



Environment

Prepared for:
Tennessee Gas Pipeline Company
Houston, TX

Prepared by:
AECOM
Chelmsford, MA
60340228.3
November 2015

Tennessee Gas Pipeline, L.L.C

Temporary Permit Application

Northeast Energy Direct Project
Market Path Mid 4 Compressor Station
New Ipswich, NH

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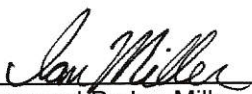
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New Ipswich, NH


Prepared By Ian Miller


Reviewed By Brian Stormwind

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List of Acronyms

bhp	Brake Horsepower
CAM	Compliance Assurance Monitoring
CO	Carbon Monoxide
ekW	Electrical Kilowatt
g/bhp-hr	Grams per Brake Horsepower-Hour
HAP	Hazardous Air Pollutant
hp	Horsepower
lb/MMBtu	Pound per Million British Thermal Unit
MACT	Maximum Available Control Technology
MCR	Maximum Continuous Rating
MMBtu/hr	Million British Thermal Units per Hour
NAAQS	National Ambient air Quality Standards
NED	Northeast Energy Direct
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHDES	New Hampshire Department of Environmental Services
NO _x	Oxides of Nitrogen
NO ₂	Nitrogen Dioxide
NNSR	Nonattainment New Source Review
NSPS	New Source Performance Standard
NSR	New Source Review
O ₃	Ozone
OTR	Ozone Transport Region
PILs	Solar Product Information Letters
PM	Particulate Matter
PM _{2.5}	Fine Particulate Matter with a Diameter less than 2.5 Microns
PM ₁₀	Fine Particulate Matter with a Diameter less than 10 Microns
ppm	Parts per Million
ppmdv	Parts per Million by Volume, dry
PSD	Prevention of Significant Deterioration
RACT	Reasonably Achievable Control Technology
RTAP	Regulated Toxic Air Pollutants
SO ₂	Sulfur Dioxide
Station	Market Path Mid 4 Compressor Station
TGP	Tennessee Gas Pipeline Company, L.L.C.
TSP	Total Suspended Particulate
UHC	Unburned Hydrocarbon
U.S.	United States
U.S. EPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compounds

1.0 Introduction

Tennessee Gas Pipeline Company, L.L.C. ("TGP"), a subsidiary of Kinder Morgan Partners, L.P., is proposing to construct a natural gas transmission pipeline compressor station in the town of New Ipswich, NH ("Project") as part of the Northeast Energy Direct Project ("NED"). TGP proposes to expand and modify its existing pipeline system in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. The NED Project is being developed to meet the increased demand in the Northeast United States ("U.S.") for transportation capacity of natural gas.

The subject of this Temporary Permit Application to the New Hampshire Department of Environmental Services ("NHDES") is the proposed Market Path Mid 4 Compressor Station ("Station") to be located in New Ipswich, NH.

Figures 1-1 and 1-2 show the proposed site of the station on a topographical map and the proposed layout of the station.

1.1 Project Description

The proposed compressor station will consist of the following equipment as shown in Tables 1-1 and 1-2. All fuel combustion equipment will be fired only with natural gas.

Table 1-1 Equipment Subject to Temporary Permitting

Equipment	Regulatory Citation
Two 168.4 MMBtu/hr Solar Turbines Titan 130 combustion turbines driving gas compressors	Env-A 607.01(d)(4) internal combustion device combusting gaseous fuel greater than 1.5 MMBtu/hr design heat input and combined heat input from such devices greater than 10 MMBtu/hr. Env-A 601*01(v)(1) stationary source subject to NOx RACT as contained in Env-A 1300.
One 16.5 million British thermal units per hour ("MMBtu/hr") Caterpillar G3516C emergency generator engine	Env-A 607.01(d)(4) internal combustion device combusting gaseous fuel greater than 1.5 MMBtu/hr design heat input and combined heat input from such devices greater than 10 MMBtu/hr.

Table 1-2 Equipment Not Subject to Temporary Permitting

Equipment	Regulatory Citation
One 4.6 MMBtu/hr Parker natural gas-fired heater	Does not meet the Env-A 607.01(a)(1) threshold of 10 MMBtu/hr design heat input.
3,760 gallon pipeline liquids drip tank and storage tanks for lubricating oils	Does not meet the Env-A 607.01(h) threshold of 40,000 gallon design capacity.
Natural Gas service piping component fugitives	Is not considered a stationary source subject to Temporary permitting. Definitions in Env-A 101.89 and 101.187.
Liquid service piping component fugitives	Is not considered a stationary source subject to Temporary permitting. Definitions in Env-A 101.89 and 101.187.
Blowdown of natural gas compressors	Does not meet the Env-A 607.01(t) threshold of requiring a permit under Env-A 1400.

1.2 Summary of Applicable Requirements

The proposed Project is located in the town of New Ipswich located in Hillsborough County which is part of the Merrimack Valley-Southern New Hampshire Interstate Air Quality Control Region in New Hampshire which is considered in attainment/unclassified status for all criteria pollutants. However, the proposed Project area is treated as moderate ozone ("O₃") nonattainment for nitrogen oxides ("NO_x") and volatile organic compounds ("VOCs") because New Hampshire is part of the Ozone Transport Region ("OTR").

The proposed facility will be a true minor source of all criteria and hazardous air pollutants ("HAPs"). That is, it will not be necessary to limit hours of operation or fuel consumption in order for the Project's potential emissions to be below Prevention of Significant Deterioration ("PSD"; Env-A 619), Nonattainment New Source Review ("NNSR"; Env-A 618), National Emissions Standards for HAPs ("NESHA"), or Title V major source thresholds.

This application demonstrates that the proposed facility will comply with all applicable emission standards and control technology requirements and dispersion modeling conducted to estimate facility's potential air quality impacts demonstrates the facility air emissions comply with applicable ambient air quality standards, established by both NHDES and U.S. Environmental Protection Agency ("U.S. EPA").

The dispersion modeling analysis is documented in the report provided in Appendix D. The modeling analysis demonstrates that the Project emissions comply with the National Ambient Air Quality Standards ("NAAQS").

1.3 The Applicant

The applicant is permit application is Tennessee Gas Pipeline Company. The primary contact with overall responsibility for this application is:

The primary technical contact for this application is:

Name Michael Zeilstra
Title Engineer-Environmental III
Address 1001 Louisiana Street, Houston, Texas
Phone 713-420-4333
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AECOM was retained by TGP to perform the necessary technical analyses to support this air permit application. The primary contact at AECOM responsible for the preparation of this application is:

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Title Manager, Air Quality Engineering & Studies
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1.4 Application Content

This document represents the full application for a Temporary Permit to Construct the New Ipswich Compressor Station, including the required permit application forms and supporting documentation. This application document is organized as follows:

- Section 1 – Introduction provides information about the Project, general regulatory requirements, and facility contact information.
- Section 2 – Emissions Summary provides details on the pollutant-specific emissions rates from the proposed project.
- Section 3 – Regulatory Review identifies the federal and state regulations and standards applicable to the Project and summarizes the requirements of the applicable regulations.
- Appendix A contains the NHDES permit application forms and supporting documentation.
- Appendix B contains the supporting emissions calculations and equipment manufacturer documentation.
- Appendix C contains the Air Pollution Control Equipment Monitoring Plan.
- Appendix D contains a copy of the dispersion modeling report and modeling file archive CD.

Figure 1-1 Location of Proposed Market Path Mid Station 4

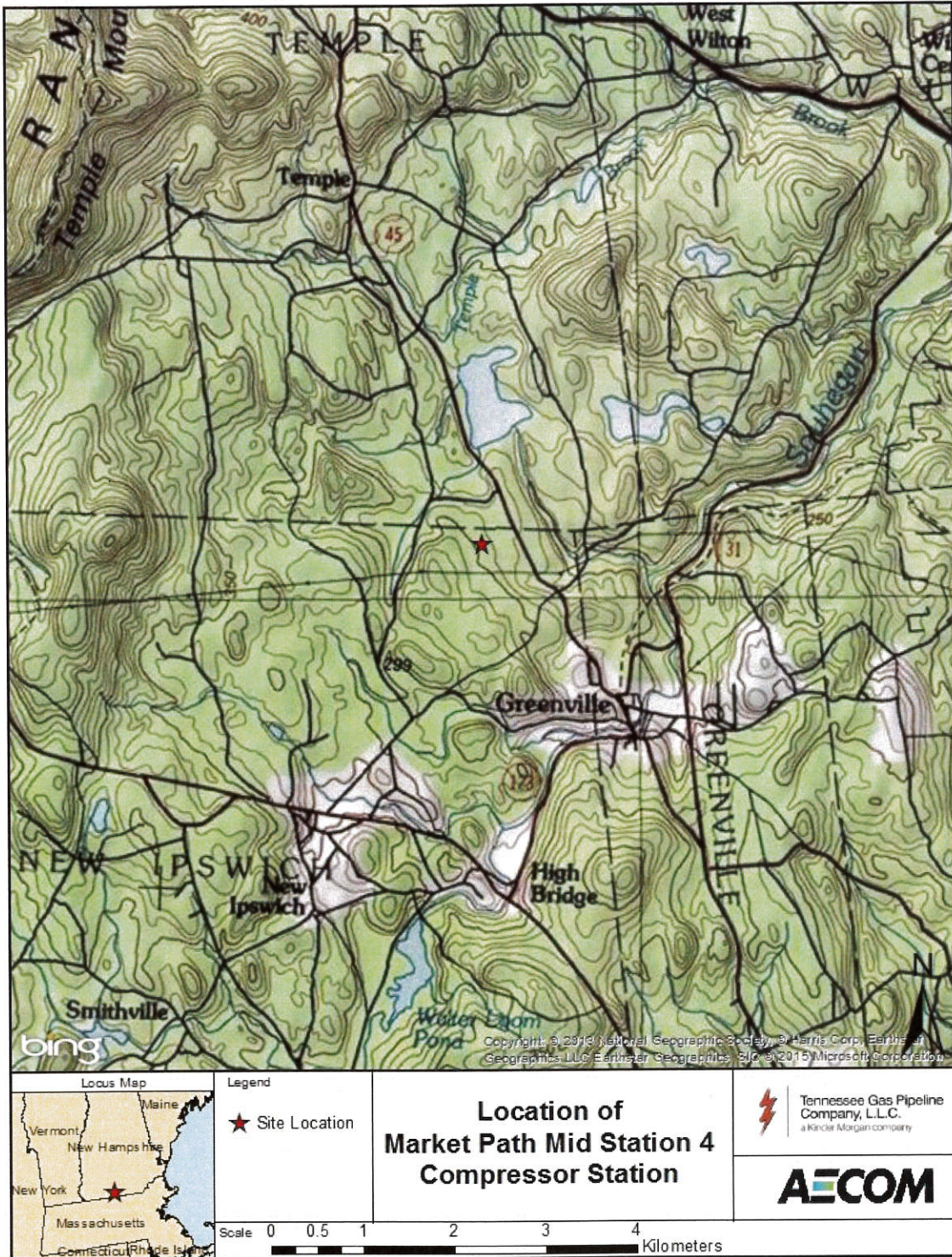
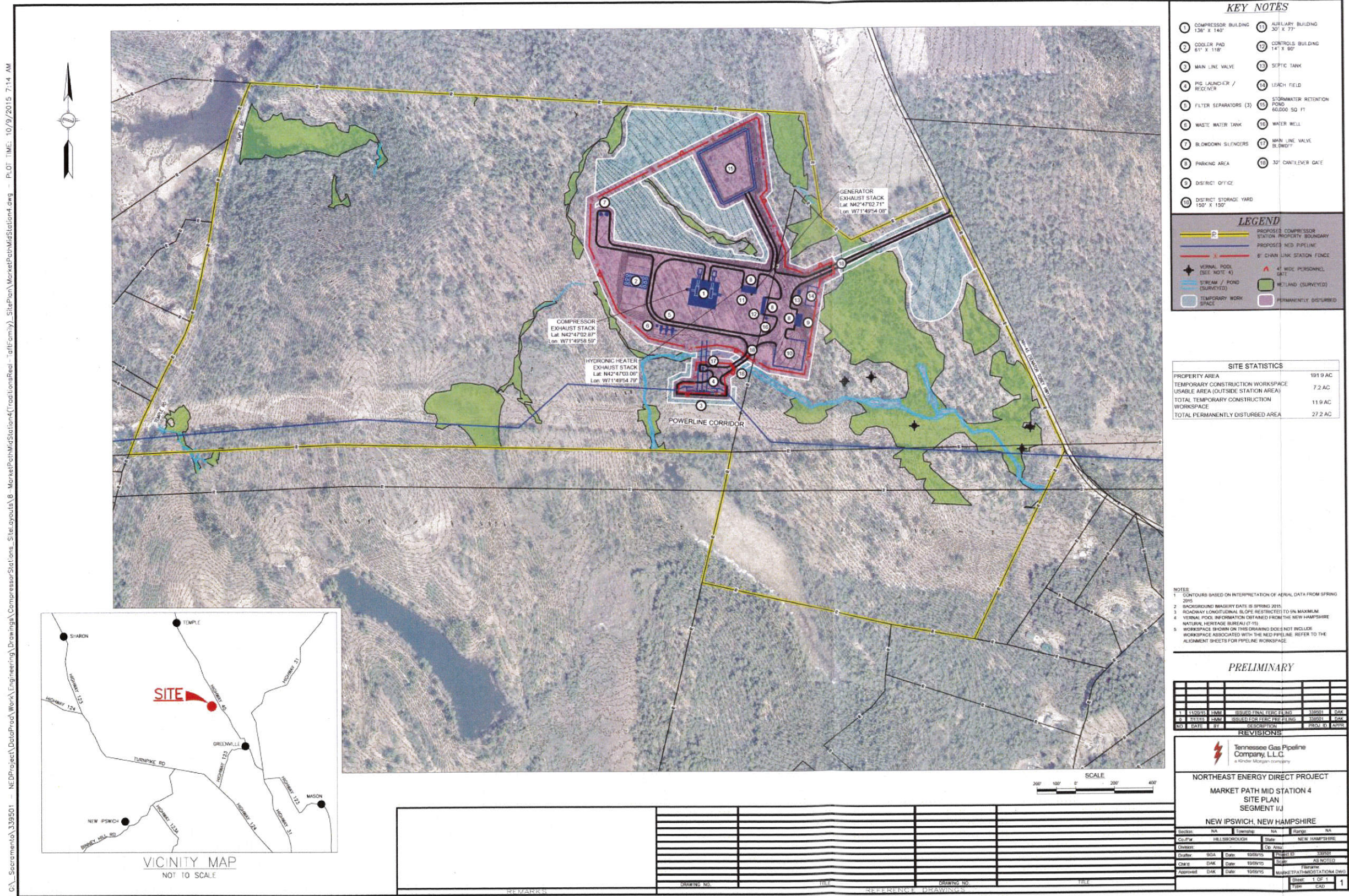


Figure 1-2 Site Plan of Proposed Market Path Mid Station 4



2.0 Emissions Estimation

This section contains the processes and procedures used to develop the emissions estimate for the proposed project. Emissions calculations and manufacturer information are provided in Appendix B.

2.1 Process Description

TGP including the proposed compressor station does not produce any goods. The proposed compressor station will not have a defined schedule of operation. Natural gas production companies (producers) will have contracts with TGP specifying that the pipeline will be available 8,760 hours per year to transfer pipeline quality natural gas from them to local distribution companies ("LDCs") and electrical utilities for power generation. In this sense, the production companies are leasing TGP's pipeline. The schedule of operation and the amount of natural gas compression at any time is based on demand.

The pipeline quality natural gas that will be transported on the TGP pipeline will also be used as fuel for the proposed Station combustion units. Pipeline quality natural gas is gas that ultimately is consumed by much of the public and private infrastructure, including homes, businesses, government offices, and schools, among other end-users. This natural gas has already been treated and / or processed prior to its entry into the TGP pipeline system so the impurities have been removed. Benzene, other HAPs / toxics, and hydrogen sulfide ("H₂S") that may be present when exiting wells have been almost completely removed prior to custody transfer into the TGP pipeline system.

The proposed Station will be installed as part of the NED project to expand and modify the existing TGP pipeline system in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. The Station is required to ensure proper operating pressure and transmission of the natural gas along the pipeline route. The Station pipeline gas pressure requirements will be accomplished through the installation of two 20,893-horsepower ("hp"; @0°F) natural gas turbine driven centrifugal compressors.

The units will be housed within a new building, and other associated appurtenant facilities. These appurtenant facilities will include an access driveway, parking areas, a station maintenance/control building, intake and exhaust silencers, turbine lube oil coolers, and a filter-separator with a pipeline liquids drip tank. Ancillary equipment will include a natural gas-fired heater and an emergency electrical power generator.

The proposed Solar Titan 130 turbines will be used for pipeline natural gas compression. The turbines will operate in a simple-cycle configuration at loads ranging from 50% to 100% of maximum continuous rating ("MCR"). There will be no limitation on the hours of operation of these turbines. The turbines will be equipped with Solar's lean premix technology, known as *SoLoNOx*TM. Solar gas turbines with *SoLoNOx*TM use this technology to ensure uniform air/fuel mixture and to limit NO_x, carbon monoxide ("CO"), and VOC emissions. Please note that this technology is intrinsic to the turbines, and therefore is not an add-on or exhaust control device.

The emergency generator will be operated during the performance of normal testing and maintenance procedures, as recommended by the manufacturer, and it will provide electrical power in the event of

unforeseeable circumstances such as a power outage or voltage reduction. Operations will be limited to a total of 100 hours per calendar year.

The 4.6 MMBtu/hr natural gas-fired heater will be operated as necessary to keep the temperature of the gas above the dew point temperature prior to combustion. This unit is exempt from obtaining a Temporary Permit, as it has a heat input capacity less than 10 MMBtu/hr.

Gas blowdown events will occur at the station. Typical compressor gas blowdowns will occur when a compressor is stopped and gas between the suction/discharge valves of the compressor is vented to the atmosphere via a blowdown vent prior to the next startup. This will not occur every time the compressor is shutdown, but are only expected to occur if the compressor will not be run for an extended period of time, if the turbine/compressor makes an emergency stop, or for compressor maintenance purposes.

2.2 Project Equipment Emissions

The Project's maximum hourly emission rates for criteria pollutants NO_x, CO, VOC, sulfur dioxide ("SO₂"), inhalable particulate matter smaller than or equal to 10 microns in diameter ("PM₁₀"), particulate matter less than 2.5 microns ("PM_{2.5}"), total HAPs, and maximum individual HAP for the Titan 130 turbine at full load operating conditions are presented in Table 2-1. Short-term emission rates are provided for full load at 0°F ambient temperature which represents the highest short-term mass emission rates.

2.2.1 Solar Titan 130 Turbine Emissions

Criteria pollutant emission rates were provided directly by Solar or based on information from Solar Product Information Letters ("PILs"). NO_x emissions are based on Solar provided emissions at 9 parts per million by volume, dry ("ppmvd") @ 15% O₂. Information from Solar Turbines is contained in Appendix B. CO emissions are based on Solar provided emissions and 90% control from the oxidation catalyst. VOC emissions are conservative (due to the minimal VOC content in the fuel) assumed to be 20% of Solar provided unburned hydrocarbon ("UHC") emissions based on PIL 168, revision 4 (dated May 14, 2012) and further reduced 40% by the oxidation catalyst. Emissions of SO₂, PM₁₀, PM_{2.5}, and HAPs are calculated based on U.S. EPA AP-42 emission factors (Chapter 3.1, Tables 3.1-2a and 3.1-3) respectively. HAPs are reduced by 40% for the oxidation catalyst. The highest individual HAP is formaldehyde.

Table 2-1 Short-term Maximum Hourly Emissions Summary for the Solar Titan 130 Turbine

Pollutant	Maximum lb/hr per turbine	Source of Emission Factors
NO_x	5.46	Manufacturer's information
CO	0.92	Manufacturer's information, with 90% control from oxidation catalyst
VOC	0.63	Manufacturer's information, based on 20% of unburned hydrocarbon emissions, with 40% control from oxidation catalyst
PM, PM₁₀/PM_{2.5}	1.11	U.S. EPA AP-42
SO₂	0.57	U.S. EPA AP-42
Total HAPs	0.10	AP-42, with 40% control from oxidation catalyst
Maximum Individual HAP; Formaldehyde	0.072	AP-42, with 40% control from oxidation catalyst

Annual emissions for the combustion turbines as shown in Table 2-2 is performed by comparing full year (8,760 hours/yr) turbine operation using the annual average ambient temperature of 48°F against a composite scenario which takes into account startup and shutdown operations and operation during periods of below zero degree (< 0°F) ambient temperature. Solar will not guarantee that the SoLoNOx™ system will operate properly at these low ambient temperatures and suggests alternate emissions to use for those periods of time.

The composite scenario consists of 150 startup and shutdown cycles per turbine and 200 hours of < 0°F operation. The equivalent time period of 150 startups/shutdowns is conservatively assumed to be 50 hours using Solar's 20 minute estimation of a startup/shutdown cycle (10 minutes per startup and per shutdown). In actual practice, the amount of time during startup, and especially shutdown, will be lower. Cold weather operation is estimated based on review of historical meteorological data for the area. Control of CO, VOCs, and HAPs are not assumed during startup, as the oxidation catalyst may not be up to operating temperature during the startup period. For shutdown, the oxidation catalyst is expected to be up to operating temperature through the shutdown period. Therefore, the same control efficiencies are assumed during shutdown as normal operation for CO, VOCs and HAPs. Detailed emissions calculations for the Titan 130 turbines are included in Appendix B.

Table 2-2 Solar Titan 130 Potential Annual Emissions Summary (per turbine)

Pollutant	Normal Operations @ 8,760 hr/yr (ton/yr/turbine)	Composite Scenario inc. SU/SD & < °F (ton/yr/turbine)	Worst-Case Emissions (ton/yr/turbine)	2 Titan 130 turbines (ton/yr)
NO _x	21.99	24.33	24.33	48.66
CO	3.72	18.82	18.82	37.65
VOC	2.56	2.88	2.88	5.75
PM, PM ₁₀ /PM _{2.5}	4.50	4.51	4.51	9.02
SO ₂	2.32	2.32	2.32	4.65
Total HAPs	0.42	0.43	0.43	0.86
Maximum Individual HAP; Formaldehyde	0.29	0.30	0.30	0.59

2.2.2 Emergency Generator Emissions

The other piece of equipment which requires a Temporary Permit is the 1,506 electrical kilowatt ("ekW")/16.5 MMBtu/hr emergency generator. The generator will be used in situations where the normal source of electric power is unavailable due to factors outside of TGP's control.

Emissions from the generator are calculated based on a run time of 100 hours per year consistent with the allowable non-emergency operations for 40 CFR Subpart JJJJ. Emissions from the generator are based on NO_x, CO, and VOC from Subpart JJJJ. Other criteria and HAP pollutants are calculated from AP-42 Chapter 3.2. Caterpillar provided data on the engine is included in Appendix B along with detailed emissions calculations. Emissions from the emergency generator are shown in Table 2-3.

Table 2-3 Emergency Generator Annual Emissions

Pollutant	Annual ton/yr	Source of Emission Factors
NO _x	0.48	NSPS Subpart JJJJ
CO	0.96	NSPS Subpart JJJJ
VOC	0.24	NSPS Subpart JJJJ
PM, PM ₁₀ /PM _{2.5}	0.008	U.S. EPA AP-42 Chapter 3.2
SO ₂	0.0005	U.S. EPA AP-42 Chapter 3.2
Total HAPs	0.059	U.S. EPA AP-42 Chapter 3.2
Maximum Individual HAP; Formaldehyde	0.043	U.S. EPA AP-42 Chapter 3.2

2.2.3 Natural Gas-Fired Heater Emissions

The natural gas-fired heater is not subject to Temporary Permit applicability because the 4.6 MMBtu/hr heat input is below the Env-A 618 permit threshold.

Emissions from the natural gas-fired heater are calculated based on a run time of 8,760 hours per year consistent with the Titan 130 combustion turbines. The manufacturer provided emissions data for NO_x, CO, particulate, and VOC. SO₂ and HAPs are calculated from AP-42 Chapter 1.4. Manufacturer provided data on the heater is included in Appendix B along with detailed emissions calculations. Emissions from the heater are shown in Table 2-4.

Table 2-4 Natural Gas-Fired Heater Annual Emissions

Pollutant	Annual ton/yr	Source of Emission Factors
NO _x	0.48	Manufacturer
CO	1.11	Manufacturer
VOC	0.62	Manufacturer
PM, PM ₁₀ /PM _{2.5}	0.20	Manufacturer
SO ₂	0.012	U.S. EPA AP-42 Chapter 1.4
Total HAPs	0.037	U.S. EPA AP-42 Chapter 1.4
Maximum Individual HAP; Hexane	0.036	U.S. EPA AP-42 Chapter 1.4

2.2.4 Fugitive and Vented Emissions

Fugitive emissions from the project will include valves, flanges, connectors, open ended lines, pump seals and other piping components in both gas service and heavy oil service. Fugitive emissions are not expected to occur from the station, but are conservatively included for emissions estimation purposes. Emissions are calculated using Table 2-4 from U.S. EPA documentation "*EPA Protocol for Equipment Leaks Emissions Estimate*"¹ which is based on testing performed at oil and gas production operations. A representative natural gas analysis from existing TGP system gas that originated from Pennsylvania was used to estimate emissions from the "natural gas service" piping components. Emissions from piping components in "heavy oil" service is used for turbine lube oil and the gas-fired heater heat transfer fluid.

Vented emissions include emissions from the pipeline liquids drip tank and compressor blowdowns. The same representative natural gas analysis used to estimate fugitive gas service emissions is also used to estimate emissions from compressor blowdowns. Compressor blowdowns occur quickly (typically less than 2 minutes) and because natural gas is lighter than air, it will dissipate as it is released from the vent. The ideal gas law is used to estimate the blowdown volume based on the temperature, pressure, and volume of natural gas contained in the compressor shell. For emissions

¹ <http://www3.epa.gov/ttnchie1/efdocs/equiplks.pdf> (EPA-453/R-95-017)

estimation purposes, 75 compressor blowdowns per compressor have been assumed. As described in Section 3.2.10, emissions from the compressor blowdowns meet the requirements of regulated toxic air pollutants.

Emissions from the pipeline liquids drip tank are estimated using the EPA Tanks program and an assumed turnover of once per year (3,000 gallons of liquid throughput). This is a very conservative assumption, as other TGP pipeline liquids tanks in the northeast have not received this volume over several years. The Tanks program was run using a surrogate of gasoline with a Reid vapor pressure of 7.8 to simulate pipeline liquids. The losses estimated from Tanks are assumed to be all VOC and 10% of this is conservative assumed to be hexane based on the pipeline liquid speciation profile.

Table 2-5 shows total Project emissions including fugitive emissions from natural gas service and light oil service, pipeline liquids drip tank, and compressor blowdowns.

Table 2-5 Annual Emissions Summary Including Vented and Fugitive Sources

Pollutant	Pipeline Liquid Drip Tank (ton/yr)	Compressor Blowdown (ton/yr)	Heavy Oil Service Fugitive (ton/yr)	Natural Gas Service Fugitive (ton/yr)
VOC	0.10	0.75	0.83	0.24
Total HAPs	0.01	0.011	0	0.003
Maximum Individual HAP	0.01 (hexane)	0.009 (hexane)	0	0.003 (hexane)

2.3 Facility Emissions

Table 2-6 summarizes the annual emissions from the proposed compressor station. Emissions from all pollutants are less than the respective major source thresholds for the PSD and NNSR permitting programs.

Table 2-6 Project Potential Annual Emissions Summary Post-Project Including Fugitives

Pollutant	2 Titan 130 Turbines (ton/yr)	Emergency Generator (ton/yr)	Gas-fired Heater (ton/yr)	Pipeline Liquids Drip Tank (ton/yr)	Compressor Blowdowns (ton/yr)	Liquid Service Fugitives (ton/yr)	Gas Service Fugitives (ton/yr)	Station Total (ton/yr)	NNSR/PSD Major Source Thresholds (ton/yr)
NO _x	48.66	0.48	0.48	-	-	-	-	49.62	100
CO	37.65	0.96	1.11	-	-	-	-	39.72	250
VOC	5.75	0.24	0.62	0.10	0.75	0.83	0.24	8.53	50
PM, PM ₁₀ /PM _{2.5}	9.02	0.008	0.20	-	-	-	-	9.23	250
SO ₂	4.65	0.0005	0.012	-	-	-	-	4.66	250
Total HAPs	0.86	0.059	0.037	0.01	0.011	-	0.003	0.98	25 (NESHAPS)
Maximum Individual HAP; Formaldehyde	0.59	0.043	0.0015	-	-	-	-	0.64	10 (NESHAPS)

3.0 Applicable Requirements and Standards

Federal and state of New Hampshire air pollution control and permitting requirements were reviewed to determine their potentially applicability and to confirm compliance with the applicable regulations. Potentially applicable federal regulations are:

- PSD;
- NNSR;
- New Source Performance Standards ("NSPS");
- Maximum Achievable Control Technology ("MACT");
- Compliance Assurance Monitoring ("CAM"); and
- Accidental Release Program.

New Hampshire regulations (Env-A Chapters 100 to 4300) potentially applicable to the proposed project include:

- Env-A 300 Ambient Air Quality Standards;
- Env-A 400 Acid Deposition Control Program;
- Env-A 500: Standards Applicable to Certain New or Modified Facilities and Sources of Hazardous Air Pollutants;
- Env-A 600: Statewide Permit System;
- Env-A 700: Permit Fee System;
- Env-A 800: Testing and Monitoring Procedures;
- Env-A 900: Owner or Operator Recordkeeping and Reporting Obligations;
- Env-A 1200: VOC RACT;
- Env-A 1300: NO_x RACT;
- Env-A 1400: Regulated Toxic Air Pollutants;
- Env-A 1500: Conformity;
- Env-A 1600: Fuel Specifications;
- Env-A 1700: Permit Application Forms;
- Env-A 2000: Fuel Burning Devices;
- Env-A 2900: Sulfur Dioxide and Nitrogen Oxides Annual Budget Trading and Banking Program;
- Env-A 3000: Emissions Reduction Credits Trading Program;
- Env-A 3100: Discrete Emissions Reduction Trading Program;

- Env-A 3200: NO_x Budget Trading Program;
- Env-A 3700: NO_x Emissions Reduction Fund for NO_x-Emitting Generation Sources; and
- Env-A 4600: Carbon Dioxide Budget Trading Program.

3.1 Federal Regulations

3.1.1 New Source Review

The term New Source Review refers to the preconstruction permitting programs under Part C and D of the Clean Air Act that must be satisfied *before* construction can begin on new major sources or major modifications to existing major sources. The PSD program is U.S. EPA's major NSR permitting program for major stationary sources located in areas that meet the NAAQS (attainment areas), and in areas for which there is insufficient information to determine attainment status (unclassified areas). Its counterpart for sources located in areas not meeting NAAQS (non-attainment areas) is often referred to as the NNSR program. NHDES delegated authority for implementing and enforcing of PSD and NNSR permitting programs.

The current attainment designations for New Hampshire are found in 40 CFR §81.330 and are listed in Table 3-1. The New Ipswich area (Hillsborough County) is designated as an attainment/unclassified area for all NSR-regulated pollutants, as the 1-hour ozone standard was revoked effective June 15, 2005. However, since the entire state of New Hampshire is part of the Northeast Ozone Transport Region, all areas of the state are treated as a moderate nonattainment for ozone even if an area is officially designated as attainment for ozone. Thus for purposes of this application, the project is potentially subject to NNSR review for NO_x and VOC emissions, the regulated pollutants considered precursors to ozone formation. All other NSR-regulated pollutants are considered attainment/unclassified pollutants and thus potentially subject to the PSD regulations.

Table 3-1 Attainment Designations

Pollutant	Attainment Status of Hillsborough County
Total Suspended Particulate ("TSP")	Better than national standard
SO ₂ (1971)	Better than national standard
SO ₂ (2010)	Unclassified (rest of county, including New Ipswich) Nonattainment (Goffstown Town only)
CO	Unclassifiable / Attainment [Maintenance for Cities of Manchester and Nashua]
Nitrogen Dioxide ("NO ₂ ") (1971)	Cannot be classified or better than national standards
NO ₂ (2010)	Unclassifiable / Attainment
O ₃ (8-hr) (1997, 2008)	Unclassifiable / Attainment [Maintenance for Amherst, Bedford, Brookline, Goffstown, Hollis, Hudson, Litchfield, City of Manchester, Merrimack, Milford, City of Nashua, Pelham]
PM _{2.5} (1997, 2006, 2012)	Unclassifiable / Attainment
Lead	Unclassifiable / Attainment

The proposed compressor station is not one of the 28 specifically named source categories. Therefore, the major source thresholds [40 CFR 52.21(b)(1)(i)(b), and 52.21(b)(49)(iv)(a)], significant thresholds [40 CFR 52.21(b)(23)(i)(b)], and nonattainment thresholds in Table 3-2 apply to the proposed project.

Table 3-2 New Source Review Thresholds

Pollutant	PSD NSR Major Source Threshold	Nonattainment Threshold (Ozone Transport Region)
NO _x	250	100
Ozone (VOC or NO _x)	250	100
CO	250	-
SO ₂	250	-
PM (TSP)	250	-
PM ₁₀	250	-
PM _{2.5}	250	-

3.1.2 Nonattainment New Source Review

The NNSR permitting requirements are implemented in New Hampshire under the approved State Implementation Plan regulations as found in Env-A 618. Table 2-2 shows emissions from the proposed facility are less than NNSR permitting thresholds.

3.1.3 Prevention of Significant Deterioration Review

The PSD permitting requirements are implemented in New Hampshire under the approved State Implementation Plan regulations as found in Env-A 619. Table 2-2 shows emissions from the proposed facility are less than PSD permitting thresholds.

3.1.4 New Source Performance Standards

NSPS regulations are promulgated under 40 CFR Part 60 and are designed to limit criteria pollutant emissions from new, modified, or reconstructed sources in certain source categories. The proposed equipment at the New Ipswich compressor station are subject to the following regulations.

The natural gas-fired heater is not subject to Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units. The 4.6 MMBtu/hr natural gas-fired heater is below the 10 MMBtu threshold to be applicable to the regulation [§60.40c(a)].

The Solar Titan 130 turbines are subject to Subpart KKKK – Standards of Performance for Stationary Combustion Turbines. As a new natural gas-fired turbine with a rated heat input greater than 50 MMBtu/hr and less than 850 MMBtu/hr, Subpart KKKK prescribes a NO_x emission limit of 25 ppm_{dv} @ 15% O₂. A separate limit of 150 ppm_{dv} @ 15% O₂ is applicable to operating at less than 75% of peak load and when ambient temperatures are below 0°F. TGP will meet the NO_x emission limit from the Titan 130 turbine for temperatures above 0°F by performance testing of the turbine exhaust as required by §60.4400. According to §60.4400(b)(6), stack testing must occur at ambient

temperatures above 0°F. Compliance with the below 0°F limit is part of the cold weather package from Solar Turbines which guarantees NO_x emission levels of 42 parts per million ("ppm").

Subpart KKKK also limits emissions of SO₂ to 0.060 pound per million British thermal unit ("lb/MMBtu") heat input. Monitoring of natural gas sulfur content is not required if a demonstration is made that the potential emissions of SO₂ are less than the limit. A demonstration is made according to the provisions of §60.4365(a). Therefore, sulfur monitoring is not required.

The emergency generator engine is subject to Subpart JJJJ – Stationary Spark Ignition Internal Combustion Engines. The rule allows compliance to be demonstrated by purchase of a certified engine or a non-certified engine and an initial performance test. For emergency engines greater than 130 brake horsepower ("bhp"), the performance test for a non-certified engine must show compliance with applicable emission limits of:

- NO_x – 2.0 grams per brake horsepower-hour ("g/bhp-hr") or 160 ppmvd @ 15% O₂;
- CO – 4.0 g/bhp-hr or 540 ppmvd @ 15% O₂; and
- VOC (not including formaldehyde) – 1.0 g/bhp-hr or 86 ppmvd @ 15% O₂.

TGP will comply with all other applicable rules within this subpart.

NSPS Subpart OOOO – Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution does not apply to the project. Centrifugal compressors and gas pneumatic devices are only affected if they are located between the wellhead and custody transfer points prior to entering the transmission pipeline (§60.5365(c)). Compressor stations (not including compressors) are not subject unless located at an onshore natural gas processing facility (§60.5365(f)(2)). The pipeline liquids drip tank being installed as part of this project will have potential VOC emissions less than 6 tons per year (§60.5365(e)); therefore, the emission limitations specified in Subpart OOOO do not apply. This regulation is in the process of being updated by Subpart OOOOa which will apply to sources which commence construction after September 18, 2015.

The proposed Subpart OOOOa² may apply to the project, if construction commences after September 18, 2015. For natural gas transmission stations, the rule as initially proposed may have limited applicability to the proposed station. The centrifugal gas compressors will use dry seals, which are not covered under the proposed NSPS OOOOa. Only wet centrifugal seal systems are covered. Pneumatic pumps and continuous bleed gas-driven controllers are two source categories covered by the proposed rule which are not part of the proposed station. The same potential 6 ton VOC/yr threshold in the current NSPS OOOO will also potentially apply under the proposed OOOOa. However, the pipeline liquids drip tank emissions are well below this threshold. The one other portion of the proposed rule which may apply to the proposed station is the fugitive methane and VOC leak detection and repair. This would apply only after the station is constructed and operating, and therefore will not affect construction.

² Published September 18, 2015 (80 FR 56663)

3.1.5 National Emission Standards for Hazardous Air Pollutants (40 CFR 63)

MACT regulations are promulgated under 40 CFR Part 63 and are designed to limit and control HAPs. Facilities are considered either major sources (having the potential to emit greater than 25 tons of combined individual HAPs or greater than 10 tons of any individual HAP) or area sources (anything that is not a major source).

The Station is not subject to Subpart HH – Oil and Natural Gas Production Facilities because it is not in a production facility. The New Ipswich Station is located after the transmission system custody transfer point.

The Station is not subject to Subpart HHH – Natural Gas Transmission and Storage because it will not be a major source of HAP emissions.

The combustion turbines are not subject to Subpart YYYY – Stationary Combustion Turbines because the Station will not be a major source of HAP emissions.

The emergency generator engine is subject to Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines, but does not have applicable requirements. Compliance with NSPS Subpart JJJJ constitutes compliance with Subpart ZZZZ for new lean-burn engines at area sources of HAP emissions as per §63.6590(c)(1).

3.1.6 Compliance Assurance Monitoring (40 CFR 64)

The CAM rule was put into effect to ensure that Title V major sources of emissions have adequate measures in place to assure that control devices operate effectively to comply with emission limits. The proposed New Ipswich Compressor Station will not be a major source under Title V (40 CFR Part 70) and therefore CAM does not apply.

3.1.7 Accidental Release Program (40 CFR 68)

Section 112(r) of the Clean Air Act Amendments of 1990 established a program for Accidental Release Prevention, which requires affected facilities to take preventive action to avoid accidental releases of toxic or flammable chemicals. Facilities are required to prevent, detect, and respond to accidental releases through the preparation and implementation of risk management plans and hazard assessments. U.S. EPA has promulgated regulations under 40 CFR 68 that identify the list of regulated substances and threshold quantities.

Transportation of natural gas subject to requirements of 49 CFR Part 192 – Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards is specifically excluded from the definition of a stationary source under the rule.

3.2 New Hampshire Regulatory Review

Only potentially applicable sections of the Administrative Rules Governing the Control of Air Pollution relevant to this application are included. For example, Env-A 100 (Organizational Rules) and Env-A 200 (Procedural Rules) are both general in nature and apply to all sources.

3.2.1 Env-A 300: Ambient Air Quality Standards

This chapter establishes primary and secondary ambient air quality standards to protect the public health and welfare of New Hampshire citizenry. The primary and secondary standards are listed in.

Dispersion modeling results given in Appendix D demonstrate that the proposed project described in this application will not violate any of the applicable standards required to be included in the dispersion modeling analysis.

3.2.2 Env-A 400: Acid Deposition Control Program

This chapter is not applicable to the project because it applies only to sources operating between 1979 and 1982.

3.2.3 Env-A 500: Standards Applicable to Certain New or Modified Facilities and Sources of Hazardous Air Pollutants

This chapter incorporates by reference 40 CFR Parts 60 (NSPS), 61 (NESHAP), and 63 (MACT) regulations. Applicability to Part 60 subparts is discussed in Section 3.1.4. Each standard in 40 CFR Part 61 applies to a specific type of HAP source category. However, the proposed project does not include any process that is regulated by 40 CFR Part 61. 40 CFR Part 63 sets forth standards for major and area sources of HAPs. Specific subparts under Part 63 are discussed in Section 3.1.5.

3.2.4 Env-A 600: Statewide Permit System

This chapter establishes the procedures to regulate the operation and modification of new and existing stationary sources through the temporary permit, state permit to operate and the Title V operating permit programs.

Env-A 605 describes the obligation of the applicant to provide proof of right, title, or interest in the proposed property or a copy of the legal agreement to use of the property and also certification by a responsible official of the permit application content.

Env-A 606 describes the requirements and procedures for performing dispersion modeling. This is explained in further detail in Appendix D of this application.

Env-A 607 describes the requirements and procedures for applying for a Temporary Permit to allow construction and initial operation of new stationary sources. Env-A 607.01 contains the specific applicability thresholds for equipment for which construction and initial operation is required to be authorized by a Temporary Permit. The two combustion turbines are subject to Temporary Permit authorization because they are gaseous fueled internal combustion devices which have a heat input greater than 1.5 MMBtu/hr and the combined heat input of all internal combustion devices is greater than 10 MMBtu/hr [607.01(d)(4)] and they are also subject to NO_x Reasonably Available Control Technology ("RACT") requirements under Env-A 1300 [607.01(v)]. The emergency generator is subject to Temporary Permit authorization because it is a gaseous fueled internal combustion device which has a heat input greater than 1.5 MMBtu/hr and the combined heat input of all internal combustion devices is greater than 10 MMBtu/hr [607.01(d)(4)]. The natural gas-fired heater is not subject to Temporary Permit authorization because it is a natural gas fired external combustion device which has a heat input less than 10 MMBtu/hr [607.01(a)(1)] it is also not subject to NO_x RACT requirements as specified under Env-A 1301.02(d). The required contents of a Temporary Permit application are found in Env-A 607.03(b) and applicable elements are contained in this application.

Env-A 618 and 619 contains NHDES's implementation of the nonattainment and PSD permitting programs, respectively. EPA recently approved³ both sections as part of the State Implementation Plan. Section 2 contains the calculations of potential emissions from the proposed project which show that emissions will be below the thresholds for each permitting program.

3.2.5 Env-A 700: Permit Fee System

This chapter establishes a fee system requiring the payment of fees to cover costs of the administering the temporary permit, state permit to operate, and Title V operating permit programs in New Hampshire.

3.2.6 Env-A 800: Testing and Monitoring Procedures

This chapter establishes minimum testing and monitoring procedures, calculation procedures, standards, and requirements in order to determine compliance with applicable state and federal statutes and rules. Testing will be performed in accordance with an issued Temporary Permit.

Additional requirements apply to sources which employ a air pollution control equipment. In accordance with Env-A 810(b), a monitoring plan for the oxidation catalyst is included in Appendix C.

3.2.7 Env-A 900: Recordkeeping and Reporting Obligations

This chapter requires that records be kept at sources that discharge air pollutants so that the emissions of such pollutants can be readily calculated or estimated and reported to the department for the purposes of demonstrating compliance, compiling emission inventories, and developing air-related strategic plans. Applicable recordkeeping requirements from Chapter 900 will be included by NHDES in a Temporary Permit.

3.2.8 Env-A 1200: Volatile Organic Compounds (VOCs) Reasonably Available Control Technology (RACT)

The station is not subject to the VOC RACT requirements because it is not one of the named source categories in Env-A 1201.03(a)(1) through (21) and potential VOC emissions are less than 50 tons per year as a miscellaneous VOC source under Env-A 1222.01(a).

3.2.9 Env-A 1300: Nitrogen Oxides (NO_x) Reasonably Available Control Technology (RACT)

The combustion turbines are subject to NO_x RACT requirements since the heat input to each turbine is greater than the 25 MMBtu/hr threshold set in Env-A 1301.02(e). Env-A 1306.02 sets the NO_x RACT limit for natural gas fired turbines constructed after May 27, 1999 as 25 ppmvd, corrected to 15% oxygen, equivalent to 0.092 lb/MMBtu.

The emergency generator is not subject to NO_x RACT requirements because the potential emissions from the proposed station are less than 50 tons of NO_x per year, operation of the emergency generator is limited to less than 500 hours per year, and the potential emissions from the emergency generator is less than 25 tons of NO_x per year.

³ Published on September 25, 2015 (80 FR 57722), effective October 26, 2015.

The 4.6 MMBtu/hr gas-fired heater is not subject to NO_x RACT requirements because the heat input to the heater is less than the 50 MMBtu/hr threshold in Env-A 1301.02(d).

3.2.10 Env-A 1400: Regulated Air Toxic Pollutants

Chapter 1400 is not applicable to the proposed combustion sources (combustion turbines, heater, and emergency generator) because Env-A1402.02(a)(2) specifically exempts sources which create air toxic emissions from the result of combustion of natural gas.

Chapter 1400 is potentially applicable to emissions from compressor blowdowns. As previously stated in Sections 2.1 and 2.2.4., the blowdown of natural gas from the compressors are performed for maintenance or other safety reasons. The blowdown gas may contain regulated toxic air pollutants ("RTAPs") as listed in Table 1450-1. These gasses can include isomers of n-hexane and heptane, n-hexane, benzene, heptane and toluene. Appendix B contains calculations of emissions from compressor blowdowns, summarized in Table 3-3, which demonstrates that the emissions of the RTAPS meet the respective 24-hour and annual *De Minimis* thresholds. The compressor blowdown stacks will be vertically oriented and will be unobstructed which meets the requirements of Env-A 1405.03 and 1403.03 for not requiring permitting of the blowdown stacks based on the nature and amount of emissions.

Table 3-3 Compressor Blowdown RTAP Emissions and De Minimis Levels

RTAP	Project lb/day	24-hr De Minimis lb/day	Project lb/yr	Annual De Minimis lb/year
2,2-dimethylbutane ¹	0.09116.83,838			
2-methylpentane ¹	0.281120.83,838			
3-methylpentane ¹	0.12119.13,838			
n-Hexane	0.251118.73,838			
Benzene	0.0280.0682.125			
2-methylhexane ²	0.07985.335,771			
2,3-dimethylpentane ²	0.02981.835,771			
3-methylhexane ²	0.08986.235,771			
Heptane	0.09986.835,771			
Toluene	0.01591.121,682			
¹ Hexane, isomers other than n-Hexane.				
² Isomers of heptane				

3.2.11 Env-A 1500: Conformity

Chapter 1500 implements the regulations of 40 CFR Part 93. Conformity is not applicable to the proposed project because this application is for an air permit to be issued by NHDES in accordance with Env-A 600.

3.2.12 Env-A 1600: Fuel Specifications

Chapter 1600 limits the sulfur content of liquid petroleum fuels and is applicable to users or suppliers of such fuels. As the project will only burn natural gas, the project is not subject to its contents.

3.2.13 Env-A 1700: Permit Application Forms

Chapter Env-A 1700 describes the information required in the applicable permit forms. Completed permit application forms are provided in Appendix A.

3.2.14 Env-A 2000: Fuel Burning Devices

Chapter Env-A 2000 establishes the particulate and visible emissions standards for new stationary fuel burning devices. Opacity is limited to 20% for any 6-minute period for fuel burning devices installed after May 13, 1970 which an allowance for one 6 continuous minutes in any 60-minute period during startup and shutdown [Env-A 2002.02 and 2002.04(c)].

The compressor turbines are also subject to the 0.15 lb/MMBtu particulate matter emission limit from Env-A 2003.03(b)(2) for fuel burning devices installed after January 1, 1985 with maximum gross heat input rate of between 100 and 250 MMBtu/hr. The combustion turbines will comply with the 0.15 lb/MMBtu limit. Manufacturer's information indicates a particulate emission rate of 0.015 lb/MMBtu.

3.2.15 Env-A 2900: Sulfur Dioxide and Nitrogen Oxides Annual Budget Trading and Banking Program

Chapter 2900 is not applicable to the proposed project because it is not named as one of the affected sources as defined in Env-A 2901.02. The named sources are utility-sized electric generating units.

3.2.16 Env-A 3000: Emissions Reduction Credits Trading Program

This chapter is not applicable to the proposed project. It is applicable to the creation of VOC, NO_x, and CO emissions reduction credits for trading with other sources under economic incentive programs. As the project is for a new site, no credits are created.

3.2.17 Env-A 3100: Discrete Emissions Reduction Trading Program

This chapter is not applicable to the proposed project. It is concerned with creating discrete emissions reduction credits for VOC and NO_x reductions. As the project is for a new site, no reductions are included.

3.2.18 Env-A 3200: NO_x Budget Trading Program

The NO_x Budget program is applicable to NO_x Budget sources which are defined in Env-A 3203.17 as "a fossil fuel fired boiler or indirect heat exchanger with a maximum rated heat input capacity of 250 MMBtu/Hour, or more; and all electric generating devices with a rated output of 15 MW or more." The project equipment does not fit this definition and is therefore not applicable to the NO_x Budget Program.

3.2.19 Env-A 3700: NO_x Emissions Reduction Fund for NO_x-Emitting Generation Sources

This chapter requires NO_x-emitting generation sources to report power generation and NO_x emissions information, and to either acquire emissions reduction credit mechanisms, or to make direct payment of fees to the NO_x emissions reduction fund. The definition of a NO_x-emitting generation source in 3702.01 includes "any internal combustion engine or combustion turbine which generates electricity for sale, except for sources which meet the definition of a NO_x budget source." TGP is not proposing an electric generating internal combustion engine or a combustion turbine as part of this application; therefore Chapter 3700 does not apply.

Appendix A

NHDES Permit Application Forms



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15-0524 NEW HAMPSHIRE
NOV 19 2015

ARD-1 FORM GENERAL FACILITY INFORMATION

Air Resources Division/Permitting and Environmental Health Bureau

RSA/Rule: RSA 125-C:12 and Env-A 1700

This ARD-1 General Facility Information form shall be submitted with every application for an air permit.

1. TYPE OF FACILITY¹			
☐ Title V ☒ Non-Title V ☐ Unknown			
2. TYPE OF PERMIT²			
☒ Temporary Permit (Construction) ☐ State Permit to Operate ☐ Title V Operating Permit ☐ General State Permit ☐ Limitation on Potential to Emit (Env-A 625)			
3. TYPE OF APPLICATION³			
☒ New ☐ Renewal ☐ Modification ☐ Administrative Amendment			
4. FACILITY INFORMATION			
FACILITY NAME ⁴ : Market Path Mid Station Compressor Station 4		AFS NUMBER ⁵ :	
PHYSICAL ADDRESS: Senator Tobey Highway (NH State Route 45)			
TOWN/CITY: New Ipswich		STATE: NH	ZIP: 03071
GOVERNMENT FACILITY CODE ⁶ : 0			
5. BUSINESS INFORMATION AS REGISTERED WITH SECRETARY OF STATE⁷ (If applicable)			
REGISTERED NAME: Tennessee Gas Pipeline Company, L.L.C.			
REGISTERED ADDRESS: 1001 Louisiana St., Ste 1000			
TOWN/CITY: Houston		STATE: TX	ZIP: 77002
6. PARENT CORPORATION INFORMATION (If applicable)			
PARENT CORPORATION NAME: Kinder Morgan, L.P.			
MAILING ADDRESS: 1001 Louisiana St., Ste 1000			
TOWN/CITY: Houston		STATE: TX	ZIP: 77002
7. MAJOR ACTIVITY OR PRODUCT DESCRIPTION List all activities performed at this facility and provide SIC and/or NAICS Code(s) ⁸ .			
SIC Code	Activity Description	NAICS Code	Activity Description
4922	Natural Gas Transmission	486210	Pipeline Transportation of Natural Gas

At a minimum, please provide contact information below for Responsible Official, Technical, Invoicing and Legal contacts. Make as many copies of this page as necessary in order to include all contacts that you wish to associate with the application. Multiple people can be assigned one role; multiple roles can be assigned to one person.

8. RESPONSIBLE OFFICIAL INFORMATION		
RESPONSIBLE OFFICIAL NAME ⁹ : Thomas C. Dender		
TITLE: Vice President – Operations		
MAILING ADDRESS: 1001 Louisiana Street, Suite 1000		
TOWN/CITY: Houston	STATE: TX	ZIP: 77002
EMAIL ADDRESS:		
TELEPHONE NUMBER: 713-420-3833	EXTENSION:	
FAX NUMBER:		
ROLES: ☒ Responsible Official ☐ Technical ☐ Invoicing ☐ Legal ☐ Prepared Application ☐ Corporate ☐ Owner/Operator ☐ Consultant		
9. ADDITIONAL CONTACT INFORMATION		
CONTACT NAME: Michael Zeilstra		
TITLE: Engineer-Environment III		
COMPANY NAME: Kinder Morgan		
MAILING ADDRESS: 1001 Louisiana Street, Suite 1000		
TOWN/CITY: Houston	STATE: TX	ZIP: 77002
EMAIL ADDRESS: Michael_Zeilstra@kindermorgan.com		
TELEPHONE NUMBER: 713-420-4333	EXTENSION:	
FAX NUMBER: 713-420-4343		
ROLES: ☐ Responsible Official ☒ Technical ☒ Invoicing ☒ Legal ☐ Prepared Application ☐ Corporate ☐ Owner/Operator ☐ Consultant		
10. ADDITIONAL CONTACT INFORMATION		
CONTACT NAME: Brian Stormwind		
TITLE: Manager, Air Quality Engineering Studies		
COMPANY NAME: AECOM		
MAILING ADDRESS: 250 Apollo Drive		
TOWN/CITY: Chelmsford	STATE: MA	ZIP: 01824
EMAIL ADDRESS: Brian.Stormwind@aecom.com		
TELEPHONE NUMBER: 978-905-2413	EXTENSION:	
FAX NUMBER: 978-905-2101		
ROLES: ☐ Responsible Official ☐ Technical ☐ Invoicing ☐ Legal ☒ Prepared Application ☐ Corporate ☐ Owner/Operator ☒ Consultant		

11. ADDITIONAL CONTACT INFORMATION		
CONTACT NAME: Ian Miller		
TITLE: Senior Air Quality Engineer		
COMPANY NAME: AECOM		
MAILING ADDRESS: 250 Apollo Drive		
TOWN/CITY: Chelmsford	STATE: MA	ZIP: 01824
EMAIL ADDRESS: ian.miller@aecom.com		
TELEPHONE NUMBER: 978-905-2326	EXTENSION:	
FAX NUMBER: 978-905-2101		
ROLES: ☐ Responsible Official ☐ Technical ☐ Invoicing ☐ Legal ☒ Prepared Application ☐ Corporate ☐ Owner/Operator ☒ Consultant		
12. ADDITIONAL CONTACT INFORMATION		
CONTACT NAME:		
TITLE:		
COMPANY NAME:		
MAILING ADDRESS:		
TOWN/CITY:	STATE:	ZIP:
EMAIL ADDRESS:		
TELEPHONE NUMBER:	EXTENSION:	
FAX NUMBER:		
ROLES: ☐ Responsible Official ☐ Technical ☐ Invoicing ☐ Legal ☐ Prepared Application ☐ Corporate ☐ Owner/Operator ☐ Consultant		
13. ADDITIONAL CONTACT INFORMATION		
CONTACT NAME:		
TITLE:		
COMPANY NAME:		
MAILING ADDRESS:		
TOWN/CITY:	STATE:	ZIP:
EMAIL ADDRESS:		
TELEPHONE NUMBER:	EXTENSION:	
FAX NUMBER:		
ROLES: ☐ Responsible Official ☐ Technical ☐ Invoicing ☐ Legal ☐ Prepared Application ☐ Corporate ☐ Owner/Operator ☐ Consultant		

This section of the form must be completed and signed by the Responsible Official only.

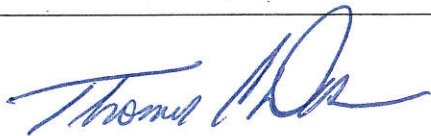
14. CERTIFICATIONS

- ☒ I certify that the applicant, or the owner or operator the applicant represents, has right, title, or interest in all of the property that is proposed for development or use because the owner or operator owns, leases, or has binding options to purchase all of the property proposed for development or use.
- ☒ I am authorized to make this submission on behalf of the affected source or affected units for which this submission is made. I certify under penalty of law that I have personally examined, and am familiar with, the information submitted in this document and all of its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

15. RESPONSIBLE OFFICIAL INFORMATION AND SIGNATURE

RESPONSIBLE OFFICIAL NAME: Thomas C. Dender

TITLE: Vice President – Operations



RESPONSIBLE OFFICIAL'S SIGNATURE

11-9-15

DATE:

ARD-1 GENERAL FACILITY INFORMATION INSTRUCTIONS

- ¹ List of Title V facilities in NH: <http://des.nh.gov/organization/divisions/air/pehb/tvs/table.htm>
Most facilities are Non-Title V. Check Unknown if you are unsure.
- ² Temporary Permit = New Construction at Existing or New Facility
State Permit to Operate = Existing Non-Title V Facilities
Title V Operating Permit = Existing Title V Facilities
GSP = General State Permit
Limitation on Potential to Emit = Small Facilities requesting coverage under Env-A 625
- ³ New = New devices at facility, change in operation at Existing facility or New facility never permitted before
Renewal = Renewal of any permit type
Modification = Currently permitted by non-expired permit and wants to make amendment/modification to information contained in permit. This includes adding/removing devices covered by GSP.
- ⁴ Facility Name = Trade name or Doing Business As
- ⁵ AFS number is assigned by NHDES and is a 10-digit number starting with 33 (example 3300100001).
- ⁶

0 = Facility is not government owned	3 = Source owned by the County
1 = Source owned by the Federal Government	4 = Source owned by the Municipality
2 = Source owned by the State	5 = Source owned by the District
- ⁷ Name registered with NH Secretary of State: http://sos.nh.gov/corp_div.aspx
- ⁸ Find SIC Code: https://www.osha.gov/pls/imis/sic_manual.html
Find NAICS Code: <http://www.census.gov/cgi-bin/sssd/naics/naicsrch>
- ⁹ Responsible Official:
For a corporation = President, Secretary, treasurer, or vice-president in charge of a principal business function
For a partnership = General partner or proprietor
For a municipality = Principal executive officer or ranking elected official

airpermitting@des.nh.gov or phone (603) 271-1370
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form
ARD-2



Information Required for Permits for Fuel Burning Devices

RECEIVED
NEW HAMPSHIRE

NOV 19 2015

I. EQUIPMENT INFORMATION – Complete a separate form for each device.

Device Description: Solar Turbine Titan 130 #1

Date Construction

Commenced: _____

Device Start-Up Date: _____

AIR RESOURCES DIVISION

A. Boiler ☒ Not Applicable

Boiler Manufacturer

Boiler Model Number

Boiler Serial Number

Gross Heat Input Nameplate Rating (MMBtu/hr)

Burner Manufacturer

Burner Model Number

☐ gal/hr
☐ mmcf/hr
☐ ton/hr

Burner Serial Number

Potential Fuel Flow Rate

1. Type of Burner:

a. Solid Fuel:

- ☐ Cyclone
☐ Pulverized (☐ wet ☐ dry)
☐ Spreader Stoker
☐ Underfeed Stoker
☐ Overfeed Stoker
☐ Hand-Fired
☐ Fly Ash Re-injection
☐ Other (specify): _____

b. Liquid Fuel:

- ☐ Pressure Gun
☐ Rotary Cup
☐ Steam Atomization
☐ Air Atomization
☐ Other (specify): _____

c. Gaseous Fuel:

- ☐ Natural Gas
☐ Propane
☐ Other (specify): _____

2. Combustion Type:

- ☐ Tangential Firing ☐ Opposite End Firing ☐ Limited Excess Firing ☐ Flue Gas Recirculation
☐ Staged Combustion ☐ Biased Firing ☐ One End Only Firing
☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines

☐ Not Applicable

Solar Turbines

Manufacturer

TBD

Serial Number

20,893 @ 0°F

Engine Output Rating

☒ hp
☐ kW

Titan 130

Model Number

0.165

Fuel Flow Rate

☐ gal/hr
☒ mmcf/hr

Natural Gas Compression

Reason for Engine Use

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No (if yes, provide data for each stack)

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☒ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

64
Stack ☐ Inside Diameter (ft) ☒ Exit Area (ft²)

253,724
Exhaust Flow (acfm)

902
Exhaust Temperature (°F)

83
Discharge height above ground level (ft)

66.07
Exhaust Velocity (ft/sec)

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

Tennessee Gas Pipeline Company
Supplier's Name

1001 Louisiana Street
Street

Houston TX 77002
Town/City State Zip Code

Telephone Number

2. Fuel Additives:

Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information (List each fuel utilized by this device):

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
Natural				1020	168.4	1,332
Gas				Btu/cf		mmscf/yr

B. Hours of Operation

Hours per day: 24 Days per year: 365

III. POLLUTION CONTROL EQUIPMENT ☐ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- | | |
|--|---|
| ☐ baffled settling chamber | ☐ wide bodied cyclone |
| ☐ long cone cyclone | ☐ irrigated long cone cyclone |
| ☐ multiple cyclone (_____ inch diameter) | ☐ carbon absorption |
| ☐ electrostatic precipitator | ☐ irrigated electrostatic precipitator |
| ☐ spray tower | ☐ absorption tower |
| ☐ venturi scrubber | ☐ baghouse |
| ☐ afterburners (incineration) | ☐ packed tower/column |
| ☐ selective catalytic reduction | ☐ selective non-catalytic reduction |
| ☐ reburn | |
| ☒ other (specify): <u>Oxidation Catalyst</u> | |

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
CO	902	0.92	9.23	3.72	37.23
VOC	902	0.63	1.06	2.56	4.27
				(normal operation)	(normal operation)

Method used to determine entering emissions:

- ☐ stack test ☒ vendor data ☒ emission factor ☐ material balance
☐ other (specify): _____

C. Operating Data

- Capture Efficiency: 100% Verified by: ☐ test ☒ calculations
- Control Efficiency: 90 (CO) 40% (VOC) % Verified by: ☐ test ☒ calculations
- Normal Operating Conditions (*supply the following data as applicable*)

<u>253,724</u> Total gas volume through unit (acfm)	<u>902</u> Temperature (°F)	_____ Percent Carbon Dioxide (CO ₂)
_____ Voltage	_____ Spark Rate	_____ Milliamps
_____ Pressure Drop (inches of water)	_____ Liquid Recycle Rate (gallons per minute)	

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx	902	5.02	5.46	21.99	24.33
CO	902	0.85	0.92	3.72	18.82
VOC	902	0.58	0.63	2.56	2.88
SO2	902	0.53	0.57	2.32	2.32
PM10/2.5	902	1.03	1.11	4.50	4.51

Method used to determine exiting emissions:

☐ stack test ☒ vendor data ☒ emission factor ☐ material balance

☒ other (specify): POTENTIAL EMISSIONS INCLUDES ALL
MODES OF OPERATION, NOT JUST NORMAL
OPERATION. ACTUAL EMISSIONS INCLUDES
ONLY NORMAL OPERATION.

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form
ARD-2



Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – Complete a separate form for each device.

AIR RESOURCES DIVISION

Device Description: Solar Turbine Titan 130 #2

Date Construction

Commenced: _____

Device Start-Up Date: _____

A. Boiler ☒ Not Applicable

Boiler Manufacturer

Boiler Model Number

Boiler Serial Number

Gross Heat Input Nameplate Rating (MMBtu/hr)

Burner Manufacturer

Burner Model Number

☐ gal/hr
☐ mmcf/hr
☐ ton/hr

Burner Serial Number

Potential Fuel Flow Rate

1. Type of Burner:

a. Solid Fuel:

- ☐ Cyclone
☐ Pulverized (☐ wet ☐ dry)
☐ Spreader Stoker
☐ Underfeed Stoker
☐ Overfeed Stoker
☐ Hand-Fired
☐ Fly Ash Re-injection
☐ Other (specify): _____

b. Liquid Fuel:

- ☐ Pressure Gun
☐ Rotary Cup
☐ Steam Atomization
☐ Air Atomization
☐ Other (specify): _____

c. Gaseous Fuel:

- ☐ Natural Gas
☐ Propane
☐ Other (specify): _____

2. Combustion Type:

- ☐ Tangential Firing ☐ Opposite End Firing ☐ Limited Excess Firing ☐ Flue Gas Recirculation
☐ Staged Combustion ☐ Biased Firing ☐ One End Only Firing
☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines

☐ Not Applicable

Solar Turbines

Manufacturer

TBD

Serial Number

20,893 @ 0°F

Engine Output Rating

☒ hp
☐ kW

Titan 130

Model Number

0.165

Fuel Flow Rate

☐ gal/hr
☒ mmcf/hr

Natural Gas Compression

Reason for Engine Use

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No (if yes, provide data for each stack)

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☒ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

64
Stack ☐ Inside Diameter (ft) ☒ Exit Area (ft²)

253,724
Exhaust Flow (acfm)

902
Exhaust Temperature (°F)

83
Discharge height above ground level (ft)

66.07
Exhaust Velocity (ft/sec)

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

Tennessee Gas Pipeline Company
Supplier's Name

1001 Louisiana Street
Street

Houston TX 77002
Town/City State Zip Code

Telephone Number

2. Fuel Additives:

Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information (List each fuel utilized by this device):

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
Natural				1020	168.4	1,332
Gas				Btu/cf		mmscf/yr

B. Hours of Operation

Hours per day: 24 Days per year: 365

III. POLLUTION CONTROL EQUIPMENT ☐ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- | | |
|--|---|
| ☐ baffled settling chamber | ☐ wide bodied cyclone |
| ☐ long cone cyclone | ☐ irrigated long cone cyclone |
| ☐ multiple cyclone (_____ inch diameter) | ☐ carbon absorption |
| ☐ electrostatic precipitator | ☐ irrigated electrostatic precipitator |
| ☐ spray tower | ☐ absorption tower |
| ☐ venturi scrubber | ☐ baghouse |
| ☐ afterburners (incineration) | ☐ packed tower/column |
| ☐ selective catalytic reduction | ☐ selective non-catalytic reduction |
| ☐ reburn | |
| ☒ other (specify): <u>Oxidation Catalyst</u> | |

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
CO	902	0.92	9.23	3.72	37.23
VOC	902	0.63	1.06	2.56	4.27
				(normal operation)	(normal operation)

Method used to determine entering emissions:

- ☐ stack test ☒ vendor data ☒ emission factor ☐ material balance
☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: 100% Verified by: ☐ test ☒ calculations
2. Control Efficiency: 90 (CO) 40 (VOC) % Verified by: ☐ test ☒ calculations
3. Normal Operating Conditions (*supply the following data as applicable*)

<u>253,724</u> Total gas volume through unit (acfm)	<u>902</u> Temperature (°F)	Percent Carbon Dioxide (CO ₂)
Voltage	Spark Rate	Milliamps
Pressure Drop (inches of water)	Liquid Recycle Rate (gallons per minute)	

Device: _____

Page 4 of 4

Form
ARD-2

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NO _x	902	5.02	5.46	21.99	24.33
CO	902	0.85	0.92	3.72	18.82
VOC	902	0.58	0.63	2.56	2.88
SO ₂	902	0.53	0.57	2.32	2.32
PM _{10/2.5}	902	1.03	1.11	4.50	4.51

Method used to determine exiting emissions:

☐ stack test ☒ vendor data ☒ emission factor ☐ material balance

☒ other (specify): POTENTIAL EMISSIONS INCLUDES ALL
MODES OF OPERATION, NOT JUST NORMAL
OPERATION. ACTUAL EMISSIONS INCLUDES
ONLY NORMAL OPERATION.

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form
ARD-2



NEW HAMPSHIRE

NOV 19 2015

AIR RESOURCES DIVISION

Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – Complete a separate form for each device.

Device Description: Emergency Generator

Date Construction

Commenced: _____

Device Start-Up Date: _____

A. Boiler ☒ Not Applicable

Boiler Manufacturer

Boiler Model Number

Boiler Serial Number

Gross Heat Input Nameplate Rating (MMBtu/hr)

Burner Manufacturer

Burner Model Number

☐ gal/hr
☐ mmcf/hr
☐ ton/hr

Burner Serial Number

Potential Fuel Flow Rate

1. Type of Burner:

a. Solid Fuel:

- ☐ Cyclone
☐ Pulverized (☐ wet ☐ dry)
☐ Spreader Stoker
☐ Underfeed Stoker
☐ Overfeed Stoker
☐ Hand-Fired
☐ Fly Ash Re-injection
☐ Other (specify): _____

b. Liquid Fuel:

- ☐ Pressure Gun
☐ Rotary Cup
☐ Steam Atomization
☐ Air Atomization
☐ Other (specify): _____

c. Gaseous Fuel:

- ☐ Natural Gas
☐ Propane
☐ Other (specify): _____

2. Combustion Type:

- ☐ Tangential Firing ☐ Opposite End Firing ☐ Limited Excess Firing ☐ Flue Gas Recirculation
☐ Staged Combustion ☐ Biased Firing ☐ One End Only Firing
☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines

☐ Not Applicable

Caterpillar

Manufacturer

G3516C

Model Number

TBD

Serial Number

0.0161

Fuel Flow Rate

☐ gal/hr
☒ mmcf/hr

1,506

Engine Output Rating

☐ hp
☒ kW

Emergency Backup Power

Reason for Engine Use

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No (if yes, provide data for each stack)

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☒ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

1 _____

Stack ☒ Inside Diameter (ft) ☐ Exit Area (ft²)

11,703 _____

Exhaust Flow (acfm)

858 _____

Exhaust Temperature (°F)

20 _____

Discharge height above ground level (ft)

248.35 _____

Exhaust Velocity (ft/sec)

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

Tennessee Gas Pipeline Company

Supplier's Name

1001 Louisiana Street

Street

Houston

TX

77002

Town/City

State

Zip Code

Telephone Number

2. Fuel Additives:

Manufacturer's Name

Street

Town/City

State

Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information (List each fuel utilized by this device):

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
Natural		nil		1020	16.46	1.61
Gas				Btu/cf		mmcf/yr

B. Hours of Operation

Hours per day: 1 Days per year: 52

III. POLLUTION CONTROL EQUIPMENT ☒ **Not Applicable**

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- | | |
|---|---|
| ☐ baffled settling chamber | ☐ wide bodied cyclone |
| ☐ long cone cyclone | ☐ irrigated long cone cyclone |
| ☐ multiple cyclone (_____ inch diameter) | ☐ carbon absorption |
| ☐ electrostatic precipitator | ☐ irrigated electrostatic precipitator |
| ☐ spray tower | ☐ absorption tower |
| ☐ venturi scrubber | ☐ baghouse |
| ☐ afterburners (incineration) | ☐ packed tower/column |
| ☐ selective catalytic reduction | ☐ selective non-catalytic reduction |
| ☐ reburn | |
| ☐ other (specify): _____ | |

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)

Method used to determine entering emissions:

- ☐ stack test ☐ vendor data ☐ emission factor ☐ material balance
☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: _____ % Verified by: ☐ test ☐ calculations
2. Control Efficiency: _____ % Verified by: ☐ test ☐ calculations
3. Normal Operating Conditions (*supply the following data as applicable*)

_____ Total gas volume through unit (acfm)	_____ Temperature (°F)	_____ Percent Carbon Dioxide (CO ₂)
_____ Voltage	_____ Spark Rate	_____ Milliamps
_____ Pressure Drop (inches of water)	_____ Liquid Recycle Rate (gallons per minute)	

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NO _x	858	9.59	9.59	0.48	42.0
CO	858	19.18	19.18	0.96	84.0
VOC	858	4.80	4.80	0.24	21.0
PM _{10/2.5}	858	0.16	0.16	0.0082	0.72
SO ₂	858	0.01	0.01	0.0005	0.04

Method used to determine exiting emissions:

- ☐ stack test ☒ vendor data ☒ emission factor ☐ material balance
☒ other (specify): NSPS SUBPART JJJJ, TABLE 1

Appendix B

Emissions Calculations and Manufacturer Data

Market Path CS 4 - New Ipswich, NH
Compressor Station Emissions (ton/yr)

	Titan 130 #1	Titan 130 #2	Emergency Generator	Gas-Fired Heater	Storage Tank	Blowdown	Liquid Fugitives	Gas Fugitives	STATION TOTAL
NO _x	24.33	24.33	0.48	0.48	-	-	-	-	49.62
CO	18.82	18.82	0.96	1.11	-	-	-	-	39.72
VOC	2.88	2.88	0.24	0.62	0.10	0.75	0.83	0.24	8.53
PM, PM ₁₀ , PM _{2.5}	4.51	4.51	0.008	0.20	-	-	-	-	9.23
SO ₂	2.32	2.32	0.0005	0.012	-	-	-	-	4.66
Total HAPs	0.43	0.43	0.059	0.037	0.01	0.011	-	0.003	0.98
Formaldehyde (individual HAP)	0.30	0.30	0.043	0.0015	-	-	-	-	0.64

Market Path CS4 Compressor Station (New Ipswich, NH)
Solar Titan 130 Estimated Annual Emissions

Normal Operations

°F	ann. avg °F	
151.70	140.16	MMBtu/hr (LHV) Solar heat input at 100% load
168.39	155.58	MMBtu/hr (HHV) Using conversion of 1.11 HHV/LHV
164.53	152.02	mscf/hr fuel flow, based on Solar provided scf/min
	8,760	hours/year (not accounting for SU/SD, low temp. operation)
	1,332	mmcf/yr (= 152.02 mcf/hr * 8,760 hr/yr * mmcf/1000 mcf)

Pollutant	ppmdv @ 15% O2	lb/MMBtu	kg/MMBtu	maximum lb/hr ¹	ann. avg. lb/hr ²	annual ton/yr	Note(s)
NO _x	9			5.46	5.02	21.99	3.
CO	2.5			0.92	0.85	3.72	4.
VOC	3.0			0.63	0.58	2.56	5.
PM, PM ₁₀ , PM _{2.5}		0.0066		1.11	1.03	4.50	6.
SO ₂		0.0034		0.57	0.53	2.32	7.
HAPs (total)		0.00062		0.10	0.10	0.42	7.
1,3-butadiene		2.58E-07		4.34E-05	4.01E-05	0.000176	7.
Acetaldehyde		2.40E-05		4.04E-03	3.73E-03	0.016354	7.
Acrolein		3.84E-06		6.47E-04	5.97E-04	0.002617	7.
Benzene		7.20E-06		1.21E-03	1.12E-03	0.004906	7.
Ethylbenzene		1.92E-05		3.23E-03	2.99E-03	0.013083	7.
Formaldehyde		4.26E-04		7.17E-02	6.63E-02	0.290289	7.
Naphthalene		7.80E-07		1.31E-04	1.21E-04	0.000532	7.
PAH		1.32E-06		2.22E-04	2.05E-04	0.000899	7.
Propylene Oxide		1.74E-05		2.93E-03	2.71E-03	0.011857	7.
Toluene		7.80E-05		1.31E-02	1.21E-02	0.053152	7.
Xylenes		3.84E-05		6.47E-03	5.97E-03	0.026167	7.

Notes

1. Maximum based on HHV heat input operating at 100% load and 0°F.
2. Annual average based on HHV heat input operating at 100% load and annual average temp.
3. NO _x based on Solar provided information.
4. CO based on Solar provided emissions data with 90% control from oxidation catalyst.
5. VOC based on Solar provided emissions data as 20% of UHC is VOC per PIL 168 (rev.4). Includes 40% control from oxidation catalyst.
6. PM, PM ₁₀ and PM _{2.5} lb/MMBtu based on AP-42 Table 3.1-2a. Includes condensable emissions.
7. SO ₂ and individual HAPs based on AP-42 Section 3.1. Individual HAP emission factors include 40% control from oxidation catalyst.

Market Path CS4 Compressor Station (New Ipswich, NH)
Solar Titan 130 Estimated Annual Emissions

Startup/Shutdown Operations

Number	150	su/sd / yr (per turbine)
Hours/yr	50.0	using 20 min for a SU/SD cycle

Pollutant	Startup lb/SU	Shutdown lb/SD	Total lbs per SU/SD cycle	ton/yr	Note(s)
NO _x	1.9	2.4	4.30	0.32	1.
CO	176.9	20.8	197.66	14.82	1.
VOC	2.02	1.43	3.45	0.26	2.
PM, PM ₁₀ , PM _{2.5}	0.19	0.19	0.37	0.03	3.
SO ₂	0.10	0.10	0.19	0.01	3.
HAPs (total)	2.88E-02	1.73E-02	4.61E-02	3.46E-03	3.
1,3-butadiene	1.21E-05	7.24E-06	1.93E-05	1.45E-06	3.
Acetaldehyde	1.12E-03	6.74E-04	1.80E-03	1.35E-04	3.
Acrolein	1.80E-04	1.08E-04	2.87E-04	2.16E-05	3.
Benzene	3.37E-04	2.02E-04	5.39E-04	4.04E-05	3.
Ethylbenzene	8.98E-04	5.39E-04	1.44E-03	1.08E-04	3.
Formaldehyde	1.99E-02	1.20E-02	3.19E-02	2.39E-03	3.
Naphthalene	3.65E-05	2.19E-05	5.84E-05	4.38E-06	3.
PAH	6.17E-05	3.70E-05	9.88E-05	7.41E-06	3.
Propylene Oxide	8.14E-04	4.88E-04	1.30E-03	9.77E-05	3.
Toluene	3.65E-03	2.19E-03	5.84E-03	4.38E-04	3.
Xylenes	1.80E-03	1.08E-03	2.87E-03	2.16E-04	3.

Notes:

1. NO_x, CO, and UHC startup and shutdown emissions are from Solar PIL 170, rev. 5. CO during shutdown includes 90% control from oxidation catalyst.
2. During startup and shutdown, VOC emissions are based on 20% of UHC emissions. Shutdown includes 40% control of VOC emissions from oxidation catalyst.
3. SO₂, PM, PM₁₀, PM_{2.5}, and HAP emissions during startup and shutdown based on maximum lb/hr emissions and operation of 10 minutes for each of startup and shutdown (20 minutes for SU/SD cycle). HAPs during shutdown include 40% control from oxidation catalyst.

Market Path CS4 Compressor Station (New Ipswich, NH)
Solar Titan 130 Estimated Annual Emissions

Below Zero Operation (< 0°F)

154.15 MMBtu/hr (LHV) Solar heat input at 100% load and -10°F
171.11 MMBtu/hr (HHV) Using conversion of 1.11 HHV/LHV
200 hours/year (estimated use)

Pollutant	ppmdv @ 15% O2	lb/MMBtu	kg/MMBtu	lb/hr	ton/yr	Note(s)
NO _x	42	0.155		26.47	2.65	1.
CO	10	0.022		3.83	0.38	2.
VOC	6	0.008		1.32	0.13	3.
PM, PM ₁₀ , PM _{2.5}		0.0066		1.13	0.113	4.
SO ₂		0.0034		0.58	0.0582	5.
HAPs (total)		1.03E-03		1.76E-01	0.018	5.
1,3-butadiene		4.30E-07		7.36E-05	7.36E-06	5.
Acetaldehyde		4.00E-05		6.84E-03	6.84E-04	5.
Acrolein		6.40E-06		1.10E-03	1.10E-04	5.
Benzene		1.20E-05		2.05E-03	2.05E-04	5.
Ethylbenzene		3.20E-05		5.48E-03	5.48E-04	5.
Formaldehyde		7.10E-04		1.21E-01	1.21E-02	5.
Naphthalene		1.30E-06		2.22E-04	2.22E-05	5.
PAH		2.20E-06		3.76E-04	3.76E-05	5.
Propylene Oxide		2.90E-05		4.96E-03	4.96E-04	5.
Toluene		1.30E-04		2.22E-02	2.22E-03	5.
Xylenes		6.40E-05		1.10E-02	1.10E-03	5.

Notes

1. NO _x based on Solar PIL 167 Rev 4, Table 1 for less than zero degree operation (42 ppm), hourly emissions calculated from EPA Method 19. $\text{NO}_x \text{ lb/hr} = \text{ppm NO}_x * (8710 \text{ dscf/MMBtu} * 1.194\text{e-}07 * (20.9/(20.9-15)) * \text{MMBtu/hr}$
2. CO based on Solar PIL 167 Rev 4, Table 1 for less than zero degree operation (100 ppm), hourly emissions calculated from EPA Method 19 derived by molecular weight. Includes 40% control from oxidation catalyst. $\text{CO lb/hr} = (\text{ppm CO}/1,000,000) * (8710 \text{ dscf/MMBtu} * (28.01/385.6) * (20.9/(20.9-15))) * (1-0.9) * \text{MMBtu/hr}$
3. VOC based on Solar PIL 167 Rev 4, Table 1 for less than zero degree operation, hourly emissions calculated from EPA Method 19 derived by molecular weight (used VOC as CH ₄). VOC based on Solar provided emissions data as 20% of UHC per PIL 168 (rev.4). UHC is 50 ppm from Solar PIL 167 Rev 4, Table 1. $\text{VOC lb/MMBtu} = (\text{ppm VOC}/1,000,000) * (8710 \text{ dscf/MMBtu} * (16.05/385.6) * (20.9/(20.9-15))) * (1-0.4)$
4. PN, PM ₁₀ and PM _{2.5} lb/MMBtu based on AP-42 Table 3.1-2a. Includes condensable emissions.
5. SO ₂ and individual HAPs based on AP-42 Section 3.1.

Market Path CS4 Compressor Station (New Ipswich, NH)
Solar Titan 130 Estimated Annual Emissions

Summary of Scenarios

Scenario	Normal	SU/SD	Below 0°F	Total
Hours	8510	50	200	8760
Pollutant	ton/yr	ton/yr	ton/yr	ton/yr
NO _x	21.36	0.32	2.65	24.33
CO	3.62	14.82	0.38	18.82
VOC	2.49	0.26	0.13	2.88
PM, PM ₁₀ , PM _{2.5}	4.37	0.03	0.11	4.51
SO ₂	2.25	0.01	0.06	2.32
HAPs (total)	0.408	0.003	0.018	0.429
1,3-butadiene	1.71E-04	1.45E-06	7.36E-06	1.80E-04
Acetaldehyde	1.59E-02	1.35E-04	6.84E-04	1.67E-02
Acrolein	2.54E-03	2.16E-05	1.10E-04	2.67E-03
Benzene	4.77E-03	4.04E-05	2.05E-04	5.01E-03
Ethylbenzene	1.27E-02	1.08E-04	5.48E-04	1.34E-02
Formaldehyde	2.82E-01	2.39E-03	1.21E-02	2.97E-01
Naphthalene	5.16E-04	4.38E-06	2.22E-05	5.43E-04
PAH	8.74E-04	7.41E-06	3.76E-05	9.19E-04
Propylene Oxide	1.15E-02	9.77E-05	4.96E-04	1.21E-02
Toluene	5.16E-02	4.38E-04	2.22E-03	5.43E-02
Xylenes	2.54E-02	2.16E-04	1.10E-03	2.67E-02

Worst Case		Normal @ 8,760 hrs ton/yr	Above Scenario ton/yr	Worst Case ton/yr emissions for Permitting (per turbine)	
Pollutant					
NO _x	21.99	24.33	24.33	Composite Scenario	
CO	3.72	18.82	18.82	Composite Scenario	
VOC	2.56	2.88	2.88	Composite Scenario	
PM, PM ₁₀ , PM _{2.5}	4.50	4.51	4.51	Composite Scenario	
SO ₂	2.32	2.32	2.32	Composite Scenario	
HAPs (total)	0.42	0.43	0.43	Composite Scenario	
1,3-butadiene	1.76E-04	1.80E-04	1.80E-04	Composite Scenario	
Acetaldehyde	1.64E-02	1.67E-02	1.67E-02	Composite Scenario	
Acrolein	2.62E-03	2.67E-03	2.67E-03	Composite Scenario	
Benzene	4.91E-03	5.01E-03	5.01E-03	Composite Scenario	
Ethylbenzene	1.31E-02	1.34E-02	1.34E-02	Composite Scenario	
Formaldehyde	2.90E-01	2.97E-01	2.97E-01	Composite Scenario	
Naphthalene	5.32E-04	5.43E-04	5.43E-04	Composite Scenario	
PAH	8.99E-04	9.19E-04	9.19E-04	Composite Scenario	
Propylene Oxide	1.19E-02	1.21E-02	1.21E-02	Composite Scenario	
Toluene	5.32E-02	5.43E-02	5.43E-02	Composite Scenario	
Xylenes	2.62E-02	2.67E-02	2.67E-02	Composite Scenario	

Market Path CS 4 - New Ipswich, NH

Caterpillar G3516C

4-stroke lean burn emergency engine

1506 kW_e

2175 bhp

16140 cf/hr

6705 Btu/bhp-hr (LHV)

16.46 MMBtu/hr

1.61 MMcf/yr

100 hr/yr

	g/hp-hr	lb/MMBtu	kg/MMBtu	lb/hr	ton/yr
NO _x	2.0			9.59	0.48
CO	4.0			19.18	0.96
VOC	1.0			4.80	0.24
PM, PM ₁₀ , PM _{2.5}		1.0E-02		0.16	0.008
SO ₂		5.9E-04		0.010	0.0005
Total HAPs		7.22E-02		1.19	0.059
1,1,2,2-Tetrachloroethane		4.00E-05		6.59E-04	3.29E-05
1,1,2-Trichloroethane		3.18E-05		5.24E-04	2.62E-05
1,3-Butadiene		2.67E-04		4.40E-03	2.20E-04
1,3-Dichloropropene		2.64E-05		4.35E-04	2.17E-05
2-Methylnaphthalene		3.32E-05		5.47E-04	2.73E-05
2,2,4-Trimethylpentane		2.50E-04		4.12E-03	2.06E-04
Acenaphthene		1.25E-06		2.06E-05	1.03E-06
Acenaphthylene		5.53E-06		9.10E-05	4.55E-06
Acetaldehyde		8.36E-03		1.38E-01	6.88E-03
Acrolein		5.14E-03		8.46E-02	4.23E-03
Benzene		4.40E-04		7.24E-03	3.62E-04
Benzo(b)fluoranthene		1.66E-07		2.73E-06	1.37E-07
Benzo(e)pyrene		4.15E-07		6.83E-06	3.42E-07
Benzo(g,h,i)perylene		4.14E-07		6.82E-06	3.41E-07
Biphenyl		2.12E-04		3.49E-03	1.75E-04
Carbon Tetrachloride		3.67E-05		6.04E-04	3.02E-05
Chlorobenzene		3.04E-05		5.00E-04	2.50E-05
Chloroform		2.85E-05		4.69E-04	2.35E-05
Chrysene		6.93E-07		1.14E-05	5.70E-07
Ethylbenzene		3.97E-05		6.54E-04	3.27E-05
Ethylene Dibromide		4.43E-05		7.29E-04	3.65E-05
Fluoranthene		1.11E-06		1.83E-05	9.14E-07
Fluorene		5.67E-06		9.33E-05	4.67E-06
Formaldehyde		5.28E-02		8.69E-01	4.346E-02
Methanol		2.50E-03		4.12E-02	2.06E-03
Methylene Chloride		2.00E-05		3.29E-04	1.65E-05
n-Hexane		1.11E-03		1.83E-02	9.14E-04
Naphthalene		7.44E-05		1.22E-03	6.12E-05
PAH		2.69E-05		4.43E-04	2.21E-05
Phenanthrene		1.04E-05		1.71E-04	8.56E-06
Phenol		2.40E-05		3.95E-04	1.98E-05
Pyrene		1.36E-06		2.24E-05	1.12E-06
Styrene		2.36E-05		3.89E-04	1.94E-05
Tetrachloroethane		2.48E-06		4.08E-05	2.04E-06
Toluene		4.08E-04		6.72E-03	3.36E-04
Vinyl Chloride		1.49E-05		2.45E-04	1.23E-05
Xylene		1.84E-04		3.03E-03	1.51E-04

NO_x, CO, VOC based on NSPS Subpart JJJJ, Table 1

SO₂, particulates, HAPs based on AP-42 Table 3.2-2

Annual emissions based on 100 hours per year of annual operation

Market Path CS 4 - New Ipswich, NH
Parker Boiler - Gas-Fired Heater

4.60 MMBtu/hr heat input	8,760 hours/year	1020 MMBtu/MMscf
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	lb/MMscf	lb/MMBtu	kg/MMBtu	lb/hr	ton/yr
NO _x		0.024		0.11	0.48
CO		0.0552		0.25	1.11
VOC		0.031		0.143	0.62
PM, PM ₁₀ , PM _{2.5}		0.01		0.046	0.20
SO ₂	0.60	5.88E-04		0.0027	0.012
Total HAPs	1.89E+00	1.85E-03		8.51E-03	0.037
2-Methylnaphthalene	2.40E-05	2.35E-08		1.08E-07	4.74E-07
3-Methylchloranthrene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.57E-08		7.22E-08	3.16E-07
Acenaphthene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
Acenaphthylene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
Anthracene	2.40E-06	2.35E-09		1.08E-08	4.74E-08
Benz(a)anthracene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
Benzene	2.10E-03	2.06E-06		9.47E-06	4.15E-05
Benzo(a)pyrene	1.20E-06	1.18E-09		5.41E-09	2.37E-08
Benzo(b)fluoranthene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
Benzo(g,h,i)perylene	1.20E-06	1.18E-09		5.41E-09	2.37E-08
Benzo(k)fluoranthene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
Chrysene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
Dibenzo(a,h)anthracene	1.20E-06	1.18E-09		5.41E-09	2.37E-08
Dichlorobenzene	1.20E-03	1.18E-06		5.41E-06	2.37E-05
Fluoranthene	3.00E-06	2.94E-09		1.35E-08	5.93E-08
Fluorene	2.80E-06	2.75E-09		1.26E-08	5.53E-08
Formaldehyde	7.50E-02	7.35E-05		3.38E-04	1.48E-03
Hexane	1.80	1.76E-03		0.0081	0.0356
Indeno(1,2,3-cd)pyrene	1.80E-06	1.76E-09		8.12E-09	3.56E-08
Naphthalene	6.10E-04	5.98E-07		2.75E-06	1.20E-05
Phenanthrene	1.70E-05	1.67E-08		7.67E-08	3.36E-07
Pyrene	5.00E-06	4.90E-09		2.25E-08	9.88E-08
Toluene	3.40E-03	3.33E-06		1.53E-05	6.72E-05
Arsenic	2.00E-04	1.96E-07		9.02E-07	3.95E-06
Beryllium	1.20E-05	1.18E-08		5.41E-08	2.37E-07
Cadmium	1.10E-03	1.08E-06		4.96E-06	2.17E-05
Chromium	1.40E-03	1.37E-06		6.31E-06	2.77E-05
Cobalt	8.40E-05	8.24E-08		3.79E-07	1.66E-06
Manganese	3.80E-04	3.73E-07		1.71E-06	7.51E-06
Mercury	2.60E-04	2.55E-07		1.17E-06	5.14E-06
Nickel	2.10E-03	2.06E-06		9.47E-06	4.15E-05
Selenium	2.40E-05	2.35E-08		1.08E-07	4.74E-07

NO_x, CO, VOC, particulates based on Manufacturer provided information

SO₂ based on AP-42 Table 1.4-2, HAPs based on AP-42 Table 1.4-3

NED Compressor Station
Calculation of liquid service fugitive emissions

type of fugitive source	Number of sources	type of service ¹	kg gas/hr/ source ²	lb VOC/hr/ source	lb VOC/hr	ton VOC/yr
Connectors	160	Heavy Oil	7.50E-06	1.65E-05	0.003	0.012
Flanges	100	Heavy Oil	3.90E-07	8.60E-07	0.000	0.000
Valves	50	Heavy Oil	8.40E-06	1.85E-05	0.001	0.004
Pump Seals	4	Heavy Oil	2.10E-02	4.63E-02	0.185	0.811
Total					0.189	0.827

1. Heavy Oil service used for turbine lube oil and gas-fired heater heat transfer fluid

2. EPA Protocol for Equipment Leaks Emissions Estimate (EPA-453/R-95-017)

Connectors/Flanges/Valves: Table 2-4: Oil and Gas Production Operations Average Emission Factor

Pump Seals: Table 2-2: Refinery Average Emission Factor (no factor is listed in Table 2-4 for heavy oil service)

Calculations

Source-specific emission rate = lb /hr/source * 100% VOC in liquid

Hourly emission rate = lb /hr/source * 100% VOC in liquid * number of sources

Annual tpy emissions = lb /hr/source * 100% VOC in liquid * number of sources * 8,760 hr/yr / 2,000 lb/ton

Market Path CS 4 - New Ipswich, NH
Calculation of natural gas fugitive and vented emissions

Gas Service Fugitive

type of fugitive source	Number of sources ¹	type of service	lb gas/hr/ source ²	lb VOC/hr/ source	lb VOC/hr ton VOC/yr	lb HAPs/hr/ source	lb HAP/hr	ton HAP/yr
Connectors	3,309	Gas Service	4.41E-04	2.27E-06	0.007	0.033	0.000	0.000
Flanges	676	Gas Service	8.60E-04	4.42E-06	0.003	0.013	6.47E-08	0.000
Others	96	Gas Service	1.94E-02	9.97E-05	0.010	0.042	1.46E-06	0.001
Valves	657	Gas Service	9.92E-03	5.10E-05	0.033	0.147	7.46E-07	0.002
Open Ended Lines	26	Gas Service	4.41E-03	2.27E-05	0.001	0.003	3.32E-07	0.000
Total					0.054	0.237	0.001	0.003

Individual HAPs

type of fugitive source	Number of sources ¹	type of service	lb gas/hr/ source ²	lb n-hexane/hr/ source	lb n-hexane/hr ton n-hexane/yr	lb benzene/hr/ source	lb benzene/hr ton benzene/yr	lb toluene/hr/ source	lb toluene/hr ton toluene/yr
Connectors	3,309	Gas Service	4.41E-04	2.84E-08	9.40E-05	4.12E-04	3.13E-09	1.04E-05	4.54E-05
Flanges	676	Gas Service	8.60E-04	5.54E-08	3.74E-05	1.64E-04	6.11E-09	1.32E-05	5.79E-05
Others	96	Gas Service	1.94E-02	1.25E-06	1.20E-04	5.23E-04	1.38E-07	4.13E-06	1.81E-05
Valves	657	Gas Service	9.92E-03	6.39E-07	4.20E-04	1.84E-03	7.04E-08	4.63E-05	2.03E-04
Open Ended Lines	26	Gas Service	4.41E-03	2.84E-07	7.38E-06	3.23E-05	3.13E-08	8.14E-07	3.57E-06
Total					6.79E-04	2.97E-03	7.48E-05	3.28E-04	1.72E-04

1. Source counts based on similar design of another TGP compressor station

2. EPA Protocol for Equipment Leaks Emissions Estimate (EPA-453/R-95-017) table 2-4; Oil and Gas Production Operations Average Emission Factor

Calculations

Source-specific emission rate = lb gas/hr/source * wt% of component in natural gas

Hourly emission rate = lb gas/hr/source * wt% of component in natural gas * number of sources

Annual tpy emissions = lb gas/hr/source * wt% of component in natural gas * number of sources * 8,760 hr/yr / 2,000 lb/ton

Vented Compressor Blowdowns

Short-term Emissions

713 actual cf/blowdown
 44,431 scf/blowdown = 713 acf/blowdown * (1007.7 psia / 14.7 psia) * (519.679R / 571.679R)
 1 blowdown/day/compressor @ < 1 min/blowdown
 1939.020 lb/compressor/day = 44431 scf/blowdown * 0.0436 lb/scf
 2 compressors
 3878.041 lb/day = 1939.02 lb/compressor/day * 2 compressors
 19.926 lb VOC/day = 3878.041 lb/day * 0.5138 wt. % VOC
 0.292 lb HAPs/day = 3878.041 lb/day * 0.0075 wt. % HAP

Annual Emissions

713 actual cf/compressor blowdown
 75 blowdowns/year
 2 compressors
 106,950 acf/yr = 713 acf/compressor blowdown * 75 blowdowns/yr * 2 compressors
 6,664,644 scf/yr = 106950 acf/yr * (1007.7 psia / 14.7 psia) * (519.679R / 571.679R)
 145,426 ton/yr = 6664644 scf/yr * 0.0436 lb/scf / 2000 lb/ton

0.747 ton VOC/yr = 145,426 ton/yr * 0.5138 wt. % VOC
 0.011 ton/yr HAPs/yr = 145,426 ton/yr * 0.0075 wt. % HAPs
 6.83 lb/yr 2,2-dimethylbutane = 145,426 ton/yr * 0.0023 wt. % 2,2-dimethylbutane
 20.76 lb/yr 2-methyl Pentane = 145,426 ton/yr * 0.0071 wt. % 2-methyl Pentane
 9.11 lb/yr 3-methyl Pentane = 145,426 ton/yr * 0.0031 wt. % 3-methyl Pentane
 18.73 lb/yr n-Hexane = 145,426 ton/yr * 0.0064 wt. % n-Hexane
 2.07 lb/yr Benzene = 145,426 ton/yr * 0.0007 wt. % Benzene
 5.30 lb/yr 2-methyl hexane = 145,426 ton/yr * 0.0018 wt. % 2-methyl hexane
 1.77 lb/yr 2,3-dimethyl pentane = 145,426 ton/yr * 0.0006 wt. % 2,3-dimethyl pentane
 6.18 lb/yr 3-methyl hexane = 145,426 ton/yr * 0.0021 wt. % 3-methyl hexane
 6.77 lb/yr n-Heptane = 145,426 ton/yr * 0.0023 wt. % n-Heptane
 1.08 lb/yr Toluene = 145,426 ton/yr * 0.0004 wt. % Toluene

0.09 lb/day 2,2-dimethylbutane = 3878.041 lb/day * 0.0023 wt. % 2,2-dimethylbutane
 0.28 lb/day 2-methyl Pentane = 3878.041 lb/day * 0.0071 wt. % 2-methyl Pentane
 0.12 lb/day 3-methyl Pentane = 3878.041 lb/day * 0.0031 wt. % 3-methyl Pentane
 0.25 lb/day n-Hexane = 3878.041 lb/day * 0.0064 wt. % n-Hexane
 0.028 lb/day Benzene = 3878.041 lb/day * 0.0007 wt. % Benzene
 0.07 lb/day 2-methyl hexane = 3878.041 lb/day * 0.0018 wt. % 2-methyl hexane
 0.02 lb/day 2,3-dimethyl pentane = 3878.041 lb/day * 0.0006 wt. % 2,3-dimethyl pentane
 0.08 lb/day 3-methyl hexane = 3878.041 lb/day * 0.0021 wt. % 3-methyl hexane
 0.09 lb/day n-Heptane = 3878.041 lb/day * 0.0023 wt. % n-Heptane
 0.01 lb/day Toluene = 3878.041 lb/day * 0.0004 wt. % Toluene

actual conditions	standard conditions
993 psig	0 psig
1007.7 psia	14.7 psia
112 °F	60 °F
571.67 °R	519.67 °R

Calculation of compressor blowdown from acf to scf based on ideal gas law

$$V_{std} = V_{act} * (P_{act} / P_{std}) * (T_{std} / T_{act})$$

Compressor Blowdown Env-A 1400 RTAP DeMinimis Evaluation

	project lb/day	24-hr de minimis lb/day	project lb/yr	annual de minimis lbs/yr
2,2-dimethylbutane (hexane other than n-hexane)	0.09	11	6.8	3838
2-methylpentane (hexane other than n-hexane)	0.28	11	20.8	3838
3-methylpentane (hexane other than n-hexane)	0.12	11	9.1	3838
n-hexane	0.25	11	18.7	3838
benzene	0.028	0.068	2.1	25
2-methylhexane (isomer of heptane)	0.07	98	5.3	35771
2,3-dimethylpentane (isomer of heptane)	0.02	98	1.8	35771
3-methylhexane (isomer of heptane)	0.08	98	6.2	35771
heptane	0.09	98	6.8	35771
toluene	0.01	59	1.1	21682

Representative Gas Analysis

	Mol %	M.W.	lb/lb-mol NG	Mass %		Federal HAPs	Env-A 1400 RTAPs
Helium	0.02337%	4.0026	0.00094	0.0057%			
Hydrogen	0.01927%	2.0158	0.00039	0.0024%			
Nitrogen	0.41907%	28.0135	0.11740	0.7114%			
Methane	96.84615%	16.0428	15.53680	94.1517%			
CO2	0.02995%	44.0098	0.01318	0.0799%			
Ethane	2.48888%	30.0696	0.74840	4.5352%	non-VOC		
Propane	0.13313%	44.0965	0.05871	0.3558%	VOC		
i-Butane	0.01042%	58.1234	0.00605	0.0367%			
n-Butane	0.01643%	58.1234	0.00955	0.0579%			
i-Pentane	0.00463%	72.1503	0.00334	0.0203%			
n-Pentane	0.00327%	72.1503	0.00236	0.0143%			
2,2-dimethylbutane	0.00045%	86.1754	0.00039	0.0023%			0.0023% RTAP
2-methyl Pentane	0.00137%	86.1754	0.00118	0.0071%			0.0071% RTAP
3-methyl Pentane	0.00060%	86.1754	0.00052	0.0031%			0.0031% RTAP
n-Hexane	0.00123%	86.1754	0.00106	0.0064%		0.0064% HAP	0.0064% RTAP
MCY Pentane	0.00020%	84.1595	0.00017	0.0010%			
Benzene	0.00015%	78.1118	0.00012	0.0007%		0.0007% HAP	0.0007% RTAP
2-methyl hexane	0.00030%	100.2019	0.00030	0.0018%			0.0018% RTAP
2,3-dimethyl pentane	0.00010%	100.2019	0.00010	0.0006%			0.0006% RTAP
3-methyl hexane	0.00035%	100.2019	0.00035	0.0021%			0.0021% RTAP
n-Heptane	0.00038%	100.2019	0.00038	0.0023%			0.0023% RTAP
MCY C6/2,2 DM C6	0.00015%	98.1861	0.00015	0.0009%			
Toluene	0.00007%	92.1384	0.00006	0.0004%		0.0004% HAP	0.0004% RTAP
	100.000%		16.502	100.000%		0.0075% HAPs	0.0270% RTAPs

2,2-dimethylbutane
2-methyl Pentane
3-methyl Pentane
n-Hexane
Benzene
2-methyl hexane
2,3-dimethyl pentane
3-methyl hexane
n-Heptane
Toluene

Avg. Relative Density 0.5707 same as specific gravity
lb/scf 0.0436 = 0.5707 * 1.225 kg/m3 * 2.2046 lb/kg / 35.31467 cf/m3

1.225 kg/m3, used for conversion from specific gravity to lb/scf based on the international standard atmosphere

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	MidStation4_Tank1
City:	New Ipswich
State:	New Hampshire
Company:	TGP
Type of Tank:	Vertical Fixed Roof Tank
Description:	

Tank Dimensions

Shell Height (ft):	10.00
Diameter (ft):	8.00
Liquid Height (ft):	8.00
Avg. Liquid Height (ft):	6.00
Volume (gallons):	3,000.00
Turnovers:	1.00
Net Throughput(gal/yr):	3,000.00
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft)	0.00
Slope (ft/ft) (Cone Roof)	0.06

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meteorological Data used in Emissions Calculations: Concord, New Hampshire (Avg Atmospheric Pressure = 14.54 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

MidStation4_Tank1 - Vertical Fixed Roof Tank
New Ipswich, New Hampshire

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Gasoline (RVP 7.8)	Jan	34.24	29.49	38.99	45.08	2.2817	2.0510	2.5333	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Feb	36.00	30.86	41.13	45.08	2.3723	2.1156	2.6538	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Mar	41.17	35.98	46.36	45.08	2.6561	2.3716	2.9679	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Apr	46.57	40.33	52.82	45.08	2.9812	2.6078	3.3969	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	May	51.90	44.83	58.97	45.08	3.3327	2.8730	3.8504	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Jun	56.10	49.11	63.09	45.08	3.6334	3.1447	4.1818	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Jul	58.38	51.43	65.33	45.08	3.8054	3.3008	4.3706	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Aug	57.09	50.57	63.61	45.08	3.7073	3.2423	4.2250	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Sep	52.90	46.71	59.08	45.08	3.4022	2.9899	3.8594	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Oct	47.51	41.77	53.26	45.08	3.0410	2.6908	3.4275	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Nov	42.31	38.02	46.61	45.08	2.7223	2.4799	2.9838	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3
Gasoline (RVP 7.8)	Dec	36.58	32.45	40.71	45.08	2.4029	2.1922	2.6297	68.0000			92.00	Option 4: RVP=7.8, ASTM Slope=3

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

MidStation4_Tank1 - Vertical Fixed Roof Tank
New Ipswich, New Hampshire

Month:	January	February	March	April	May	June	July	August	September	October	November	December
Standing Losses (lb):	9.0919	9.2980	11.7517	15.7017	20.9189	22.1239	23.9889	21.7681	18.0383	15.1802	9.5614	8.2724
Vapor Space Volume (cu ft):	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507
Vapor Density (lb/cu ft):	0.0293	0.0303	0.0336	0.0373	0.0413	0.0446	0.0465	0.0455	0.0421	0.0380	0.0344	0.0307
Vapor Space Expansion Factor:	0.0729	0.0807	0.0866	0.1124	0.1371	0.1438	0.1477	0.1356	0.1209	0.1041	0.0718	0.0644
Vented Vapor Saturation Factor:	0.6694	0.6608	0.6350	0.6078	0.5810	0.5598	0.5484	0.5548	0.5759	0.6031	0.6293	0.6579
Tank Vapor Space Volume:												
Vapor Space Volume (cu ft):	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507	205.2507
Tank Diameter (ft):	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000
Vapor Space Outage (ft):	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833
Tank Shell Height (ft):	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000
Average Liquid Height (ft):	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000	6.0000
Roof Outage (ft):	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833
Roof Outage (Cone Roof):												
Roof Outage (ft):	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833
Roof Height (ft):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Roof Slope (ft/ft):	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Shell Radius (ft):	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
Vapor Density:												
Vapor Density (lb/cu ft):	0.0293	0.0303	0.0336	0.0373	0.0413	0.0446	0.0465	0.0455	0.0421	0.0380	0.0344	0.0307
Vapor Molecular Weight (lb/lb-mole):	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	2.2817	2.3723	2.6561	2.9812	3.3327	3.6334	3.8054	3.7073	3.4022	3.0410	2.7223	2.4029
Daily Avg. Liquid Surface Temp. (deg. R):	493.9096	495.6669	500.8426	506.2432	511.5685	515.7728	518.0523	516.7634	512.5661	507.1845	501.9845	496.2480
Daily Average Ambient Temp. (deg. F):	18.6000	21.7000	32.4500	43.9000	55.1500	64.2500	69.4500	67.2500	58.8000	47.8000	37.0500	24.3000
Ideal Gas Constant R (psia cu ft / (lb-mol-deg R)):	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731
Liquid Bulk Temperature (deg. R):	504.7483	504.7483	504.7483	504.7483	504.7483	504.7483	504.7483	504.7483	504.7483	504.7483	504.7483	504.7483
Tank Paint Solar Absorptance (Shell):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Tank Paint Solar Absorptance (Roof):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Daily Total Solar Insolation Factor (Btu/sq ft day):	604.3994	897.2396	1,229.1040	1,499.1008	1,778.6156	1,927.7325	1,921.3871	1,682.4828	1,325.5541	922.3039	572.3551	478.1259
Vapor Space Expansion Factor:												
Vapor Space Expansion Factor:	0.0729	0.0807	0.0866	0.1124	0.1371	0.1438	0.1477	0.1356	0.1209	0.1041	0.0718	0.0644
Daily Vapor Temperature Range (deg. R):	19.0049	20.5429	20.7545	24.9917	28.2662	27.9680	27.7938	26.0806	24.7416	22.9662	17.1964	16.5319
Daily Vapor Pressure Range (psia):	0.4822	0.5382	0.5963	0.7891	0.9773	1.0370	1.0998	0.9827	0.8695	0.7368	0.5039	0.4375
Breather Vent Press. Setting Range (psia):	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	2.2817	2.3723	2.6561	2.9812	3.3327	3.6334	3.8054	3.7073	3.4022	3.0410	2.7223	2.4029
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	2.0510	2.1156	2.3716	2.6078	2.8730	3.1447	3.3008	3.2423	2.9899	2.6908	2.4799	2.1922
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	2.5333	2.6538	2.9679	3.3969	3.8504	4.1818	4.3706	4.2250	3.8594	3.4275	2.9838	2.6297
Daily Avg. Liquid Surface Temp. (deg. R):	493.9096	495.6669	500.8426	506.2432	511.5685	515.7728	518.0523	516.7634	512.5661	507.1845	501.9845	496.2480
Daily Min. Liquid Surface Temp. (deg. R):	489.1583	490.5311	495.6539	499.9952	504.5020	508.7808	511.1038	510.2433	506.3807	501.4430	497.6854	492.1150
Daily Max. Liquid Surface Temp. (deg. R):	498.6608	500.8026	506.0312	512.4911	518.6351	522.7648	525.0007	523.2836	518.7515	512.9261	506.2836	500.3810
Daily Ambient Temp. Range (deg. R):	22.4000	22.6000	20.7000	24.8000	27.5000	26.1000	25.9000	25.1000	25.6000	25.8000	20.1000	19.8000
Vented Vapor Saturation Factor:												
Vented Vapor Saturation Factor:	0.6694	0.6608	0.6350	0.6078	0.5810	0.5598	0.5484	0.5548	0.5759	0.6031	0.6293	0.6579
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	2.2817	2.3723	2.6561	2.9812	3.3327	3.6334	3.8054	3.7073	3.4022	3.0410	2.7223	2.4029
Vapor Space Outage (ft):	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833	4.0833
Working Losses (lb):												
Working Losses (lb):	0.9236	0.9602	1.0751	1.2067	1.3490	1.4707	1.5403	1.5006	1.3771	1.2309	1.1019	0.9726
Vapor Molecular Weight (lb/lb-mole):	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000	68.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	2.2817	2.3723	2.6561	2.9812	3.3327	3.6334	3.8054	3.7073	3.4022	3.0410	2.7223	2.4029
Net Throughput (gal/mo.):	250.0000	250.0000	250.0000	250.0000	250.0000	250.0000	250.0000	250.0000	250.0000	250.0000	250.0000	250.0000
Annual Turnovers:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Turnover Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Maximum Liquid Volume (gal):	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000	3,000.0000
Maximum Liquid Height (ft):	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000
Tank Diameter (ft):	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000
Working Loss Product Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total Losses (lb):	10.0155	10.2582	12.8268	16.9084	22.2679	23.5945	25.5272	23.2667	19.4153	16.4111	10.6633	9.2450

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: January, February, March, April, May, June, July, August, September, October, November, December

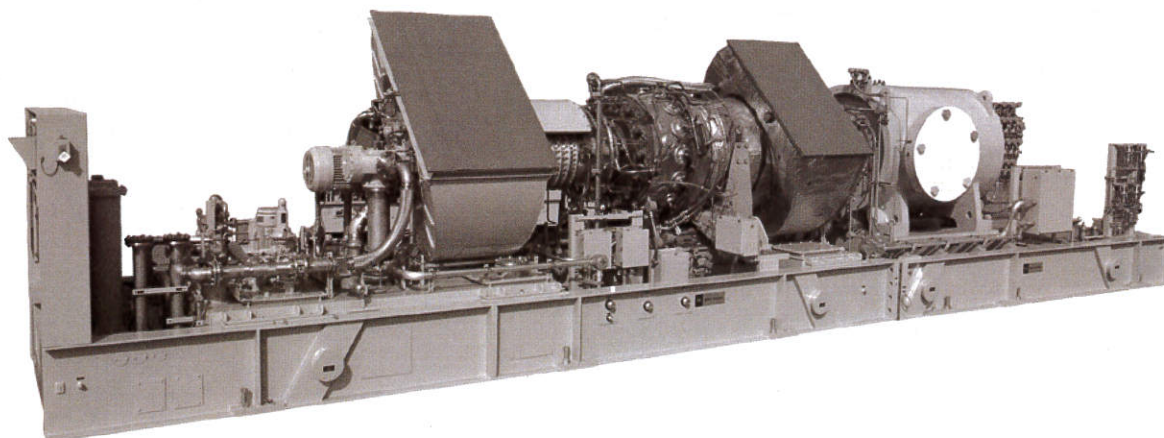
MidStation4_Tank1 - Vertical Fixed Roof Tank
New Ipswich, New Hampshire

Components	Losses(lbs)		
	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 7.8)	14.71	185.69	200.40

10% of storage tank emissions assumed to be HAPs (hexane)

$200.4 \text{ lb/yr} * 0.1 = 20.04 \text{ lb/yr hexane}$

Manufacturer's Information Solar Turbines



General Specifications

Titan™ 130 Gas Turbine

- Industrial, Two-Shaft
- Axial Compressor
 - 14-Stage
 - Variable Inlet Guide Vanes and Stators
 - Pressure Ratio: 16:1
 - Inlet Airflow: 47.4 kg/sec (105.2 lb/sec)
 - Vertically Split Case
- Combustion Chamber
 - Annular-Type, Conventional or Lean-Premixed, Dry, Low Emission (SoLoNOx™)
 - 21 Fuel Injectors (Conventional)
 - 14 Fuel Injectors (SoLoNOx)
 - Torch Ignitor System
- Gas Generator Turbine
 - 2-Stage, Reaction
 - Max. Speed: 11,220 rpm
 - Thrust Bearing, Active: Tilting-Pad
 - Thrust Bearing, Inactive: Fixed Tapered Land
- Power Turbine
 - 2-Stage, Reaction
 - Max. Speed: 8855 rpm
 - Full Tilting-Pad Thrust Bearing
- Journal Bearings
 - Tilting-Pad
- Coatings
 - Compressor: Inorganic Aluminum
 - Turbine and Nozzle Blades: Precious Metal Diffusion Aluminide
- Vibration Transducer Type
 - Proximity Probes

Key Package Features

- Driver Skid with Drip Pans
- Driven Equipment Skid
 - Multi-Stage Compressor Options, Single-Body or Tandem Compressor Configurations
 - Pipeline Compressor Options
 - Compressor Auxiliary Systems
- Compressors
- 316L Stainless Steel Piping $\leq 4"$ dia.
- Compression-Type Tube Fittings
- Electrical System Options
 - NEC, Class I, Group D, Div 1, or Div 2
 - ATEX, Zone 2
 - CENELEC, Zone 1
- *Turbotronic™* Microprocessor Control System
 - Onskid Control System (Div 2 or ATEX, Zone 2)
 - Freestanding Control Console
 - Color Video Display
 - Vibration Monitoring
- Control Options
 - 120-VDC Accessory Battery/Charger System
 - Gas Turbine and Package Temperature Monitoring
 - Serial Link Supervisory Interface
 - Turbine Performance Map
 - Compressor Performance Map
 - Historical Displays
 - Printer/Logger
 - Remote Monitoring and Diagnostics Option
 - Process Controls
 - Compressor Anti-Surge Control
 - Field Programming
 - Predictive Emissions Monitoring
- Start Systems
 - Pneumatic
 - Direct-Drive AC
- Natural Gas Fuel System
- Integrated Lube Oil System
 - Turbine-Driven Accessories
 - AC Motor-Driven Accessories
- Oil System Options
 - Oil Cooler
 - Oil Heater
 - Tank Vent Separator
 - Flame Trap
- Package Skid Design
 - Accommodates *Mars®* and *Titan* Turbines
 - Optional Modifications for Floating Production Applications
 - Drop-In Lube Oil Tank
 - Modularized System Design
- Axial Compressor Cleaning Systems
 - On-Crank
 - On-Crank/On-Line
 - Portable Cleaning Tank
- Gearbox (if applicable)
 - Speed Increaser
 - Speed Decreaser
- Air Inlet and Exhaust System Options (Carbon or Stainless Steel)
- Enclosure and Associated Options
- Factory Testing of Turbine and Package
- Documentation
 - Drawings
 - Quality Control Data Book
 - Inspection and Test Plan
 - Test Reports
 - Operation and Maintenance Manuals

Solar Turbines

A Caterpillar Company

TITAN 130

Gas Turbine Compressor Set

Oil & Gas Applications

Performance

Output Power	15 290 kW (20,500 hp)
Heat Rate	9940 kJ/kW-hr (7025 Btu/hp-hr)
Exhaust Flow	180 050 kg/hr (396,940 lb/hr)
Exhaust Temp.	505°C (940°F)

Nominal rating – per ISO
At 15°C (59°F), at sea level

No inlet/exhaust losses

Relative humidity 60%

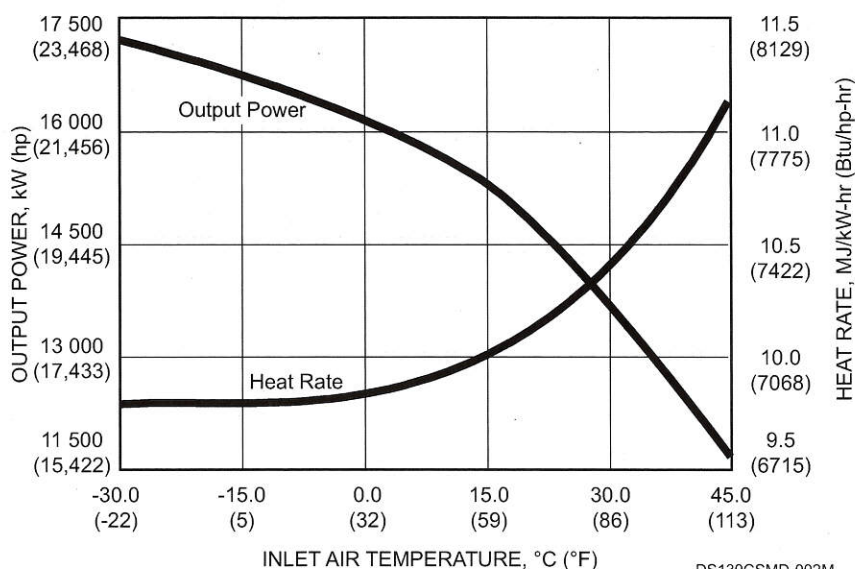
Natural gas fuel with
LHV = 35 MJ/nm³ (940 Btu/scf)

Optimum power turbine speed

AC-driven accessories

Engine efficiency: 36.2%

Available Power



DS130CSMD-002M

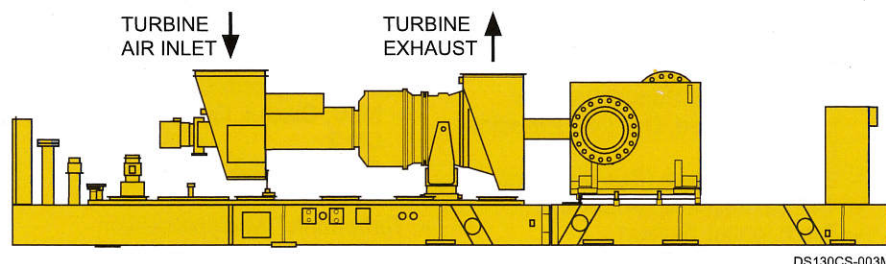
Package Dimensions*

Length: 9.8 m (32' 0")

Width: 3.1 m (10' 2")

Height: 3.2 m (10' 4")

Typical Weight: 38 555 kg (85,000 lb)



DS130CS-003M

*Driver package only

Solar Turbines Incorporated
P.O. Box 85376
San Diego, CA 92186-5376

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DS130CS/1109/EO

FOR MORE INFORMATION

Telephone: (+1) 619-544-5352
Internet: www.solarturbines.com



SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.16.1.18.10
JOB ID:

DATE RUN: 29-Sep-15
RUN BY: David A Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 1

HP=20893, %Full Load=100.0, Elev= 968ft, %RH= 60.0, Temperature= 0.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS

28.90	in Hg	AMBIENT PRESSURE
60.0	percent	RELATIVE HUMIDITY
0.0006	---	SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)

LHV (Btu/Scf) = 922.0 SG = 0.5672 W.I. @60F (Btu/Scf) = 1224.2

Methane (CH4)	= 97.3999
Ethane (C2H6)	= 2.1000
Propane (C3H8)	= 0.1000
Carbon Dioxide (CO2)	= 0.1000
Nitrogen (N2)	= 0.3000
Sulfur Dioxide (SO2)	= 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

!!! PLEASE, SUBMIT INQUIRY ON GAS FUEL SUITABILITY TO SAN DIEGO !!!

GENERAL OUTPUT DATA

7123.	lbm/hr	FUEL FLOW
2742.22	Scfm	FUEL FLOW
21297.	Btu/lbm	LOWER HEATING VALUE
922.	Btu/Scf	LOWER HEATING VALUE
93520.	Scfm	EXHAUST FLOW @ 14.7 PSIA & 60F
253724.	Acfm	ACTUAL EXHAUST FLOW CFm
422482.	lbm/hr	EXHAUST GAS FLOW
4610.6	deg R	ADIA STOICH FLAME TEMP, CHOICE GAS
4612.2	deg R	ADIA STOICH FLAME TEMP, SDNG
28.58	---	MOLECULAR WEIGHT OF EXHAUST GAS
58.52	---	AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2	
0.91	3.01	5.98	75.71	14.39	VOLUME PERCENT WET
0.96	3.20	0.00	80.53	15.31	VOLUME PERCENT DRY
5348.	19582.	15920.	313550.	68073.	lbm/hr
0.75	2.75	2.23	44.02	9.56	g/(g FUEL)

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.16.1.18.10
JOB ID:

DATE RUN: 29-Sep-15
RUN BY: David A Pocengal

NEW EQUIPMENT PREDICTED EMISSION PERFORMANCE
DATA FOR POINT NUMBER 1

Fuel: CHOICE GAS Customer:
Water Injection: NO Inquiry Number:
Model: TITAN 130-20502S CS/MD 59F MATCH GAS
Emissions Data: REV. 0.0

The following predicted emissions performance is based on the following specific single point:

HP=20893, %Full Load=100.0, Elev= 968ft, %RH= 60.0, Temperature= 0.0F

NOX	CO	UHC	
9.00	25.00	25.00	PPMvd at 15% O2
23.91	40.43	23.16	ton/yr
0.036	0.061	0.035	lbm/MMBtu (Fuel LHV)
0.35	0.59	0.34	lbm/(MW-hr)
			(gas turbine shaft pwr)
5.46	9.23	5.29	lbm/hr

NOTES:

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load or gas, fuel, and between 65% and 100% load for liquid fuel except for the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.16.1.18.10
JOB ID:

DATE RUN: 29-Sep-15
RUN BY: David A Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 2

HP=19767, %Full Load=100.0, Elev= 968ft, %RH= 60.0, Temperature= 48.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS
28.90 in Hg AMBIENT PRESSURE
60.0 percent RELATIVE HUMIDITY
0.0044 --- SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)

LHV (Btu/Scf) = 922.0 SG = 0.5672 W.I. @60F (Btu/Scf) = 1224.2

Methane (CH4) = 97.3999
Ethane (C2H6) = 2.1000
Propane (C3H8) = 0.1000
Carbon Dioxide (CO2) = 0.1000
Nitrogen (N2) = 0.3000
Sulfur Dioxide (SO2) = 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

!!! PLEASE, SUBMIT INQUIRY ON GAS FUEL SUITABILITY TO SAN DIEGO !!!

GENERAL OUTPUT DATA

6581. lbm/hr FUEL FLOW
2533.62 Scfm FUEL FLOW
21297. Btu/lbm LOWER HEATING VALUE
922. Btu/Scf LOWER HEATING VALUE
85975. Scfm EXHAUST FLOW @ 14.7 PSIA & 60F
238200. Acfm ACTUAL EXHAUST FLOW CFm
387508. lbm/hr EXHAUST GAS FLOW
4655.8 deg R ADIA STOICH FLAME TEMP, CHOICE GAS
4657.3 deg R ADIA STOICH FLAME TEMP, SDNG
28.51 --- MOLECULAR WEIGHT OF EXHAUST GAS
58.09 --- AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2	
0.90	3.01	6.58	75.25	14.26	VOLUME PERCENT WET
0.96	3.23	0.00	80.55	15.26	VOLUME PERCENT DRY
4886.	18023.	16108.	286478.	62005.	lbm/hr
0.74	2.74	2.45	43.53	9.42	g/(g FUEL)

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.16.1.18.10
JOB ID:

DATE RUN: 29-Sep-15
RUN BY: David A Pocengal

NEW EQUIPMENT PREDICTED EMISSION PERFORMANCE
DATA FOR POINT NUMBER 2

Fuel: CHOICE GAS Customer:
Water Injection: NO Inquiry Number:
Model: TITAN 130-20502S CS/MD 59F MATCH GAS
Emissions Data: REV. 0.0

The following predicted emissions performance is based on the following specific single point:

HP=19767, %Full Load=100.0, Elev= 968ft, %RH= 60.0, Temperature= 48.0F

NOX	CO	UHC	
9.00	25.00	25.00	PPMvd at 15% O2
22.01	37.21	21.32	ton/yr
0.036	0.061	0.035	lbm/MMBtu (Fuel LHV)
0.34	0.58	0.33	lbm/(MW-hr)
			(gas turbine shaft pwr)
5.02	8.50	4.87	lbm/hr

NOTES:

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load or gas, fuel, and between 65% and 100% load for liquid fuel except for the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.16.1.18.10
JOB ID:

DATE RUN: 29-Sep-15
RUN BY: David A Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 4

HP=21024, %Full Load=100.0, Elev= 968ft, %RH= 60.0, Temperature=-10.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS

28.90	in Hg	AMBIENT PRESSURE
60.0	percent	RELATIVE HUMIDITY
0.0004	---	SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)

LHV (Btu/Scf) = 922.0 SG = 0.5672 W.I. @60F (Btu/Scf) = 1224.2

Methane (CH4)	= 97.3999
Ethane (C2H6)	= 2.1000
Propane (C3H8)	= 0.1000
Carbon Dioxide (CO2)	= 0.1000
Nitrogen (N2)	= 0.3000
Sulfur Dioxide (SO2)	= 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

GENERAL OUTPUT DATA

7238.	lbm/hr	FUEL FLOW
2786.56	Scfm	FUEL FLOW
21297.	Btu/lbm	LOWER HEATING VALUE
922.	Btu/Scf	LOWER HEATING VALUE
95167.	Scfm	EXHAUST FLOW @ 14.7 PSIA & 60F
257580.	Acfm	ACTUAL EXHAUST FLOW CFm
429986.	lbm/hr	EXHAUST GAS FLOW
4600.3	deg R	ADIA STOICH FLAME TEMP, CHOICE GAS
4601.9	deg R	ADIA STOICH FLAME TEMP, SDNG
28.58	---	MOLECULAR WEIGHT OF EXHAUST GAS
58.61	---	AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2	
0.91	3.01	5.94	75.74	14.41	VOLUME PERCENT WET
0.96	3.20	0.00	80.52	15.31	VOLUME PERCENT DRY
5444.	19903.	16086.	319198.	69345.	lbm/hr
0.75	2.75	2.22	44.10	9.58	g/(g FUEL)

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.16.1.18.10
JOB ID:

DATE RUN: 29-Sep-15
RUN BY: David A Pocengal

TITAN 130-20502S
CS/MD
59F MATCH
GAS
TLA-2S REV. 1.1

DATA FOR NOMINAL PERFORMANCE

Fuel Type	CHOICE GAS			
Elevation	feet	968		
Inlet Loss	in H2O	4.0		
Exhaust Loss	in H2O	6.0		
Accessory on GP Shaft	HP	29.2		
Engine Inlet Temp.**	deg F	0	48.0	-10.0
Relative Humidity	%	60.0	60.0	60.0
Elevation Loss	HP	741	702	746
Inlet Loss	HP	331	319	332
Exhaust Loss	HP	185	183	184
Driven Equipment Speed	RPM	8305	8342	8291
Optimum Equipment Speed	RPM	8305	8342	8291
Gas Generator Speed	RPM	11220	11220	11220
Specified Load	HP	FULL	FULL	FULL
Net Output Power	HP	20893	19767	21024
Fuel Flow	mmBtu/hr	151.70	140.16	154.15
Heat Rate	Btu/HP-hr	7261	7091	7332
Therm Eff	%	35.044	35.885	34.703
Inlet Air Flow	lbm/hr	416818	382265	424232
Engine Exhaust Flow	lbm/hr	422482	387508	429986
PCD	psiG	242.2	230.1	244.1
Compensated PTIT	deg F	1362	1385	1360
PT Exit Temperature	deg F	907	930	906
Exhaust Temperature	deg F	902	930	898

FUEL GAS COMPOSITION (VOLUME PERCENT)

LHV (Btu/Scf) = 922.0 SG = 0.5672 W.I. @60F (Btu/Scf) = 1224.2

Methane (CH4)	= 97.3999
Ethane (C2H6)	= 2.1000
Propane (C3H8)	= 0.1000
Carbon Dioxide (CO2)	= 0.1000
Nitrogen (N2)	= 0.3000
Sulfur Dioxide (SO2)	= 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

This performance was calculated with a basic inlet and exhaust system.
Special equipment such as low noise silencers, special filters, heat
recovery systems or cooling devices will affect engine performance.

Emission Estimates at Start-up, Shutdown, and Commissioning for SoLoNOx Combustion Products

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

The purpose of this Product Information Letter (PIL) is to provide emission estimates for start-up and shutdown events for *Solar*[®] gas turbines with SoLoNOx[™] dry low emissions combustion systems. The commissioning process is also discussed.

INTRODUCTION

The information presented in this document is representative for both generator set (GS) and compressor set/mechanical drive (CS/MD) combustion turbine applications. Operation of duct burners and/or any add-on control equipment is not accounted for in the emissions estimates. Emissions related to the start-up, shutdown, and commissioning of combustion turbines will not be guaranteed or warranted.

Combustion turbine start-up occurs in one of three modes: cold, warm, or hot. On large, utility size, combustion turbines, the start-up time varies by the "mode". The start-up duration for a hot, warm, or cold *Solar* turbine is less than 10 minutes in simple-cycle and most combined heat and power applications.

Heat recovery steam generator (HRSG) steam pressure is usually 250 psig or less. At 250 psig or less, thermal stress within the HRSG is minimized and, therefore, firing ramp-up is not limited. However, some combined heat and power plant applications will desire or dictate longer start-up times, therefore emissions assuming a 60-minute start are also estimated.

A typical shutdown for a *Solar* turbine is <10 minutes. Emissions estimates for an elongated shutdown, 30-minutes, are also included.

Start-up and shutdown emissions estimates for the *Mercury*[™] 50 engine are found in PIL 205.

For start-up and shutdown emissions estimates for conventional combustion turbines, landfill gas, digester gas, or other alternative fuel applications, contact Solar's Environmental Programs Department.

START-UP SEQUENCE

The start-up sequence, or getting to SoLoNOx combustion mode, takes three steps:

1. Purge-crank
2. Ignition and acceleration to idle
3. Loading / thermal stabilization

During the "purge-crank" step, rotation of the turbine shaft is accomplished with a starter motor to remove any residual fuel gas in the engine flow path and exhaust. During "igni-

tion and acceleration to idle," fuel is introduced into the combustor and ignited in a diffusion flame mode and the engine rotor is accelerated to idle speed.

The third step consists of applying up to 50% load¹ while allowing the combustion flame to transition and stabilize. Once 50% load is achieved, the turbine transitions to *SoLoNOx* combustion mode and the engine control system begins to hold the combustion primary zone temperature and limit pilot fuel to achieve the targeted nitrogen oxides (NOx), carbon monoxide (CO), and unburned hydrocarbons (UHC) emission levels.

Steps 2 and 3 are short-term transient conditions making up less than 10 minutes.

SHUTDOWN PROCESS

Normal, planned cool down/shutdown duration varies by engine model. The *Centaur*[®] 40, *Centaur* 50, *Taurus*[™] 60, and *Taurus* 65 engines take about 5 minutes. The *Taurus* 70, *Mars*[®] 90 and 100, *Titan*[™] 130 and *Titan* 250 engines take about 10 minutes. Typically, once the shutdown process starts, the emissions will remain in *SoLoNOx* mode for approximately 90 seconds and move into a transitional mode for the balance of the estimated shutdown time (assuming the unit was operating at full-load).

START-UP AND SHUTDOWN EMISSIONS ESTIMATES

Tables 1 through 5 summarize the estimated pounds of emissions per start-up and shutdown event for each product. Emissions estimates are presented for both GS and CS/MD applications on both natural gas and liquid fuel (diesel #2). The emissions estimates are calculated using empirical exhaust characteristics.

COMMISSIONING EMISSIONS

Commissioning generally takes place over a two-week period. Static testing, where no combustion occurs, usually requires one week and no emissions are expected. Dynamic testing, where combustion will occur, will see the engine start and shutdown a number of times and a variety of loads will be placed on the system. It is impossible to predict how long the turbine will run and in what combustion / emissions mode it will be running. The dynamic testing period is generally followed by one to two days of "tune-up" during which the turbine is running at various loads, most likely within low emissions mode (warranted emissions range).

Solar Turbines Incorporated
9330 Sky Park Court
San Diego, CA 92123-5398

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Solar, *Titan*, *Mars*, *Taurus*, *Mercury*, *Centaur*, *Saturn*, *SoLoNOx*, and *Turbotronic* are trademarks of Solar Turbines Incorporated. All other trademarks are the intellectual property of their respective companies. Specifications are subject to change without notice.

¹ 40% load for the *Titan* 250 engine on natural gas. 65% load for all engines on liquid fuel (except 80% load for the *Centaur* 40).

Table 3. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx CS/MD Applications
10 Minute Start-up and 10 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4702S				Centaur 50 6102S				Taurus 60 7802S			
	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)
Total Emissions per Start (lbs)	0.7	64.4	3.7	392	0.8	69.1	4.0	469	0.7	64.3	3.7	410
Total Emissions per Shutdown (lbs)	0.3	30.2	1.7	181	0.4	35.4	2.0	217	0.4	33.0	1.9	204

	Taurus 70 10302S				Mars 90 13002S CSMD				Mars 100 16002S CSMD				Titan 130 20502S				Titan 250 30002S			
	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)	NOx (lbs)	CO (lbs)	UHC (lbs)	CO2 (lbs)
Total Emissions per Start (lbs)	0.8	73.1	4.2	519	1.2	109.3	6.2	805	1.4	123.5	7.1	829	1.9	176.9	10.1	1,161	2.6	26.2	1.7	1,794
Total Emissions per Shutdown (lbs)	1.1	93.4	5.3	575	1.5	132.6	7.6	817	1.7	149.2	8.5	920	2.4	207.6	11.9	1,272	2.9	19.1	1.4	1,918

Assumes ISO conditions: 59F, 60% RH, sea level, no losses.

Assumes unit is operating at full load prior to shutdown.

Assumes natural gas fuel; ES 9-98 compliant.

Manufacturer's Information Caterpillar Emergency Generator

G3516C

GENSET APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA QPS Eng

CATERPILLAR®

ENGINE SPEED (rpm): 1800
COMPRESSION RATIO: 11.3:1
AFTERCOOLER TYPE: SCAC
AFTERCOOLER - STAGE 2 INLET (°F): 130
AFTERCOOLER - STAGE 1 INLET (°F): 198
JACKET WATER OUTLET (°F): 210
ASPIRATION: TA
COOLING SYSTEM: JW+OC+1AC, 2AC
CONTROL SYSTEM: ADEM3 W/ IM
EXHAUST MANIFOLD: DRY
COMBUSTION: LOW EMISSION
NOx EMISSION LEVEL (g/bhp-hr NOx): 1.0
ANCILLARY LOAD (ekW): 61
SET POINT TIMING: 28

RATING STRATEGY:
RATING LEVEL:
FUEL SYSTEM:

STANDARD
STANDBY
CAT LOW PRESSURE
WITH AIR FUEL RATIO CONTROL

SITE CONDITIONS:

FUEL: Nat Gas
FUEL PRESSURE RANGE(psig): 0.5-5.0
FUEL METHANE NUMBER: 84.8
FUEL LHV (Btu/scf): 905
ALTITUDE(ft): 800
MAXIMUM INLET AIR TEMPERATURE(°F): 77
STANDARD RATED POWER: 2175 bhp@1800rpm
POWER FACTOR: 1.0
VOLTAGE(V): 400-480

RATING	NOTES	LOAD	MAXIMUM SITE RATING AT MAXIMUM RATING INLET AIR TEMPERATURE			
			100%	100%	75%	50%
GENSET POWER (WITH ANCILLARY LOAD)	(1)(2)	ekW	1506	1506	1129	753
GENSET POWER (WITH ANCILLARY LOAD)	(1)(2)	kVA	1506	1506	1129	753
ENGINE POWER (WITHOUT FAN)	(2)	bhp	2175	2175	1661	1150
INLET AIR TEMPERATURE		°F	77	77	77	77
GENERATOR EFFICIENCY	(1)	%	96.6	96.6	96.1	94.9
GENSET EFFICIENCY (ISO 3046/1)	(3)	%	36.1	36.1	34.6	31.1
THERMAL EFFICIENCY	(4)	%	48.3	48.3	48.9	50.9
TOTAL EFFICIENCY	(5)	%	84.4	84.4	83.5	82.0

ENGINE DATA							
GENSET FUEL CONSUMPTION (ISO 3046/1)	(6)	Btu/ekW-hr	9455	9455	9868	10956	
GENSET FUEL CONSUMPTION (NOMINAL)	(6)	Btu/ekW-hr	9686	9686	10109	11223	
ENGINE FUEL CONSUMPTION (NOMINAL)	(6)	Btu/bhp-hr	6705	6705	6875	7348	
AIR FLOW (@inlet air temp, 14.7 psia) (WET)	(7)	ft3/min	4414	4414	3473	2545	
AIR FLOW (WET)	(7)	lb/hr	19574	19574	15398	11283	
FUEL FLOW (60°F, 14.7 psia)		scfm	269	269	210	156	
INLET MANIFOLD PRESSURE	(8)	in Hg(abs)	79.7	79.7	62.2	46.2	
EXHAUST TEMPERATURE - ENGINE OUTLET	(9)	°F	858	858	914	937	
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia) (WET)	(10)	ft3/min	11703	11703	9584	7149	
EXHAUST GAS MASS FLOW (WET)	(10)	lb/hr	20308	20308	15974	11710	
MAX INLET RESTRICTION	(11)	in H2O	10.04	10.04	10.04	10.04	
MAX EXHAUST RESTRICTION	(11)	in H2O	20.07	20.07	20.07	20.07	

EMISSIONS DATA - ENGINE OUT							
NOx (as NO2)	(12)(13)	g/bhp-hr	1.00	1.00	1.00	1.00	
CO	(12)(13)	g/bhp-hr	2.16	2.16	2.73	2.70	
THC (mol. wt. of 15.84)	(12)(13)	g/bhp-hr	4.21	4.21	4.95	5.61	
NMHC (mol. wt. of 15.84)	(12)(13)	g/bhp-hr	0.63	0.63	0.74	0.84	
NMNEHC (VOCs) (mol. wt. of 15.84)	(12)(13)(14)	g/bhp-hr	0.42	0.42	0.50	0.56	
HCHO (Formaldehyde)	(12)(13)	g/bhp-hr	0.56	0.56	0.55	0.63	
CO2	(12)(13)	g/bhp-hr	449	449	462	488	
EXHAUST OXYGEN	(12)(15)	% DRY	9.9	9.9	9.8	9.6	

HEAT REJECTION							
LHV INPUT	(16)	Btu/min	243056	243056	190262	140822	
HEAT REJ. TO JACKET WATER (JW)	(17)	Btu/min	34857	34857	27698	25108	
HEAT REJ. TO ATMOSPHERE	(17)	Btu/min	7856	7856	6618	5389	
HEAT REJ. TO LUBE OIL (OC)	(17)	Btu/min	6273	6273	5629	4852	
HEAT REJECTION TO EXHAUST (LHV TO 248°F)	(17)	Btu/min	55437	55437	47676	36269	
HEAT REJ. TO A/C - STAGE 1 (1AC)	(17)(19)	Btu/min	17462	17462	8685	2656	
HEAT REJ. TO A/C - STAGE 2 (2AC)	(17)(19)	Btu/min	6964	6964	5248	3599	
PUMP POWER	(18)	Btu/min	1964	1964	1964	1964	

COOLING SYSTEM SIZING CRITERIA				
TOTAL JACKET WATER CIRCUIT (JW+OC+1AC)	(20)	Btu/min	64527	64527
TOTAL AFTERCOOLER CIRCUIT (2AC)	(20)	Btu/min	7341	7341
HEAT REJECTION TO EXHAUST (LHV TO 248°F)	(20)	Btu/min	60981	60981
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.				

MINIMUM HEAT RECOVERY				
TOTAL JACKET WATER CIRCUIT (JW+OC+1AC)	(21)	Btu/min	52978	52978
TOTAL AFTERCOOLER CIRCUIT (2AC)	(21)	Btu/min	6616	6616
HEAT REJECTION TO EXHAUST(LHV TO 248°F)	(21)	Btu/min	49583	49583

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Manufacturer's Information Parker Boiler

PARKER BOILER SUBMITTALS

2:28 pm, Sep 27, 2013

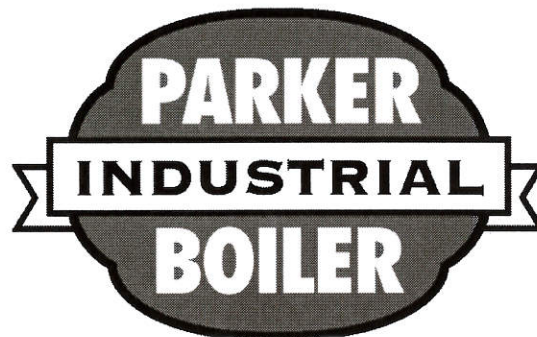
FDL

REVISED

2:34 pm, Nov 05, 2013

PO# 6501955-0-STAT
REFERENCE: AFE 62018 -TGP STATION 315 - ROSE LAKE
ACTIVITY: 620183680999999

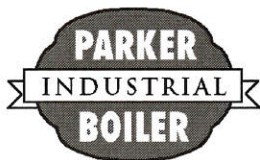
ONE (1) PARKER BOILER T4600LR,
DIRECT FIRED HOT WATER GLYCOL BOILER SKID MOUNTED

**BOILER MANUFACTURER****PARKER BOILER**

5930 BANDINI BLVD
LOS ANGELES, CA 90040
TEL: 323-727-9800
FAX: 323-722-2848
www.parkerboiler.com

KINDER MORGAN, INC

1001 LOUISIANA ST, STE 1000
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PARKER BOILER CO.

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Ph. (323) 727-9800
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9C

EMISSION DATA FOR METAL FIBER PREMIX NATURAL GAS FIRED BURNER SYSTEMS ON PARKER BOILERS

The following is our approximation of the Emission Levels from our boilers. Emissions may vary, based on Boiler and Field Conditions.

	<u>PPM @ 3%O₂</u>	
1. HC (Hydrocarbons)	60	= .031 Lbs./ 1.0 Million BTU/HR
2. CO (Carbon Monoxide)	60	= .0552 Lbs./ 1.0 Million BTU/HR
3. SO ₂ (Sulfur Dioxide)	NIL	= NIL
4. NO _x (Nitrous Oxides)	20	= .024 Lbs./ 1.0 Million BTU/HR
5. PM-15 (Particulate Matter)		< .01 Lbs./ 1.0 Million BTU/HR

By multiplying these levels by the BTU input in millions, you can calculate the Lbs./Hr. Emissions based on full firing of the subject boiler.

Contact Parker Boiler should you have any questions.

GED/srl
GREG FORM EMISSION.doc

Appendix C

Air Pollution Control Equipment Monitoring Plan

Requirements of control equipment monitoring plan and catalyst management plan as required by Env-A 810.01(c) and (d)		
(c)1.	Type of Control Device	Oxidation Catalyst
(c)2.	Control Device Manufacturer	BASF Catalyst (or similar)
(c)3.	Model and Serial Number	Catalyst housing and bed will be custom built, Model and Serial number are not applicable
(c)4.	Pollutant controlled by the device	The catalyst is designed limit emissions of carbon monoxide (CO), volatile organic compounds (VOC), and hazardous air pollutants (HAPs).
(c)5.	Description of control device	The oxidation catalyst is contained in an attachment to the exhaust stack of the turbines in a similar manner to a catalytic converter on an automobile. The catalyst oxidizes organic compounds to CO ₂ .
(c)6.	Capture efficiency	The capture efficiency of the control device is 100%, as it is located in the turbine exhaust stream with no bypass.
(c)7.	Control efficiency	The control efficiency of the control device is expected to be 90% for CO and 40% for other organic compounds, includes VOC and HAPs.
(c)8.	Operational parameters which will be monitored	The turbines will be maintained in accordance with manufacturer's specifications which were used as the design basis of the catalyst and housing. The temperature of the exhaust before the catalyst bed will be monitored when the engine is in operation for at least one hour to allow for temperature stabilization in the exhaust stream.
(c)9.	Description of data or recordkeeping	A record of the engine exhaust temperature/catalyst inlet temperature (from (c)(8)) will be maintained on site. Catalyst inspection records (from (c)(12)) will also be maintained onsite.
(c)10.	Manufacturer's recommended operating procedures	The catalyst manufacturer will provide an installation and operations manual along with the equipment. The recommended catalyst inlet temperature range based on design parameters is between 400 °F and 1100 °F.
(c)11.	Manufacturer's recommended service and maintenance	Will be determined upon contract award to catalyst vendor.

(c)12	Any other operational parameters that affect the control device	Pressure drop across the catalyst bed can be indicative of catalyst plugging or fouling. Monitoring of pressure drop may not give a good indication of catalyst operations since during the initial testing the unit would be operating at or near full load and in compression use the load may be highly variable depending on pipeline requirements. In lieu of monitoring pressure drop, a visual inspection of the catalyst to determine if maintenance is needed will be carried out every 5,000 operating hours or annually whichever comes first.
(d)1	Information from (c)1.-12.	Provided
(d)2	Description of catalyst sampling and catalyst activity determination	Catalyst sampling and activity determination, if required will be accomplished by shipping back to the manufacturer.
(d)3	Frequency of catalyst replacement	Replacement of the catalyst blocks will occur when washing or cleaning does not return the catalyst to acceptable performance.

Appendix D

Dispersion Modeling Report



Environment

Prepared for:
Tennessee Gas Pipeline Company
Houston, TX

Prepared by:
AECOM
Chelmsford, MA
60340228.4
November 2015

Dispersion Modeling Report

Temporary Permit Application
Northeast Energy Direct Project
Market Path Mid 4 Compressor Station
New Ipswich, NH



Environment

Prepared for:
Tennessee Gas Pipeline Company
Houston, TX

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Chelmsford, MA
60340228.4
November 2015

Dispersion Modeling Report

Temporary Permit Application
Northeast Energy Direct Project
Market Path Mid 4 Compressor Station
New Ipswich, NH

Prepared By Kim Zuk

Reviewed By Brian Stormwind

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List of Acronyms

Application	Temporary Permit Application
BPIP or	Building Profile Input Processor
BPIP-PRIME	
CO	Carbon Monoxide
g/s	Grams per Second
GAQM	U.S. EPA Guideline on Air Quality Models
GEP	Good Engineering Practice
K	Kelvin
km	Kilometers
lb/MMBtu	Pound per Million British Thermal Unit
$\mu\text{g}/\text{m}^3$	Micrograms per Cubic Meter
m	Meter
m/s	Meters per Second
MMBtu/hr	Million British Thermal Units per Hour
NAAQS	National Ambient Air Quality Standards
NED	Northeast Energy Direct or National Elevation Data
NHDES	New Hampshire Department of Environmental Services
NO _x	Oxides of Nitrogen
PM _{2.5}	Fine Particulate Matter with a Diameter Less than 2.5 Microns
PM ₁₀	Fine Particulate Matter with a Diameter Less than 10 Microns
RACT	Reasonably Achievable Control Technology
RTAP	Regulated Toxic Air Pollutants
SIL	Significant Impact Levels
SO ₂	Sulfur Dioxide
Station	Market Path Mid 4 Compressor Station
TGP	Tennessee Gas Pipeline Company, L.L.C.
U.S.	United States
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

1.0 Introduction

Tennessee Gas Pipeline Company, L.L.C. ("TGP"), a subsidiary of Kinder Morgan Partners, L.P., is proposing to construct a natural gas transmission pipeline compressor station in the town of New Ipswich, NH ("Project") as part of the Northeast Energy Direct Project ("NED"). TGP proposes to expand and modify its existing pipeline system in Pennsylvania, New York, Massachusetts, New Hampshire, and Connecticut. The NED Project is being developed to meet the increased demand in the Northeast United States ("U.S.") for transportation capacity of natural gas.

This report documents the dispersion modeling analysis conducted to support the Temporary Permit Application ("Application") to the New Hampshire Department of Environmental Services ("NHDES") for the proposed Market Path Mid 4 Compressor Station ("Station") to be located in New Ipswich, NH. The purpose of the modeling was to demonstrate that the proposed facility will comply with the National Ambient Air Quality Standards ("NAAQS").

Figures 1-1 and 1-2 show the proposed site of the station on a topographical map and the proposed layout of the station. An aerial view of the surrounding area is provided in Section 2.

As described in the Application, the proposed compressor station will consist of the following fuel combustion equipment which will each be serviced by a dedicated stack:

- Two Solar Turbines Titan 130 combustion turbines and associated gas compressors;
- One 16.5 MMBtu/hr Caterpillar G3516C emergency engine; and
- One 4.6 MMBtu/hr Parker natural gas -fired heater.

All fuel combustion equipment will be fired only with natural gas.

Figure 1-1 Location of Proposed Market Path Mid Station 4

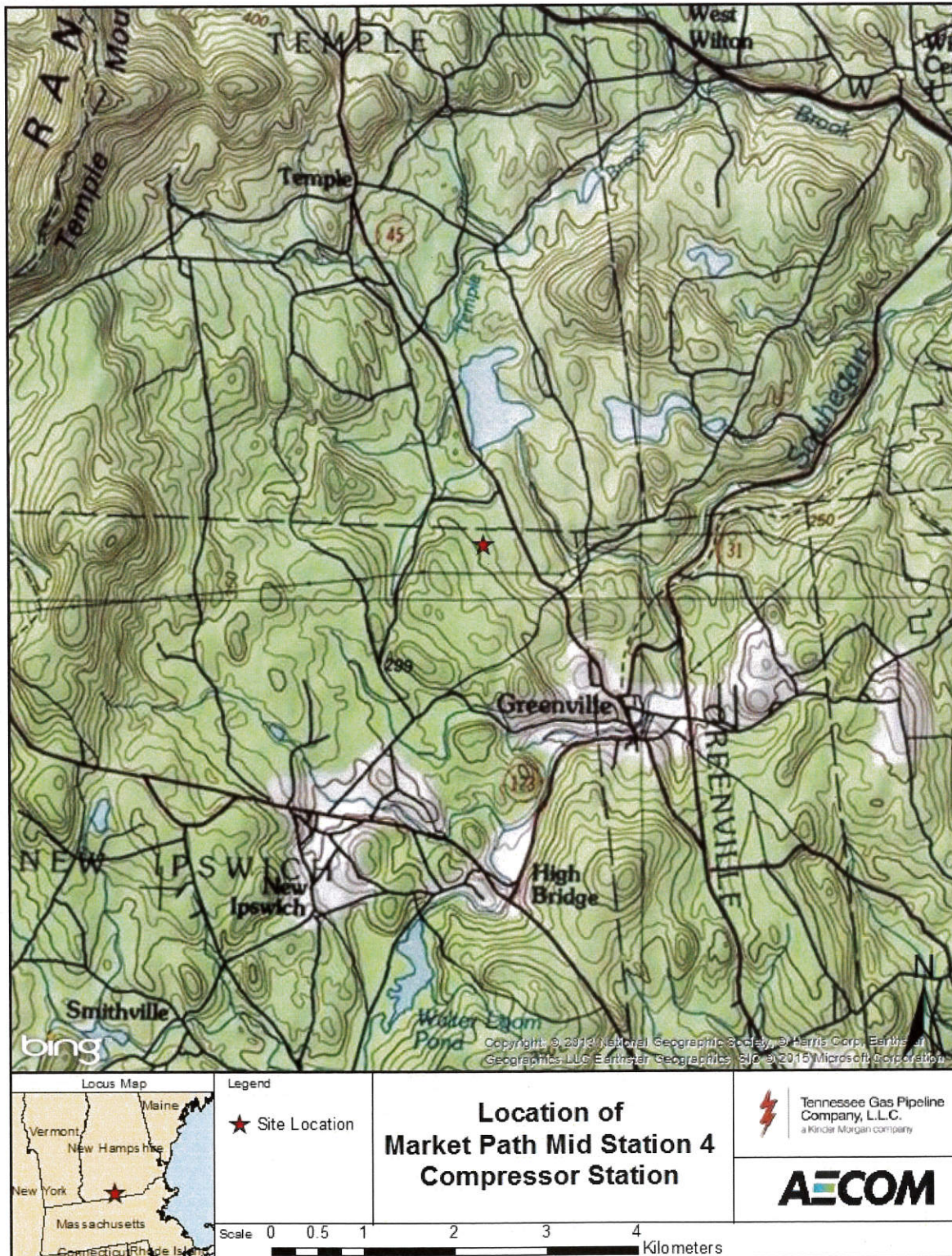
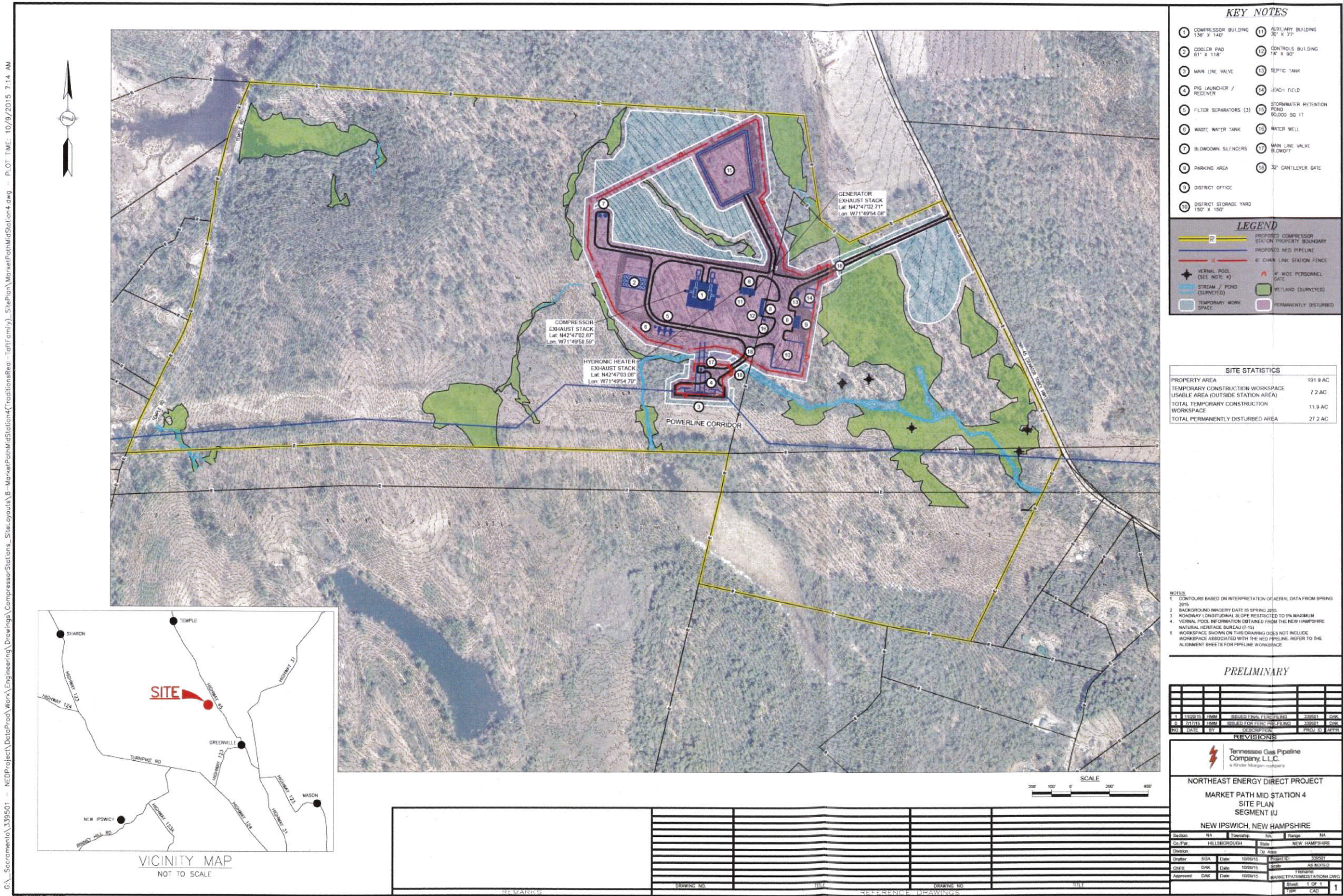


Figure 1-2 Site Plan of Proposed Market Path Mid Station 4



2.0 Dispersion Modeling Analysis

This section documents the ambient air quality modeling analysis that was conducted for the proposed Project. The analysis was conducted in accordance with U.S. Environmental Protection Agency's (U.S. EPA) *Guideline on Air Quality Models* ("GAQM") (US EPA, 2008) and guidance from the NHDES. As documented in Section 2.1.2, the Application only required modeling to be conducted for carbon monoxide ("CO") to demonstrate compliance with the NAAQS. Given the Project does not trigger major source permitting; a simplified check-list protocol was submitted to NHDES. The checklist is provided in Appendix A.

The modeling for the Project was based on the CO emissions associated with the proposed two compressor engines. As noted in the NHDES regulations Env-A 606.02(c)(1) and Env-A 607.01(a)(1) and discussed in Section 2.1.1 below, the emergency generator and natural gas-fired heater are exempted from modeling.

2.1 Applicability and Determination of Modeling Scope

The regulations governing dispersion modeling impact analysis are found under Env-A 606.

2.1.1 Sources to be Included in Modeling

Env-A 606.06(a) determines which sources are included in the dispersion modeling analysis. All of the source will have vertical, unobstructed stacks. Because the exemption under Env-A 606.02(c)(5) does not apply since facility wide emissions will be greater than the 15 ton per calendar year threshold for PM₁₀, individual equipment evaluation was conducted.

The combustion turbines are required to be included in the modeling analysis, as they have an individual heat input greater than the 1.5 million British thermal units per hour ("MMBtu/hr") threshold and cumulative heat input threshold of 10 MMBtu/hr from Env-A 607.01(d)(2).

The emergency generator is exempt from the modeling analysis per Env-A 602.02(c)(1), as operation will be limited to less than 500 hours per year.

The 4.6 MMBtu/hr natural gas-fired heater is not required to be included in the modeling analysis, as the heat input is below the 10 MMBtu/hr threshold for external combustion sources from Env-A 607.01(a)(1).

Therefore, only the two combustion turbines were required to be included in the dispersion modeling analysis.

2.1.2 Applicable Pollutants

Env-A 606.06(b) and (c) and Env-A 1402.02 determine which sources and pollutants are included in the dispersion modeling analysis. Pollutants nitrogen oxides ("NO_x"), sulfur dioxide ("SO₂"), inhalable particulate matter smaller than or equal to 10 microns in diameter ("PM₁₀"), and CO are required to be included in the dispersion modeling analysis unless otherwise exempt by Env-A 606.06(c). Particulate matter less than 2.5 microns ("PM_{2.5}") modeling is only required for major sources subject

to permitting under Env-A 619. Modeling of regulated toxic air pollutants ("RTAPs") is required unless exempted under Env-A 1402.02.

NO_x emissions are not required to be included in the dispersion modeling for the Project, as the combustion turbines will meet the NO_x Reasonably Available Control Technology ("RACT") requirements of Env-A 1306 as described in Section 3.2.9 of the Application [Env-A 606.06(c)(1)].

SO₂ emissions are not required to be included in the dispersion modeling, as the combustion turbines will meet the 0.025 pound per million British thermal unit ("lb/MMBtu") emission rate as described in Section 2 of the Application [Env-A 606.06(c)(2)].

PM₁₀ emissions are not required to be included in the dispersion modeling, as the combustion turbines will meet the PM emission rate of 0.10 lb/MMBtu as described in Section 2 of the Application [Env-A 606.06(c)(3)].

The combustion turbines are exempt from the RTAP requirements because they will only combust natural gas [Env-A 1402.02(a)(2)].

Dispersion modeling was only required for the CO emissions from the combustion turbines per Env-A 606.06(c).

2.2 Overview of Modeling Methodology

The latest version of U.S. EPA's AERMOD model (Version 15181) was used in the analysis. AERMOD was applied with the regulatory default options and 5-years (2008-2012) of hourly meteorological data consisting of surface observations from Jaffrey, NH and concurrent upper air data from Gray, ME. The meteorological data was pre-processed by NHDES and is prescribed to be used for Projects located in Hillsborough County.

As is standard modeling procedure, the first step in the modeling to demonstrate compliance with the NAAQS is to determine the maximum ambient air quality impacts of the Project for comparison to the U.S. EPA significant impact levels ("SILs"). If modeled concentrations are less than the applicable SIL(s), then compliance with the NAAQS is demonstrated with no further analysis required. However, if a modeled impact exceeds the SIL, then a cumulative modeling analysis, accounting for other emission sources in the Project area, is required to demonstrate compliance with the NAAQS.

As documented in Section 2.7, the modeling analysis for the Project demonstrates compliance with the NAAQS because modeled maximum concentrations are below the applicable SILs for CO.

All model input and output files are provided in Appendix B on the modeling archive CD to facilitate NHDES's review of the modeling analysis. The following sub-sections detail the general aspects of the modeling analysis.

2.3 Model Selection

The suitability of an air quality dispersion model for a particular application is dependent upon several factors. The following selection criteria have been evaluated:

- stack height relative to nearby structures;
- dispersion environment;

- local terrain; and
- representative meteorological data.

The U.S. EPA GAQM prescribes a set of approved models for regulatory applications for a wide range of source types and dispersion environments. Based on a review of the factors discussed below, the latest version of AERMOD (15181) was used to assess air quality impacts for the Project.

2.3.1 Good Engineering Practice Stack Height

Good engineering practice ("GEP") stack height is defined as the stack height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes or eddy effects created by the source, nearby structures or terrain features.

A GEP stack height analysis was performed for all proposed stacks in accordance with U.S. EPA's guidelines (US EPA, 1985). Per the guidelines, the physical GEP height, (H_{GEP}), is determined from the dimensions of all buildings which are within the region of influence using the following equation:

$$H_{GEP} = H + 1.5L$$

where:

H = height of the structure within 5L of the stack which maximizes H_{GEP} , and

L = lesser dimension (height or projected width) of the structure.

For a squat structure, i.e., height less than projected width, the formula reduces to:

$$H_{GEP} = 2.5H$$

In the absence of influencing structures, a "default" GEP stack height is credited up to 65 meters (213 feet).

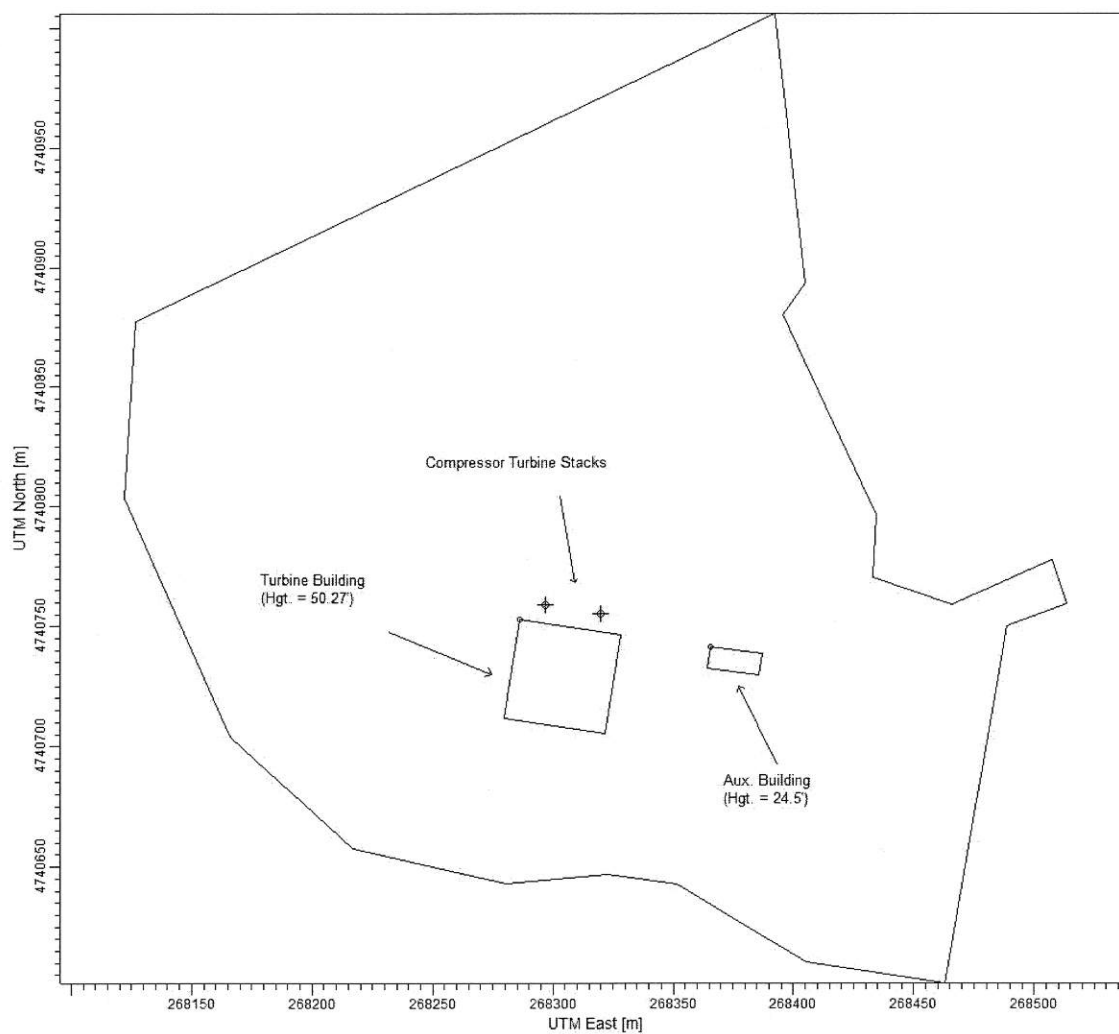
A summary of the GEP stack height analyses is presented Table 2-1. The maximum calculated GEP stack height for the combustion turbines is 125.66 feet based on the controlling structure which is the compressor building (50.27 feet at peak). Note that the compressor building will have a sloped roof but the building was conservatively represented in the model as a flat topped building set to the height of the roof peak. The proposed stack height for the combustion turbines is 83 feet.

The proposed compressor turbine stacks are less than the GEP formula height and therefore potentially subject to building downwash. Wind direction-specific building dimensions for input to AERMOD were developed with the U.S. EPA's Building Profile Input Processor ("BPIP" or "BPIP-PRIME") for input to AERMOD. The BPIP input and output files are provided in the modeling archive. The locations and dimensions of the buildings/structures relative to the exhaust stacks are depicted in Figure 2-1. Dimensions are in meters ("m").

Table 2-1 Summary of GEP Analysis

Emission Source	Model Source Name	Stack Height (m)	Controlling Buildings / Structures	Building Height (m)	Projected Width (m)	GEP Formula Height (m)
Compressor Engines	TURB1	25.30	Compressor Bldg.	15.32	42.68	38.30
	TURB2	25.30	Compressor Bldg.	15.32	42.68	38.30

Figure 2-1 Buildings and Stacks Used in GEP Analysis



2.3.2 Dispersion Environment

The application of the AERMOD requires characterization of the local (within 3 kilometers ("km")) dispersion environment as either urban or rural, based on a U.S. EPA-recommended procedure that characterizes an area by prevalent land use. This land use approach classifies an area according to 12 land use types. In this scheme, areas of industrial, commercial, and compact residential land use are designated urban. According to U.S. EPA modeling guidelines, if more than 50% of an area within a 3-km radius of the proposed Station is classified as rural, then rural dispersion coefficients are to be used in the dispersion modeling analysis. Conversely, if more than 50% of the area is urban, urban dispersion coefficients are used.

Visual inspection of the 3-km area surrounding the Project location (see Figure 2-2) clearly shows the area is rural. Therefore, the urban model option in AERMOD was not required.

2.3.3 Terrain Considerations

The U.S. EPA modeling guidelines require that the differences in terrain elevations between the stack top, plume centerline and model receptor locations be considered in the modeling analyses. There are three types of terrain:

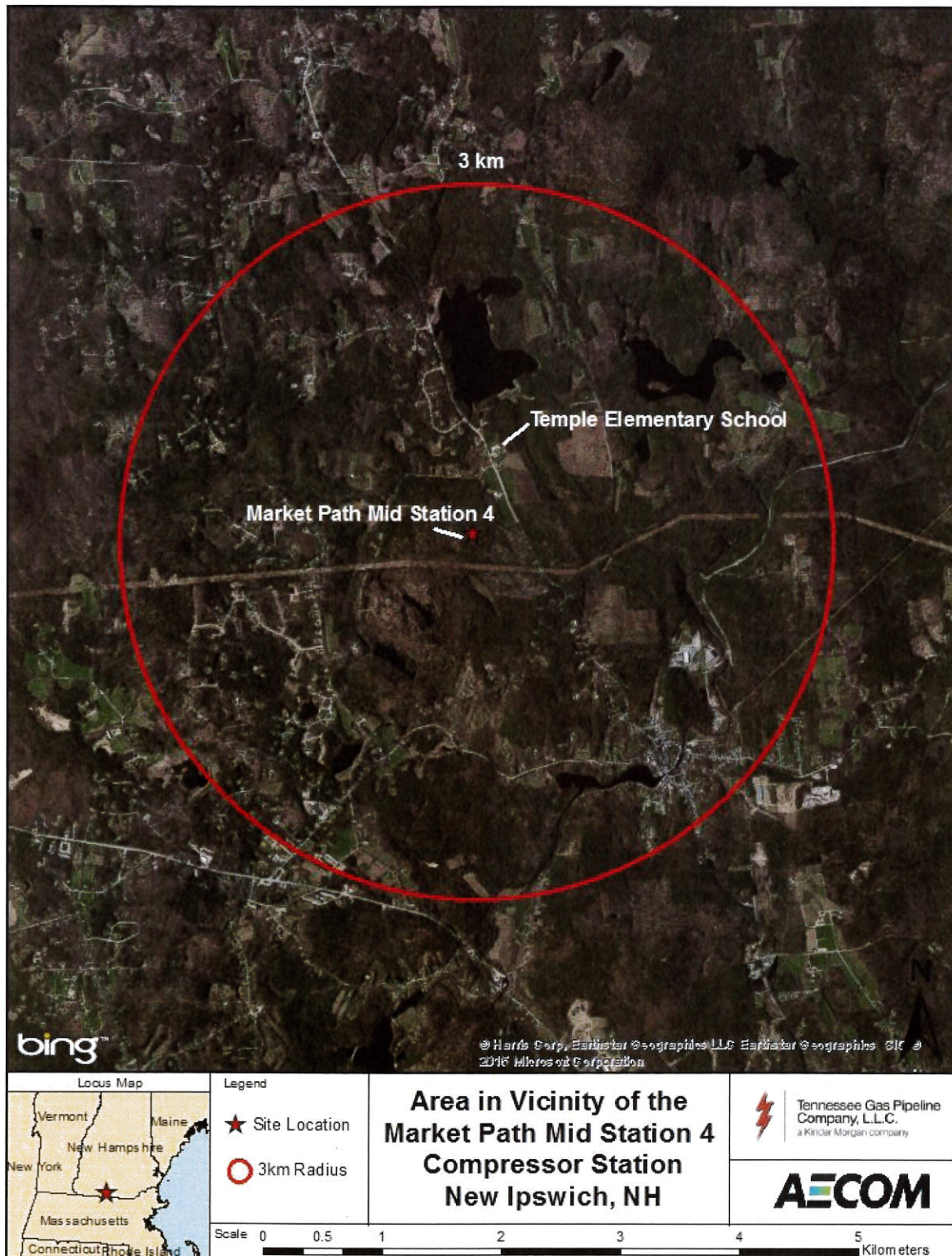
- simple terrain – locations where the terrain elevation is at or below the exhaust height of the stacks to be modeled;
- intermediate terrain – locations where the terrain is between the top of the stack and the modeled exhaust "plume" centerline (this varies as a function of plume rise, which in turn, varies as a function of meteorological condition); and
- complex terrain – locations where the terrain is above the plume centerline.

All three terrain types exist in the vicinity of the Project stacks. As discussed in Section 2.6.1, terrain elevations were developed for the model receptors.

2.4 Meteorological Data

AERMOD was applied with the regulatory default options and 5-years (2008-2012) of hourly meteorological data consisting of surface observations from Jaffrey, NH and concurrent upper air data from Gray, ME. The meteorological data was pre-processed by NHDES and is the suggested data set to be used for projects located in Hillsborough County.

Figure 2-2 Land Use Surrounding the Market Path Mid Station 4 Compressor Station



2.5 Stack and Emissions Data

2.5.1 Turbine Information

Table 2-2 summarizes the stack parameters and emission rates for the compressor turbines. Full load conditions were evaluated in the modeling as well as 50% and 75% part load cases.

Table 2-2 Stack Parameters and Emission Rates – Per Compressor Turbine

Parameter		Values		
Load		100%	75%	50%
Base Elevation (m)		295.05	295.05	295.05
Stack Height (m)		25.30	25.30	25.30
Stack Diameter (m)		2.75	2.75	2.75
Exhaust Velocity (meters per second)(“m/s”)		18.91	17.55	13.12
Exhaust Temperature (Kelvin)(“K”)		756.48	755.37	646.48
Pollutant Emissions (grams per second)(“g/sec”)	CO	0.12	0.10	0.08

2.6 Application of AERMOD

AERMOD was applied with the five years (2008-2012) of meteorological data from Jaffrey, NH to assess air quality impacts for the Project.

The receptor processing and model options are discussed below.

2.6.1 Terrain and Receptor Data Processing with AERMAP

A comprehensive Cartesian receptor grid extending to approximately 20 km from the Market Path Mid Station 4 Compressor Station was used in the AERMOD modeling to assess maximum ground-level pollutant concentrations. The 20-km receptor grid was more than sufficient to resolve the maximum impacts and any potential significant impact area(s).

The Cartesian receptors grid consists of the following receptor spacing:

- Fence-line to 300 m at 20 m increments;
- Beyond 300 m to 500 m at 50 m increments;
- Beyond 500 m to 3,000 m at 100 m increments;
- Beyond 3,000 m to 5,000 m at 500 m increments;
- Beyond 5,000 m to 10,000 m at 1,000 m increments; and
- Beyond 10,000 m to 20,000 m at 2,000 m increments.

Discrete receptors were placed approximately every 20 m along the Station fence-line. Discrete receptors directly over the Temple Elementary School were used to evaluate potential air quality

impacts at the school. See Figures 2-2 and 2-3 for the location of Temple Elementary School relative to the Station.

The near-field receptor locations are shown in Figure 2-3 and far-field receptors are shown in Figure 2-4. Terrain elevations from National Elevation Data ("NED") from U.S. Geological Survey ("USGS") (1/3 arc second [~10 m resolution]) were processed with AERMAP (version 11103) to develop the receptor terrain elevations required by AERMOD. All of the NED files are from UTM Zone 19 and are referenced to Datum NAD83 (Note that the receptors shown in Figures 2-3 and 2-3 are referenced to NAD83). The terrain data and receptor files are included in the modeling archive CD in Appendix B.

Figure 2-3 Near-field Model Receptors

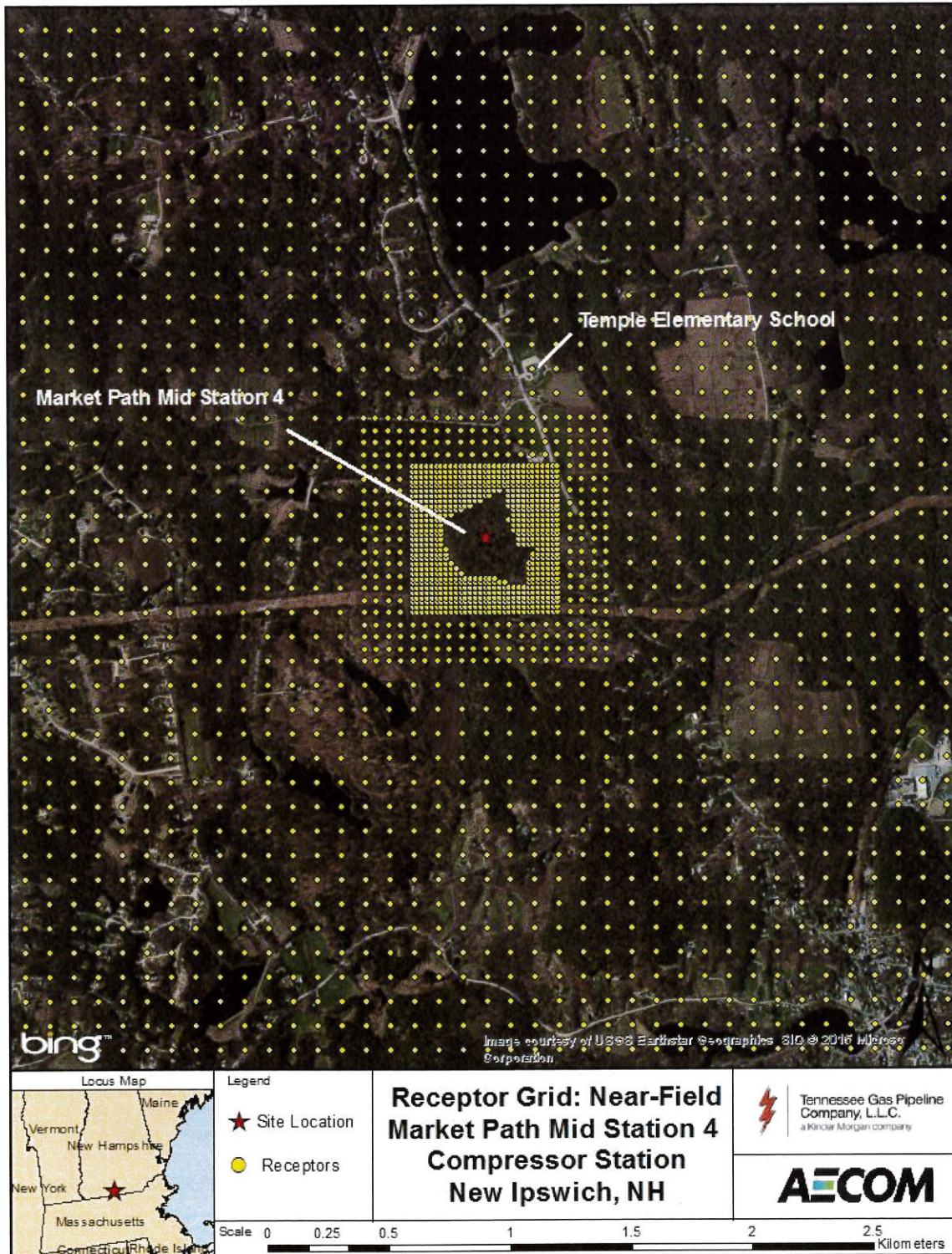
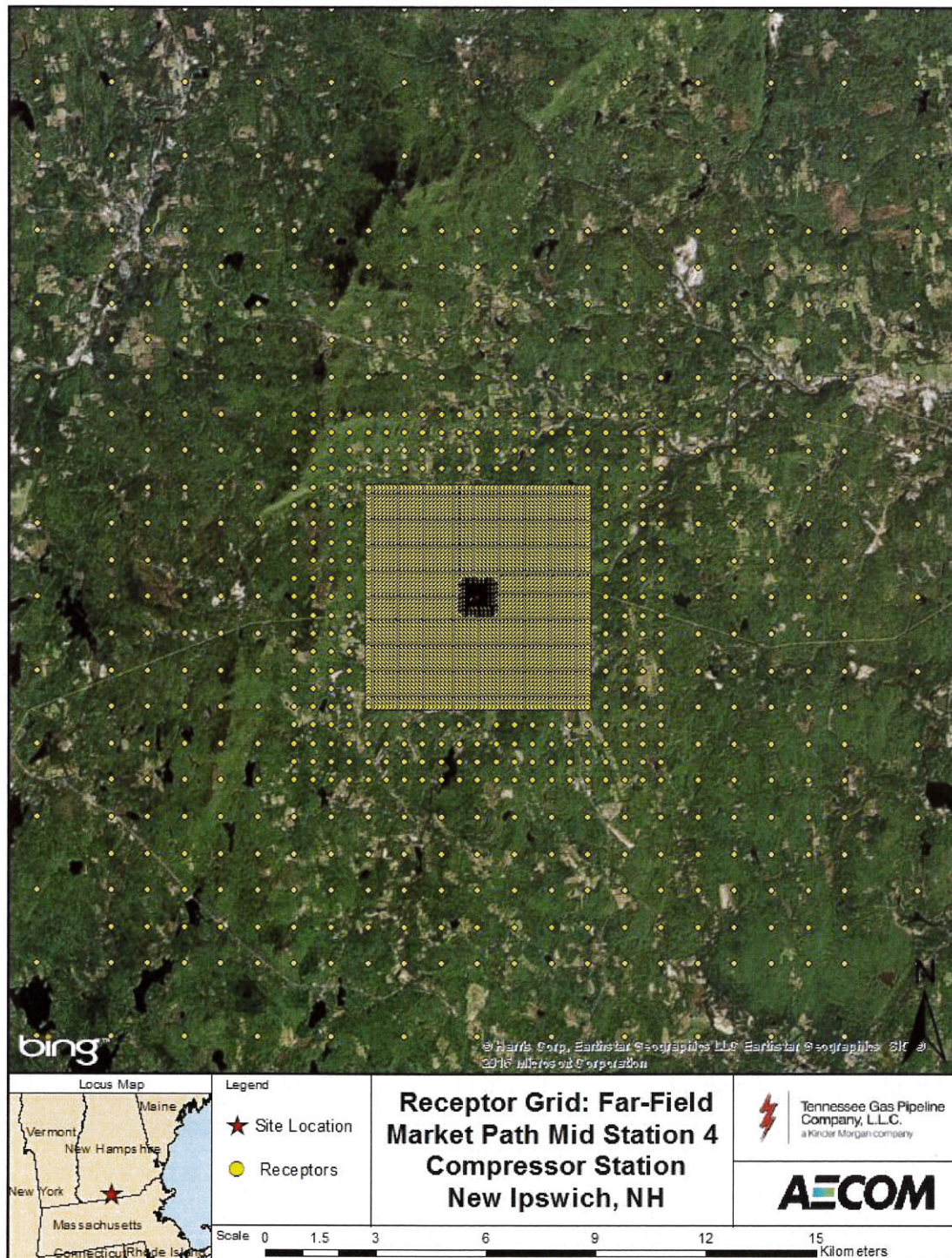


Figure 2-4 Far-field Model Receptors

3.0 Modeling Results

AERMOD was applied with the 5-years of meteorological data set and the U.S. EPA recommended default options. As described in Section 2.1, modeling was conducted for comparison to the applicable 1-hour and 8-hour CO SILs. This involves modeling the maximum 1-hour and 8-hour turbine CO emission rates and comparing the resultant maximum concentration to the applicable SIL. In all cases, the maximum concentrations modeled for 100% load.

The SIL modeling results over the entire receptor grid are summarized in Table 3-3. The modeling results indicate the maximum modeled impacts (in micrograms per cubic meter ("µg/m³")) for the Project are below the SILs and therefore, demonstrate that the Project emissions will not cause or contribute to a violation of the NAAQS. The modeling results for the Temple Elementary School are summarized in Table 3-4. As with the results for the entire receptor grid, modeled impacts over the school are below the SILs demonstrating compliance with the NAAQS.

Table 3-1 Modeling Results – Market Path Mid Station 4 Compressor Station

Pollutant	Averaging Period	Modeled Project Concentration ⁽¹⁾ (µg/m ³)	SIL (µg/m ³)	Below SIL? (Y/N)
CO	1-hour	2.92	2,000	Y
	8-hour	1.24	500	Y
(1) Maximum modeled concentration (High-first-high (H1H))				

Table 3-2 Modeling Results – Temple Elementary School

Pollutant	Averaging Period	Modeled Project Concentration ⁽¹⁾ (µg/m ³)	SIL (µg/m ³)	Below SIL? (Y/N)
CO	1-hour	0.34	2,000	Y
	8-hour	0.24	500	Y
(2) Maximum modeled concentration (High-first-high (H1H))				

4.0 References

US EPA 1985. Guideline for the Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) - Revised. EPA-450/4-80-023R, US EPA, Research Triangle Park, NC 27711.

USEPA. 2008. Guideline on Air Quality Models (Revised). Codified in the Appendix W to 40 CFR Part 51. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

Appendix A

NHDES Modeling Protocol Checklist

New Hampshire Department of Environmental Services Air Permit Modeling Protocol Checklist

Project Name: _ Northeast Energy Direct Project - Market Path Mid Station 4
Compressor Station _____

Project Location (Street/Town): _ New Ipswich _____

Company Performing Modeling: AECOM _____

Contact Name and Information: _____
Brian Stormwind. Phone: 978-905-2413. Email: brian.stormwind@aecom.com

This checklist is intended to provide permit applicants with guidance in the form of an air quality dispersion modeling protocol. **A protocol is required under Env-A 606.04 of the *New Hampshire Code of Administrative Rules Governing the Control of Air Pollution* for the purpose of ensuring that modeling analyses are performed in accordance with state and federal procedures and guidance.**

At a minimum please provide the information requested below. Contact DES with any questions on how to set up a modeling analysis.

1) Applicable air quality standards (check all that apply)

☒ NAAQS ☐ Class II Increments ☐ Env-A 1400 NH Regulated Toxic Air Pollutants (RTAPs)

Refer to Env-A 606.03 and Env-A 1450.01 for additional information.

<http://des.nh.gov/organization/commissioner/legal/rules/documents/enva600.pdf>

<http://des.nh.gov/organization/commissioner/legal/rules/documents/env-a1400.pdf>

2) Dispersion model and version to be used

☒ AERMOD v. _15181_ ☐ AERSCREEN v. _____ ☐ Other (specify) _____

Use of a dispersion model other than AERMOD or AERSCREEN requires pre-approval by DES.

3) Surface meteorological data site

Years: 2008-2012

☐ Berlin	☐ Concord	☒ Jaffrey	☐ Lebanon
☐ Manchester	☐ Portsmouth	☐ Rochester	☐ Whitefield
☐ On-Site	☐ Other _____	Profile Base Elevation: <u>306.6 meters</u>	

Use of meteorological data other than the above sites which have been pre-processed by DES requires pre-approval. See: http://des.nh.gov/organization/divisions/air/pehb/apps/aqm/help_guide.htm to determine which meteorological site to use based on the subject source location.

4) Criteria pollutant background value ($\mu\text{g}/\text{m}^3$) (NH DES can provide upon request)

☐ PM10 24-hr _____

☐ SO2 1-hr _____ 3-hr _____

☐ NO2 1-hr _____ Annual _____

☒ CO 1-hr 2875 8-hr 1955 [provided by Lisa Landry via email: 8/31/2015]

5) Receptor spacing

Provide information on receptor grid spacing and distances (scaled graphics would be acceptable):

Fenceline – 20 meter increment; Fenceline to 300 meters – 20 meter increment; From 300 to 500 meters – 50 meter increment; From 500 to 3,000 meters – 100 meter increment; From 3,000 to 5,000 meters – 500 meter increment; From 5,000 to 10,000 meters – 1,000 meter increment; From 10,000 to 20,000 meters – 2,000 meter increment. _____

Receptor spacing in the downwash region, along the property line, fence line, or refinement in area of maximum impact:

20 (m) (20 meters is recommended).

Refinement of the receptor grid where the maximum impacts are predicted may be necessary if the spacing is too coarse to determine the exact location or magnitude of the maximum impact.

6) Receptor placement in RTAP and criteria pollutant modeling

Receptor placement may be treated differently when modeling criteria pollutants or RTAPs.

For criteria pollutants:

1. Receptors placed both on and off property.
2. If proposal excludes receptors in an area provide justification. For example an area that is entirely fenced and gated that precludes public access may not require receptors.

For RTAPs:

1. Receptors should be placed at and beyond the compliance boundary, which is typically the property line of the facility. However, there are situations where the compliance boundary is not the property line. Describe how the compliance boundary was determined. And describe all areas within the property line where the owner does not have complete control. Some examples we have noted in the past include but are not limited to: baseball fields, golf courses, railroad tracks, public roads, bridges, and other businesses.

7) Terrain elevation data to be used

☒ USGS NED file (NAD datum year: 83) ☐ Survey Data ☐ Other: _____

8) Coordinates and terrain

Coordinates: DES recommends that the locations of all receptors, sources and structures be based on NAD83 coordinates and verified with satellite imagery.

Terrain: DES recommends that terrain elevations be calculated using National Elevation Database (NED) format. If survey data are available for the building base and stack elevation then that data would be preferred.

9) Stack orientation

Are all stacks vertical and unobstructed? ☒ Yes ☐ No

If No, current EPA guidance should be used to reflect the obstructed flow. Currently EPA recommends horizontal and capped stacks be modeled at an exit velocity of 0.001 m/sec.

10) Load conditions

If modeling a combustion device, will multiple operating load conditions be modeled? ☐ Yes ☒ No

If yes, which loads will be modeled? 100%
Typically 25, 50, 75, and 100% load conditions are evaluated, however depending on the type of device other load conditions may be more appropriate.

11) Emissions data and determining the Significant Impact Area.

Please note that emissions data is not reviewed as part of the modeling protocol review.

Interactive (nearby) source modeling may be required if the maximum predicted impacts are above Significant Impact Levels. DES will provide a list of interactive sources to include in the analysis.

12) In the space below, please note any special conditions or considerations related to the modeling analysis (attach additional sheets if necessary). NH DES should be contacted early in the application process if the project will involve Tier 3 NO₂ modeling methods such as OLM or PVMRM. Please note that this checklist would not provide enough detail for major source or PSD projects. In that situation DES should be contacted early in the application process.

_____Based on the DES modeling flowchart, only CO modeling will be required. Preliminary modeling indicates CO impacts are insignificant.

From: Moore, Todd [Todd.Moore@des.nh.gov]
Sent: Friday, October 16, 2015 12:55 PM
To: Stormwind, Brian
Cc: Zeilstra, Michael; Miller, Ian; Zuk, Kim; Landry, Lisa
Subject: RE: Modeling Protocol Checklist - NED Project Compressor Station

Brian,

We have reviewed the modeling protocol for the NED Compressor Station Project. The checklist indicates that NED intends to model only the 100% load condition for the compressor station. Based on conversations with Michael Zeilstra, we understand that, in Kinder Morgan's experience, highest modeled impacts for these compressor stations typically occur at 100% load. Mr. Zeilstra indicated that Kinder Morgan, therefore, routinely models only the 100% load condition.

I further discussed the load scenarios with our modeling staff. While we agree that highest impacts are most often associated with 100% load conditions, we have seen situations where the models predict higher impacts at lower loads, even though emission rates are typically lower. We routinely require 100%, 75%, and 50% loads to be evaluated - unless adequate justification is provided to support modeling a different operating condition (e.g., the device is not capable of sustained operation at partial load). We request that analysis for this project as well. Please contact me if you have further questions regarding this request.

With the addition of 50, 75, 100% load analysis, we approve the checklist as the modeling protocol required by New Hampshire Code of Administrative Rules Env-A 606.04(b).

The modeling files and summary required to be submitted with the permit application may be submitted on a CD or via a FTP site. Please contact Lisa Landry at lisa.landry@des.nh.gov if you would like our FTP site information.

Thank you,

Todd A. Moore
New Construction & Planning Manager
Permitting & Environmental Health Bureau Air Resources Division
(603) 271-6798

-----Original Message-----

From: Stormwind, Brian [<mailto:Brian.Stormwind@aecom.com>]
Sent: Thursday, October 01, 2015 3:28 PM
To: Moore, Todd
Cc: Zeilstra, Michael; Miller, Ian; Zuk, Kim
Subject: Modeling Protocol Checklist - NED Project Compressor Station

Todd, please see the attached checklist we put together for the dispersion modeling (only CO required) for the proposed compressor station in New Ipswich that we discussed in our meeting September 15th.

Please let us know if you have any comments or questions. We look forward to the Department's feedback on our outlined approach.

Regards,

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Appendix B

Modeling File Archive CD