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EMISSIONS TEST REPORT

for

OXIDES OF NITROGEN (NO_X) EMISSIONS

EUTURBINEC50 (Unit 7) and EUTURBINET70 (Unit 8)

DTE Gas, Belle River Mills Compressor Station
China Twp, Michigan

March 16, 2021

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EXECUTIVE SUMMARY

DTE Energy's Environmental Management & Safety (EM&S) Ecology, Monitoring & Remediation Group performed emissions testing at the DTE Gas, Belle River Mills Compressor Station, located in China Twp, Michigan. The fieldwork, performed on March 16, 2021 was conducted to satisfy requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B6478-2016 and 40 CFR Part 60 Subpart KKKK. Testing was performed for oxides of nitrogen (NO_x) to determine emissions from EUTURBINEC50 and EUTURBINEC70 while operating within 25% of peak load (hp).

The results of the emissions testing are highlighted below:

NO_X Emissions Test Results
Belle River Mills Compressor Station
March 16, 2021

Emission Unit	Turbine Load (% of rated hp)	NO_x Concentration (ppm @ 15% O_2) (1)	NOx Emission Rate (lb/hr) (2) (3)
EUTURBINEC50	77.0%	12.7	2.40
EUTURBINET70	78.2%	11.2	3.36

(1) Permit Limit – 25ppm - Average Oxides of Nitrogen Emissions Concentration (ppm) corrected to 15%
(2) Permit Limit – EUTURBINEC50 – 3.67 lb/hr
EUTURBINET70 – 5.34 lb/hr

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1.0 INTRODUCTION

DTE Energy's Environmental Management & Safety (EM&S) Ecology, Monitoring & Remediation Group performed emissions testing at the DTE Gas, Belle River Mills Compressor Station, located in China Twp, Michigan. The fieldwork, performed on March 16, 2021 was conducted to satisfy requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) MI-ROP-B6478-2016 and 40 CFR Part 60 Subpart KKKK. Testing was performed for oxides of nitrogen (NO_x) to determine emissions from EUTURBINEC50 and EUTURBINEC70 while operating within 25% of peak load (hp).

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 3A and ASTM Method D6348.

The fieldwork was performed in accordance with EPA Reference Methods, ASTM Methods, and EM&S's intent to test[1], which was approved by the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The following DTE personnel participated in the testing program: Mr. Thomas Snyder, Sr. Environmental Specialist, and Mr. Fred Meinecke, Senior Engineering Technician. Mr. Snyder was the project leader.

Ms. Susan King, DTE Gas, provided coordination support for the testing. Ms. Regina Angellotti, (EGLE), reviewed the test plan.

2.0 SOURCE DESCRIPTION

The Belle River Mills Compressor Station located at 5440 Puttygut Road, China Twp, Michigan, employs the use of three natural gas-fired compressor turbines rated at 6,130 horsepower (EUTURBINEC50), 10,915 horsepower (EUTURBINET70), and 15,900 horsepower (EUTURBINE1). Each turbine is equipped with a low NO_x combustor for NO_x control. The turbines generate line pressure assisting with the transmission of natural gas into and out of the gas storage field, as well as to and from the pipeline transmission system in SE Michigan. Testing for NO_x emissions was performed while the turbines operated in the $LoNO_x$ mode within 25% of peak load (rated horsepower).

The turbines exhaust directly to the atmosphere through vertical, rectangular exhaust ducts.

A schematic representation of the turbines exhaust and sampling locations are presented in Figures 1 & 2.

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[1] EGLE, Test Plan, Submitted December 18, 2020. (Attached-Appendix A)

[2] EGLE, Acceptance Letter, January 28, 2021. (Attached-Appendix A)

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3.0 SAMPLING AND ANALYTICAL PROCEDURES

DTE Energy obtained emissions measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources*. The sampling and analytical methods used in the testing program are indicated in the table below

Sampling Method	Parameter	Analysis
USEPA Method 3A	Oxygen	Instrumental Analyzer Method
ASTM Method D6348	Oxides of Nitrogen	FTIR

3.1 OXYGEN (USEPA METHOD 3A)

3.1.1 Sampling Method

Oxygen (O_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The O_2 analyzer utilizes a paramagnetic sensor. The O_2 sample was taken from the exhaust of the FTIR.

3.1.2 O_2 Sampling Train

The EPA Method 3A sampling system (Figure 3) consisted of the following components:

(1) Stainless steel sampling probe with sintered filter.
(2) Flexible heated PTFE sampling line
(3) MAK® gas conditioner with particulate filter.
(4) Flexible unheated Teflon™ sampling line.
(5) Servomex 1400 O_2/CO_2 gas analyzer
(6) Appropriate USEPA Protocol 1 Calibration Gases
(7) Data Acquisition System.

3.1.3 Sampling Train Calibration

The O_2 sampling train was calibrated according to procedures outlined in USEPA Methods 3A. Zero, span, and mid-range calibration gases were introduced directly into the O_2 analyzer to determine the instruments linearity. A zero and mid-range span gas was then introduced through the entire sampling system to determine sampling system bias for the analyzer. Additional system calibrations were performed at the completion of each test.

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3.1.4 Sampling Duration & Frequency

The emissions testing of each turbine consisted of one 30 minute sample, and duplicate 24-minute samples performed at one load. Sampling was performed simultaneously for O_2 & NO_x. For Run 1 of each turbine, a stratification test was performed. The stratification results demonstrated that the source is not stratified. For runs 2 and 3, each test consisted of sampling at three points on a line passing through the centroidal area of the stack, located at 16.7%, 50%, and 83.3% of the stack diameter. Each point was sampled for 8 minutes. Data was recorded at 10-second intervals.

3.1.5 Quality Control and Assurance (O_2)

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 3A. Calibration gases were EPA Protocol 1 gases. Calibration gas concentrations were within the acceptable ranges (analyzer span >30% of the pollutant gas measured with mid-range calibration gas values 40-60% of the analyzer span) specified in Method 3A. Methods 3A references Method 7E for calibration standards. Calibration gas certification sheets are in Appendix C.

3.1.6 Data Reduction

The O_2 readings in percent (%) were recorded at 10-second intervals and averaged to 1-minute increments. The emissions data collected can be found in Appendix B.

3.2 OXIDES of NITROGEN (ASTM METHOD D6348)

3.2.1 Sampling Method

Oxides of Nitrogen emissions were evaluated using ASTM Method D6348, "Measurement of Vapor Phase Organic Emissions by Extractive Fourier Transform Infrared (FTIR)".

The ASTM D6348 sampling system (Figure 3) consisted of the following:

(1) Stainless steel sampling probe with sintered filter
(2) Flexible heated PTFE sampling line
(3) Air Dimensions Heated Head Diaphram Pump
(4) MKS MultiGas 2030 FTIR spectrometer
(5) Appropriate calibration gases
(6) Data Acquisition System

The FTIR was equipped with a temperature controlled, 5.11 meter multipass gas cell maintained at 191°C. Gas flows and sampling system pressures were

monitored using a rotometer and pressure transducer. All data was collected at 0.5 cm^{-1} resolution.

3.2.2 Sampling Train Calibration

The FTIR was calibrated per procedures outlined in ASTM Method D6348. Direct measurements of nitrogen, nitric oxide (NO), and ethylene (C_2H_4) gas standards were made at the test location to confirm concentrations.

A calibration transfer standard (CTS) was analyzed before and after testing at each location. The concentration determined for all CTS runs were within ±5% of the certified value of the standard. Ethylene was passed through the entire system to determine the sampling system response time and to ensure that the entire sampling system was leak-free.

Nitrogen was purged through the sampling system at each test location to confirm the system was free of contaminants.

NO gas standards were passed through the sampling system at each test location to determine the response time and confirm recovery.

NO spiking was performed to verify the ability of the sampling system to quantitatively deliver a sample containing NO from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR to quantify NO in the presence of effluent gas.

As part of the spiking procedure, samples from each location were measured to determine NO concentrations to be used in the spike recovery calculations. The determined sulfur hexafluoride (SF_6) concentration in the spiked and unspiked samples was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked NO. The following equation illustrates the percent recovery calculation.

$$DF = \frac{SF_{6(spike)}}{SF_{6(direct)}}$$ (Sec. 9.2.3 (3) ASTM Method D6348)

$$CS = DF * Spike_{dir} + Unspike (1 - DF)$$ (Sec. 9.2.3 (4) ASTM Method D6348)

DF = Dilution factor of the spike gas
$SF_{6(direct)}$ = SF6 concentration measured directly in undiluted spike gas
$SF_{6(spike)}$ = Diluted SF_6 concentration measured in a spiked sample
$Spike_{dir}$ = Concentration of the analyte in the spike standard measured by the FTIR directly

CS = Expected concentration of the spiked samples
Unspike = Native concentration of analytes in unspiked samples

All analyte spikes were introduced using an instrument grade stainless steel rotometer. The spike target dilution ratio was 1:10 or less. All NO spike recoveries were within the ASTM D6348 allowance of ±30%.

3.2.3 Quality Control and Assurance

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within ± 5% agreement. If there is a difference greater than ± 5%, the spectra are reviewed for possible spectral interferences or any other possible causes that might lead to inaccurately quantified data.

3.2.4 Data Reduction

Each spectrum was derived from the coaddition of 64 scans, with a new data point generated approximately every one minute. The NO_x emissions were recorded in parts per million (ppm) dry volume basis. The moisture content was recorded in percent (%). The FTIR data was validated by Prism Analytical Technologies, Inc. The validation reports are in Appendix B.

4.0 OPERATING PARAMETERS

The test program included the collection of turbine operating data during each test run. Parameters recorded included load (horsepower), gross dry BTU content of the fuel, fuel flow, stack exhaust temperature, and compressor discharge pressure and temperature. Operational data and results of the fuel analysis can be found in Appendix E.

5.0 RESULTS

The results of the NOx emission testing conducted on EUTURBINEC50 and EUTURBINET70 are presented in Table No 1. The NOx emissions are presented in parts per million (ppm), parts per million at 15% oxygen (ppm @ 15% O_2), and pounds per hour (lb/hr). Process data presented in unit load (%).

Testing of EUTURBINEC50 and EUTURBINET70 demonstrated compliance with permitted emission rates at 77.0% and 78.2% load, respectively.

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6.0 CERTIFICATION STATEMENT

"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally accepted in the trade."

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RESULTS TABLE

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TABLE NO. 1
NITROGEN OXIDE (NOx) EMISSION TESTING RESULTS
Belle River Mills Compressor Station
EUTURBINEC50
March 16, 2021

Test	Time	Load (% of rated hp)	Oxygen [1] (%)	NO_x Emissions (ppm)	NO_x Emissions (ppm @ 15% O_2)	NO_x Emissions (lb/hr)
Test-1	11:35-12:05	77.7%	15.5	11.5	12.6	2.40
Test-2	12:20-12:44	77.3%	15.6	11.5	12.7	2.36
Test-3	13:01-13:25	76.1%	15.5	11.6	12.8	2.43
	Avg:	***77.0%***	***15.5***	***11.5***	***12.7***	***2.40***

(1) Corrected for analyzer drift per USEPA method 7E

NOx Permit Limits:

25.0 ppm corrected to 15% O2

3.67 pounds per hour

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TABLE NO. 2
NITROGEN OXIDE (NOx) EMISSION TESTING RESULTS
Belle River Mills Compressor Station
EUTURBINET70
March 16, 2021

Test	Time	Load (% of rated hP)	Oxygen [1] (%)	NO_x Emissions (ppm)	(NO_x Emissions (ppm @ 15% O_2)	NO_x Emissions (lb/hr)
Test-1	14:45-15:15	78.8%	15.1	11.0	11.2	3.37
Test-2	15:32-15:56	78.3%	15.2	10.9	11.2	3.35
Test-3	16:09-16:33	77.4%	15.2	10.9	11.2	3.35
	Avg:	***78.2%***	***15.2***	***10.9***	***11.2***	***3.36***

(1) Corrected for analyzer drift per USEPA method 7E

NOx Permit Limits:

25.0 ppm corrected to 15% O2

5.34 pounds per hour

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FIGURES

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Figure 1 – Sampling Location
Belle River Mills Compressor Station – EUTURBINEC50
March 16, 2021

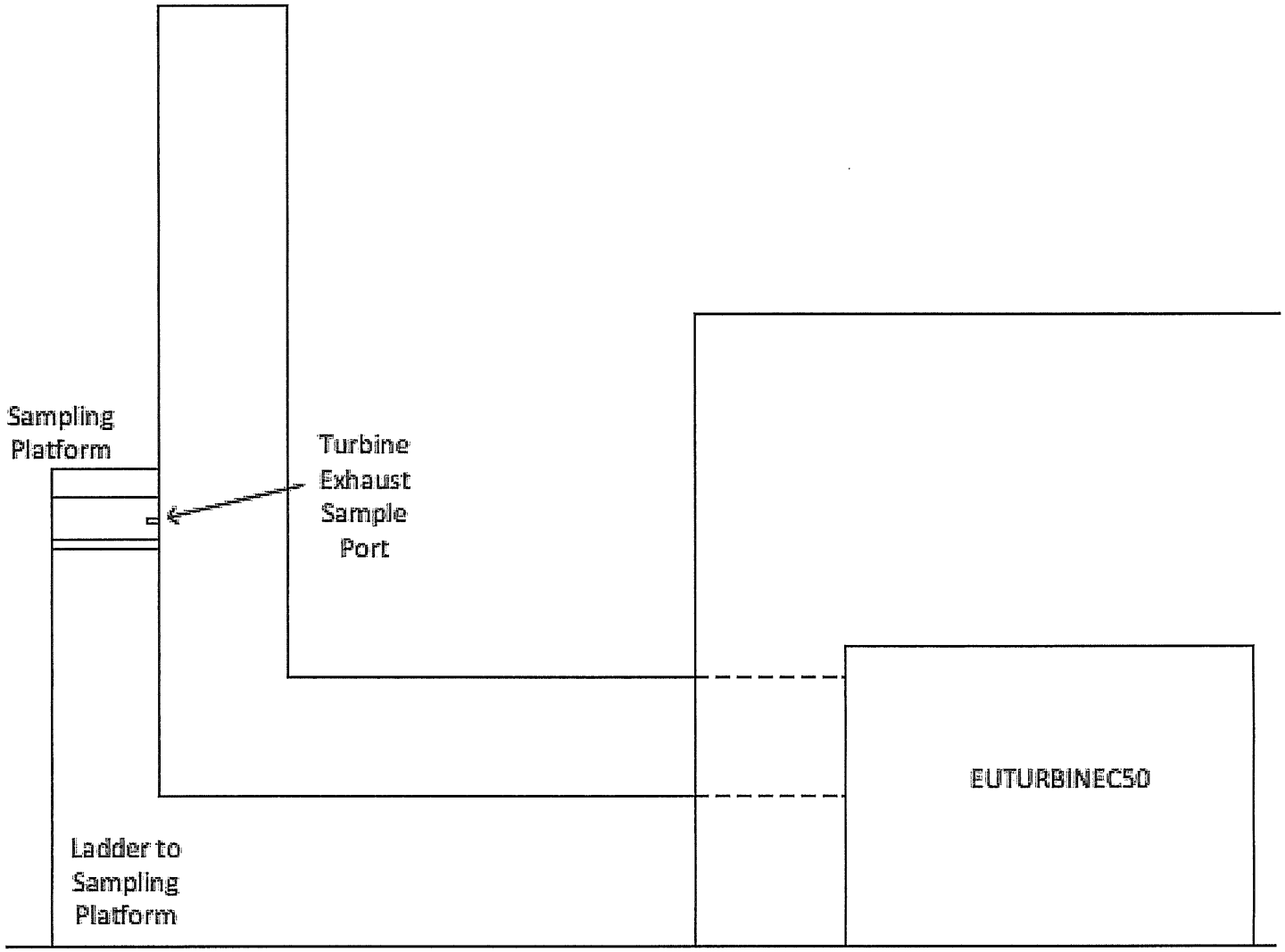

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Figure 2 – Sampling Location
Belle River Mills Compressor Station – EUTURBINET70
March 16, 2021

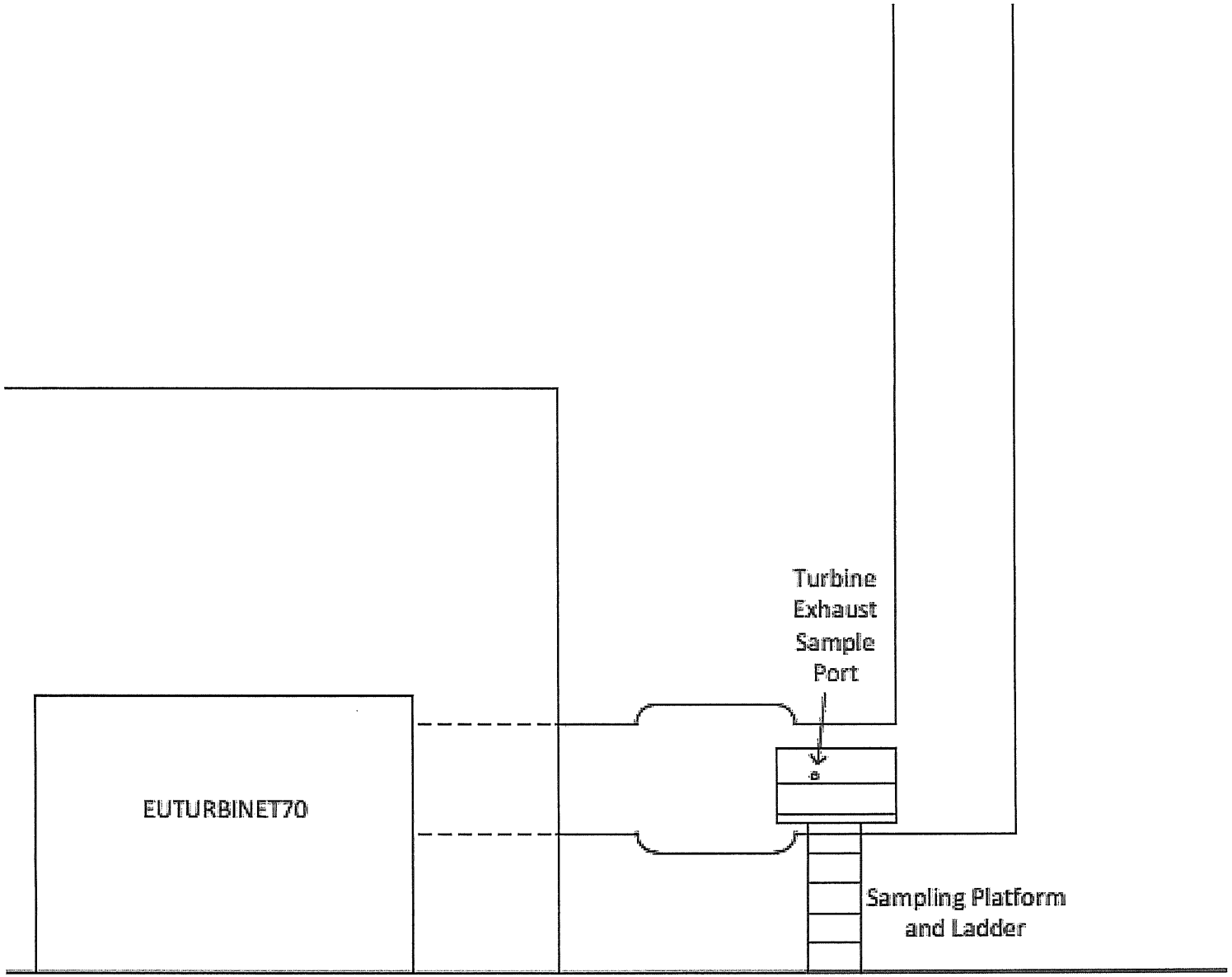

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Figure 3 – USEPA Method 3A / ASTM Method D6348
Belle River Mills Compressor Station – EUTURBINEC50 and EUTURBINEC70
March 16, 2021