third test run. Reference Method NO_x, CO and CO_2 data at each GPS are included in Attachment 2 of this report. The Unit 2-5 Run 2 reference method data, omitted from the result averages are included in Attachment 6.

Description of any major maintenance performed on the air pollution control device(s) during the three month period prior to testing

No major maintenance was performed on the SoLoNOx combustors.

In the event of a re-test, a description of any changes made to the process or air pollution control device(s)

NA

Results of any quality assurance audit sample analyses required by the reference method

NA

Calibration sheets for the dry gas meter, orifice meter, pitot tube, and any other equipment or analytical procedures which require calibration

Attachment 4 contains the analyzer calibration data, response time test results, NO_2 to NO converter efficiency check and calibration gas Certificates of Analysis.

Sample calculations of all the formulas used to calculate the results

Sample calculations for all formulas used in the test report are contained in Attachment 5.

Copies of all field data sheets, including any pre-testing, aborted tests, and/or repeat attempts

Please refer to Attachment 1 for process data collected during the test runs; Attachment 2 for calculation spreadsheets for each of the test runs; and Attachment 3 for data sheets with the measured concentrations for each test run.

Copies of all laboratory data including QA/QC

NA

TABLE 4

SUMMARY OF NOX AND CO EMISSIONS

RAY COMPRESSOR STATION

TURBINE 2-5, HIGH LOAD

JULY 23, 2015

Time Period	Run 1	Run 3	Run 4	Averages
	0937-0958	1425-1446	1504-1525	
Process Conditions				
Gas Producer Speed, % of Maximum:	95.8	95.8	95.8	**95.8**
Power Turbine Speed, % of Maximum:	98.7	98.4	98.4	**98.5**
Horsepower:	3457	3288	3330	**3358**
Fuel Flow, SCFM	661	648	645	**651**
Suction Pressure, PSIG:	570	569	570	**570**
Discharge Pressure, PSIG:	806	809	811	**809**
Outlet Gas Conditions				
Drift Corrected Carbon Dioxide (CO_2) Concentration, Dry (Percent):	2.55	2.47	2.47	**2.50**
Drift Corrected Carbon Monoxide (CO) Concentration, Dry (ppmdv):	5.75	2.30	2.3	**3.4**
Drift Corrected CO Concentration (ppmdv @ 15% O2):	7.60	3.1	3.08	**4.59**
Drift Corrected Nitrogen Oxides (NO_x) Concentration, Dry (ppmdv):	25.7	22.9	21.8	**23.4**
Drift Corrected NO_x Concentration (ppmdv @15% O2):	33.9	31.1	29.8	**31.6**
NO_x Emission Rate, Grams Per Brake Horsepower:	0.66	0.61	0.58	**0.62**
NO_x Emission Rate, pound per hour:	5.05	4.45	4.28	**4.59**
NO_x Emission Rate, tons per year:	22.14	19.47	18.75	**20.12**
CO Emission Rate, Grams Per Brake Horsepower:	0.09	0.04	0.04	**0.06**
CO Emission Rate, pound per hour:	0.69	0.27	0.27	**0.41**
CO Emission Rate, tons per year:	3.02	1.18	1.18	**1.79**

TABLE 5
SUMMARY OF NOX AND CO EMISSIONS
RAY COMPRESSOR STATION
TURBINE 2-5, LOW LOAD
JULY 23, 2015

Time Period	Run 1 1618-1639	Run 2 1653-1714	Averages
Process Conditions			
Gas Producer Speed, % of Maximum:	92.6	92.6	**92.6**
Power Turbine Speed, % of Maximum:	89.9	89.5	**89.7**
Horsepower:	3373	3373	**3373**
Fuel Flow, SCFM	588	587	**588**
Suction Pressure, PSIG:	571	571	**571**
Discharge Pressure, PSIG:	812	813	**813**
Outlet Gas Conditions			
Drift Corrected Carbon Dioxide (CO_2) Concentration, Dry (Percent):	2.46	2.46	**2.46**
Drift Corrected Carbon Monoxide (CO) Concentration, Dry (ppmdv):	3.13	3.2	**3.2**
Drift Corrected CO Concentration (ppmdv @ 15% O2):	4.29	4.36	**4.33**
Drift Corrected Nitrogen Oxides (NO_x) Concentration, Dry (ppmdv):	22.1	21.8	**21.9**
Drift Corrected NO_x Concentration (ppmdv @15% O2):	30.3	29.8	**30.1**
NO_x Emission Rate, Grams Per Brake Horsepower:	0.54	0.53	**0.53**
NO_x Emission Rate, pound per hour:	4.03	3.92	**3.97**
NO_x Emission Rate, tons per year:	17.65	17.15	**17.4**
CO Emission Rate, Grams Per Brake Horsepower:	0.05	0.05	**0.05**
CO Emission Rate, pound per hour:	0.35	0.35	**0.35**
CO Emission Rate, tons per year:	1.52	1.52	**1.52**

TABLE 6

SUMMARY OF NOX AND CO EMISSIONS

RAY COMPRESSOR STATION

TURBINE 2-6, HIGH LOAD

JULY 23, 2015

Time Period	Run 1 0937-0958	Run 2 1010-1031	Run 3 1425-1446	Run 4 1504-1525	Averages
Process Conditions					
Gas Producer Speed, % of Maximum:	95.1	95.1	95.3	95.3	**95.2**
Power Turbine Speed, % of Maximum:	98.5	98.5	98.5	98.5	**98.5**
Horsepower:	3275	3234	3113	3153	**3875**
Fuel Flow, SCFM	649	646	641	639	**643**
Suction Pressure, PSIG:	786	784	790	791	**789**
Discharge Pressure, PSIG:	1250	1249	1259	1259	**1256**
Outlet Gas Conditions					
Drift Corrected Carbon Dioxide (CO_2) Concentration, Dry (Percent):	2.60	2.57	2.60	2.57	**2.58**
Drift Corrected Carbon Monoxide (CO) Concentration, Dry (ppmdv):	12.22	11.5	2.7	2.7	**7.3**
Drift Corrected CO Concentration (ppmdv @ 15% O2):	15.85	15.04	3.54	3.59	**9.5**
Drift Corrected Nitrogen Oxides (NO_x) Concentration, Dry (ppmdv):	15.9	15.2	14.9	14.3	**15.1**
Drift Corrected NO_x Concentration (ppmdv @15% O2):	20.7	19.7	19.3	18.8	**19.6**
NO_x Emission Rate, Grams Per Brake Horsepower:	0.42	0.40	0.40	0.39	**0.40**
NO_x Emission Rate, pound per hour:	3.02	2.84	2.73	2.68	**2.82**
NO_x Emission Rate, tons per year:	13.23	12.44	11.94	11.75	**12.34**
CO Emission Rate, Grams Per Brake Horsepower:	0.20	0.20	0.05	0.04	**0.12**
CO Emission Rate, pound per hour:	1.41	1.30	0.30	0.31	**0.83**
CO Emission Rate, tons per year:	6.18	5.71	1.33	1.36	**3.65**

TABLE 7
SUMMARY OF NOX AND CO EMISSIONS
RAY COMPRESSOR STATION
TURBINE 2-6, LOW LOAD
JULY 23, 2015

Time Period	Run 1 1618- 1639	Run 2 1653- 1714	Averages
Process Conditions			
Gas Producer Speed, % of Maximum:	92.8	92.8	**92.8**
Power Turbine Speed, % of Maximum:	91.9	91.9	**91.9**
Horsepower:	3194	3194	**3194**
Fuel Flow, SCFM	591	590	**591**
Suction Pressure, PSIG:	796	796	**796**
Discharge Pressure, PSIG:	1257	1257	**1257**
Outlet Gas Conditions			
Drift Corrected Carbon Dioxide (CO_2) Concentration, Dry (Percent):	2.50	2.49	**2.50**
Drift Corrected Carbon Monoxide (CO) Concentration, Dry (ppmdv):	8.70	8.3	**8.5**
Drift Corrected CO Concentration (ppmdv @ 15% O2):	11.73	11.18	**11.45**
Drift Corrected Nitrogen Oxides (NO_x) Concentration, Dry (ppmdv):	14.2	14.0	**14.1**
Drift Corrected NO_x Concentration (ppmdv @15% O2):	19.1	18.8	**19.0**
NO_x Emission Rate, Grams Per Brake Horsepower:	0.36	0.35	**0.36**
NO_x Emission Rate, pound per hour:	2.56	2.48	**2.52**
NO_x Emission Rate, tons per year:	11.21	10.88	**11.05**
CO Emission Rate, Grams Per Brake Horsepower:	0.14	0.13	**0.13**
CO Emission Rate, pound per hour:	0.96	0.90	**0.93**
CO Emission Rate, tons per year:	4.19	3.93	**4.06**

FIGURE 1
Methods 3A, 7E & 10 Sampling Apparatus Schematic

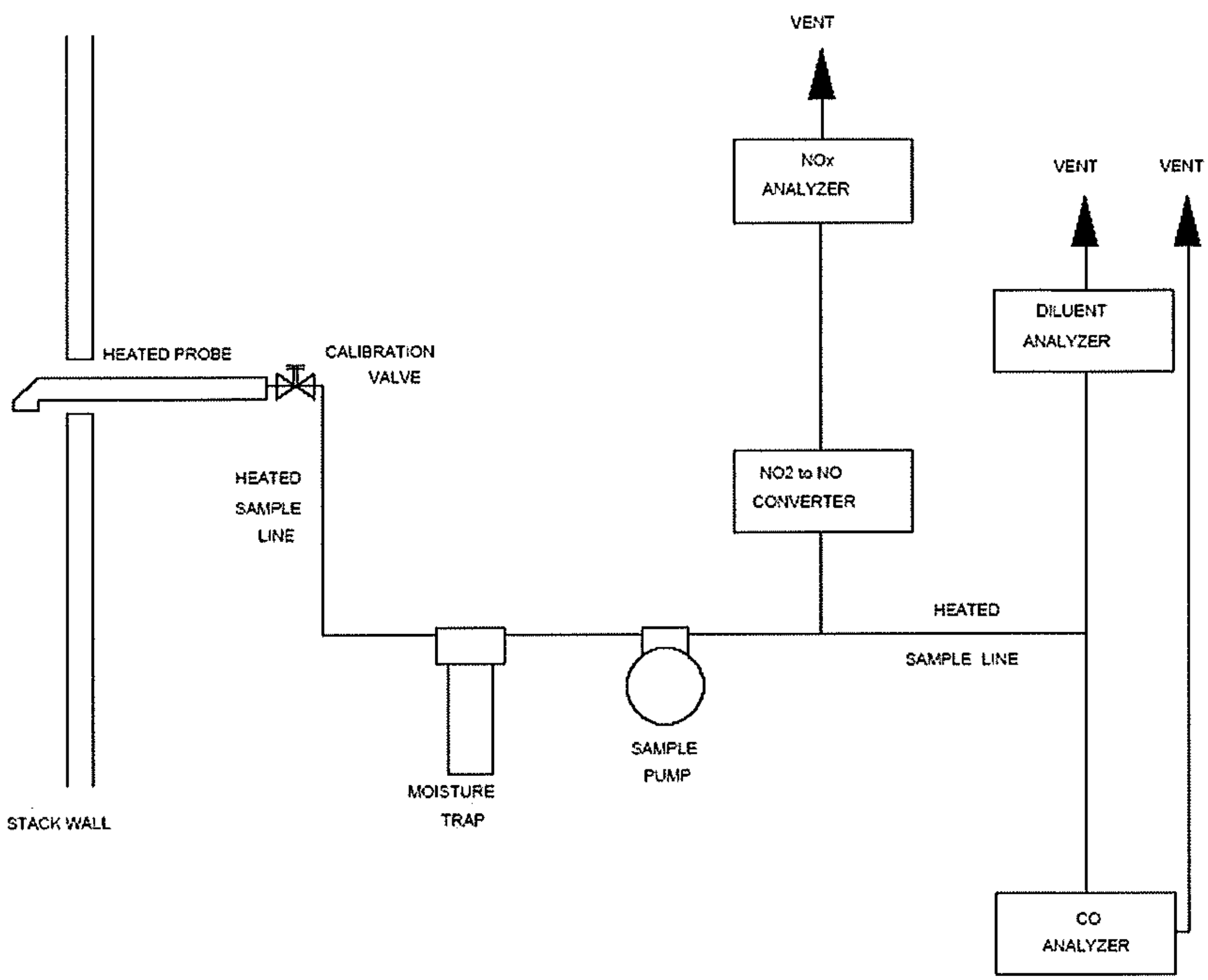
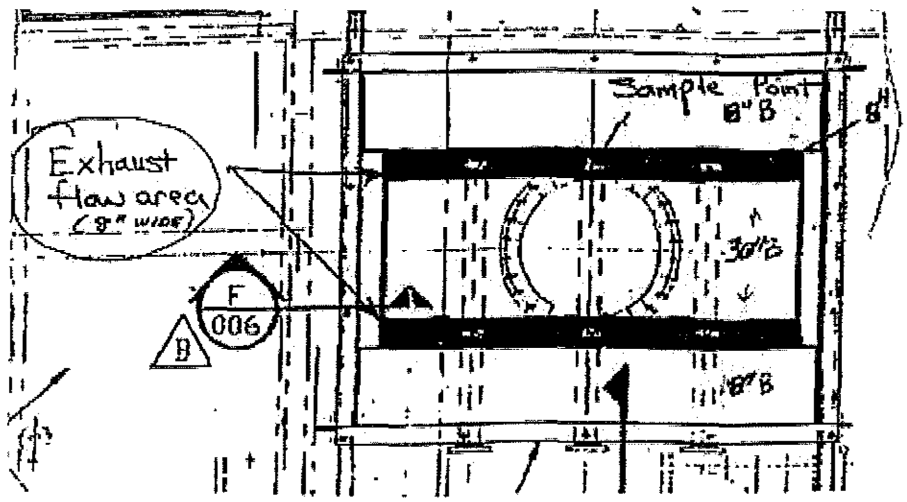
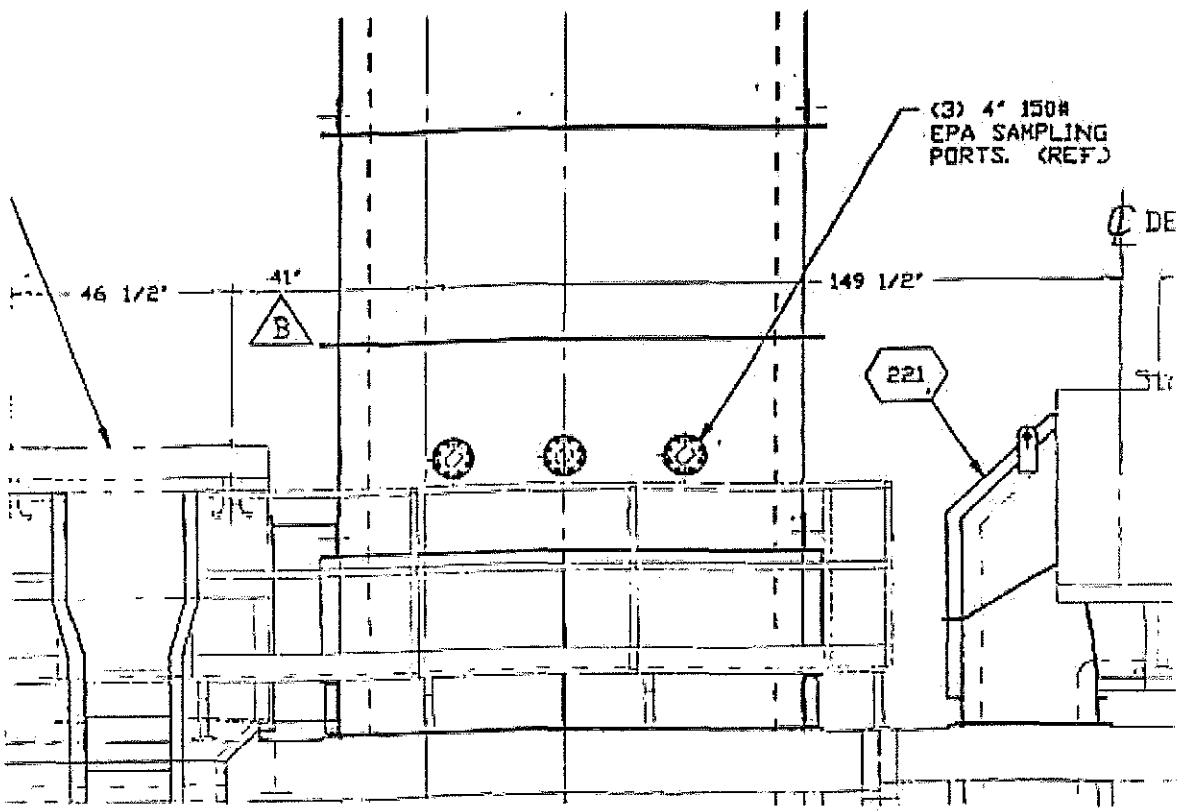

VENT
NOx ANALYZER
VENT
VENT
DILUENT ANALYZER
HEATED PROBE
CALIBRATION VALVE
NO2 to NO CONVERTER
HEATED SAMPLE LINE
HEATED SAMPLE LINE
MOISTURE TRAP
SAMPLE PUMP
STACK WALL
CO ANALYZER

FIGURE 2

Turbine 2-5 and 2-6 Stack Schematic


Sample Point
8" B
8"
Exhaust
flow area
(8" WIDE)
F
006
B
30"B
8"B


(3) 4" 150#
EPA SAMPLING
PORTS. (REF)
46 1/2"
41"
B
149 1/2"
221